# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR ATHITHATTU DUMPSITE REMEDIATION, IRITTY MUNICIPALITY



Submitted by

**Kerala Solid Waste Management Project**

# Part A

# Environmental Impact Assessment



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## Summary

### Introduction

The Iritty municipality is in Kannur District of Kerala and has an area of 46.65 Sq.km with 33 wards. The Solid waste generated from Iritty ULB is 14.12 TPD. In Iritty ULB there is an existing dumpsite at Athithattu, Ward 12, and currently there is no dumping of waste. However, Iritty ULB did not possess a designated landfill site as mandated by the Solid Waste Management Rules of 2016. Consequently, unsegregated waste was disposed of in an unscientific manner. In order to promote a healthy and sustainable environment, it is imperative to undertake the remediation of the dumpsite.

### Subproject Description

The Bio-mining and Bioremediation at the Iritty ULB dumpsite was initiated as part of the Kerala Solid Waste Management Project (KSWMP) in collaboration with funding from the World Bank and the Asian Infrastructure Investment Bank. The dumpsite situated in Ward 12, Athithattu, covers a total area of 2.44 acres and contains a legacy waste quantity of 1,254 tons. The waste at the site is approximately 20 years old, with dumping activities started in 2000 and stopped in 2020. Initially, the dumpsite served as a trenching ground for the disposal of sewage from pit latrines. The total volume of waste accumulated is approximately 2,023 cubic meters, and the dumpsite spans across an area of 0.11 acres.

- Status of Subproject Development at the time of EIA

The entry to the dumpsite is facilitated by a 5-meter-wide approach road in good condition, located in Athithattu stretch. Within the premises, there is an operational MCF, and organic waste composter units (Windrow composting unit and Thumboormuzhi unit).

- Technical Aspects

Following a comprehensive evaluation, the method or technique of Bio-mining with a goal of achieving land reclamation and recovery is found to be the most suitable remediation approach, ensuring long-term sustainability and environmentally responsible treatment of legacy waste, leading to the complete remediation of the dumpsite. Based on the Feasibility and site conditions, Mobile trommel machinery would be the most suitable option for such a small site at Athithattu, Iritty. The optimal time frame for conducting the Bio-mining Process would be from December to April Months, a period characterized by lower rainfall levels as per climate data.

### Application of Regulatory and Guidance Framework

In accordance with the SWM Rules of 2016, the selection of an appropriate method or technique for remediating a dumpsite should be determined through a feasibility study that



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consider technical, financial and Environmental aspects complying with regulatory requirements (KSPCB/NGT). The formulation of the subproject adhered to the State/National and World Bank safeguards policies, both in its planning phase and will continue to do so during the implementation and monitoring stages. This commitment to compliance will be upheld for a period.

**Baseline Environmental Scenario**

A detailed environmental baseline study was conducted for analyzing quality of air, groundwater, surface water, noise levels, and leachate characteristics. The preliminary Environmental Screening [Annexure -1] and the detailed assessment showed that this sub project falls under "E2" category. (Please note that suggestive environmental categorization of dumpsite bio-mining / bioremediation as per EMF for KSWMP is E1. However, considering the very small extent of the dumpsite, absence of any sensitive environmental feature in or around the site, short bio-mining period, and the overall positive impacts of the proposed development post mitigation measures; this is categorized as E2. At this stage, locations for disposal of bio-mined wastes are unknown, the subproject would be recategorized if the locations are near any sensitive areas. In case the bio-mining is clubbed with other multiple sites also, the overall categorization would be reconsidered)

An analysis has been conducted at the site to review and comprehend the physiography, climate, soil, cultural heritage, ecology, and biodiversity of the dumpsite. This assessment aims to identify potential impacts on the environment, human health, and biodiversity. Additionally, a traffic assessment has been performed to analyze traffic patterns and movements during the project's implementation phase.

**Terrestrial Ecology:**

The site is situated outside of a forested region. The nearest Forests/Protected Areas, known as Kottiyur reserve forest, Aralam wildlife sanctuary and also Brahmagiri wildlife sanctuary, are located. Various indigenous flora and fauna species commonly inhabit the vicinity of the site.

Fauna: Langur (*Semnopithecus entellus)*, Nilgiri Langur (*Trachypithecus johni)*, Lion-tailed Macaque (*Macaca Silenus)*, Bonnet Macaque (*Macaca radiata),* Tiger (*Panthera tigris)*, Leopard (*Panthera pardus)*, Wild Dog (*Cuon alpinus),* Jungle Cat (*Felis chaus),* Bear (*Melursus ursinus)*, Wild Boar (*Sus scrofa*) Asian Elephant (*Elephas maximus)*, Mouse Deer (*Moschiola meminna)* and Indian Muntjak (*Muntiacus muntjac),* Butterflies *(Lepidopter: Insecta),* Dragonflies and damselflies *(Odonata: Insecta),* Malabar gliding frog (*Rhacophorus malabaricus),* Malabar tree toad (*Pedostibes tuberculosus),* Glandular bush frog (*Raorchestes glandulosus),*

Flora: Tropical Evergreen Tree (*Dipterocarpus-Mesua- Palaquium),* Karanjili (*Dipterocarpus bourdillonii) etc.*



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**Air Quality:**
Air monitoring was conducted continuously for a 24-hour duration at all sites, and the obtained results were meticulously analyzed against the National Ambient Air Quality Standards of 2009. It is noteworthy that all measured pollutants' concentrations were found to be well within the permissible limits. Furthermore, no presence of hazardous or toxic gases was detected during the monitoring process.

**Water Quality:**
The monitoring of water quality was carried out at 3 locations for Ground water & 1 Location for Surface Water.

Groundwater samples were collected from three distinct locations, each within a radius of 200 meters from residences. The analysis of these samples revealed that all parameters examined fall within acceptable limits, with the exception of pH levels.

Surface water assessment indicates that the Bavali River is located approximately 1.25 kilometers from the site. There is no connectivity for the leachate pathway to reach the river. Surface water sample had been taken nearby pond which is not connected with river.

**Noise Level:**
Sample for noise level monitoring were collected within the dumpsite to assess the current ambient noise levels. The results indicate that the noise levels observed are comfortably within the permissible limits. However, it shall be noted that there is no activity currently on site. And noise levels are expected to increase with bio-mining activity.

**Assessment of Risks/Impacts and Proposed Mitigation measures and Monitoring**

The anticipated impacts of the interventions proposed have been analyzed in detail and mitigation measures proposed. The Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) documents, which assess the potential environmental and social impacts of the proposed project, serve to identify potential risks, formulate mitigation measures and ensure compliance with environmental and social standards regulations. This dumpsite remediation project comprises an overview of the current environmental conditions within the project area. Furthermore, the report delineates the environmental baseline data, Disaster Management Plan, identification of sensitive receptors and a Fire Risk Assessment. Key environmental risks include leachate and storm water from the site impacting the nearby areas, odour (including gas), visual blight, flies & pests, storage and disposal of retrieved materials, fire, accidents & other disasters, and health and safety of workers. Possible future dumping of wastes after bio-mining is also a concern. Mitigation and management measures for these in line with mitigation hierarchy are included in the EMP.



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Proposed mitigation measures are designed to address environmental and social impacts effectively, with the goal of minimizing negative consequences while maximizing positive outcomes. Additionally, this report encompasses an Environmental Management Plan (EMP) and a Social Management Plan (SMP), providing detailed strategies for the management of the project's environmental and social facets.

In addition, a detailed Environment Monitoring Plan and Social Monitoring Plan will outline the monitoring procedures to assess the efficiency of mitigation measures and guarantee adherence to environmental and social standards. To ensure seamless and timely execution, the dumpsite remediation subproject report also includes an Environmental and Social Budget. This ensures a sustainable and responsible bio-mining process that prioritizes the protection of the environment and the well-being of nearby communities throughout the waste remediation process.

**Implementation Mechanism & Budget**

The Bio-mining project, with the objective of achieving 100% land recovery, will be carried out exclusively through an outsourcing model. The bio-mining process will be conducted separately at each site. The bio-earth and coarse fraction segregated during the time of remediation are proposed to be used for filling low lying areas or can be used for agricultural land, after ensuring the desirable quality. If the land is found to be contaminated, proper remedial measures will be followed before utilizing for future facilities. The recyclables will be handed over to the authorized recyclers and the RDF is proposed to be handed over to the cement factories/boilers. The land will be restored to its pre-waste dumping condition, necessitating the complete removal of all legacy waste until it reaches the original land surface. Following the completion of the bio-mining process, the machinery and vehicles belonging to the implementing agency must be vacated within 7 days. The reclaimed land, free of any encumbrances, will then be transferred to the Urban Local Body (ULB).
The total budget proposed for Environmental monitoring and social budget is [redacted]/- which includes SMP budget.

**Consultation &Disclosure**

A transect walk was also carried out to assess the socio-environmental characteristics in the vicinity of the dumpsite. To understand the social dynamics, demographic profile, livelihood

patterns, social dynamics of the community and to understand the needs, concerns, and aspirations of the community, a transect walk was carried out on 03-June-2023, (Attendees – 12 nos.) which was crucial for developing effective dumpsite remediation strategies that align with their priorities. The findings and recommendation of the transect walk is shown in the following table.



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*Table 1 Findings and recommendation of the transect walk*

| S.No | Social risks | Findings and Recommendations |
|---|---|---|
| 1 | Presence of 2 families near (200 m) the dumpsite, | a. Free movement of the residents needs to be ensured |
| 2 | 5 women are working in the Thumboormuzhi model compost unit | Need to ensure the smooth functioning of compost unit and working conditions for women |

***Note: All the references to Social Impact Assessment and Social Management Plan may be referred to Part B- Social Impact Assessment which is a separate document attached along with this document.***



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## Summary [Malayalam]

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# 1. INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-Financing Framework agreement and as agreed Project Co-lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio-mining of multiple Legacy Waste Dumpsites in various districts. As per the Feasibility Study and methodology statement for implementing the subproject, 12 dumpsites are grouped into a single cluster. It is expected that one single contractor bids for one Cluster. However, bidding modality is yet to be finalized- whether as a single site, or as a cluster.

## 1.2 The rationale of the Proposed Sub-Project

Athithattu dumpsite in Iritty ULB at ward no.12 has a total waste quantity of 1254 Tons, spreading over 0.11 acres. The site is located between Lat- 11°58'04.44"N and Long - 75°40'54.066"E and has an elevation of MSL +39 (m). During the monsoon season, the positioning of the dumpsite causes legacy waste to flow downhill affecting nearby residential areas. Iritty ULB proposes bio-mining and bioremediation of the Athithattu legacy waste dumpsite site under KSWMP supported by the World Bank and Feasibility Report has been prepared for this subproject. Considering the environmental and social impacts associated with legacy dumpsite bio-mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

## 1.3 Objectives and scope of Environmental & Social Impact Assessment (ESIA)

As per indicative categorization for dumpsite bio-mining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (2.44 acres) and waste spread (0.11 acres) and absence of environmentally sensitive features around, this sub-project is individually



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considered as E2, and EIA is prepared accordingly. Required monitoring and analysis are carried out considering the possible impacts.

***Social Impact Assessment***:

Under this category social impact assessment is also a key factor to be considered. Accordingly, detailed assessment of the environmental and social impacts was carried out.

### 1.4 Proposed sub project details

*Table 2 Proposed Sub Project Details*

| Description | Details |
|---|---|
| Name of ULB | Iritty |
| District | Kannur |
| Taluk | Iritty |
| Total present population in the ULB | 54,151 |
| Name of the sub-project | Dumpsite Remediation at Athithattu |
| Location of the sub-project | Iritty ULB, Ward 12Athithattu |
| Total dumpsite area (in acres) | 2.44 |
| Total waste accumulated area (in acres) | 0.11 |
| GPS Co-ordinate of the Site | 11°58'04.44"N, 75°40'54.066"E |
| Legacy waste quantity | 2023 Cum |



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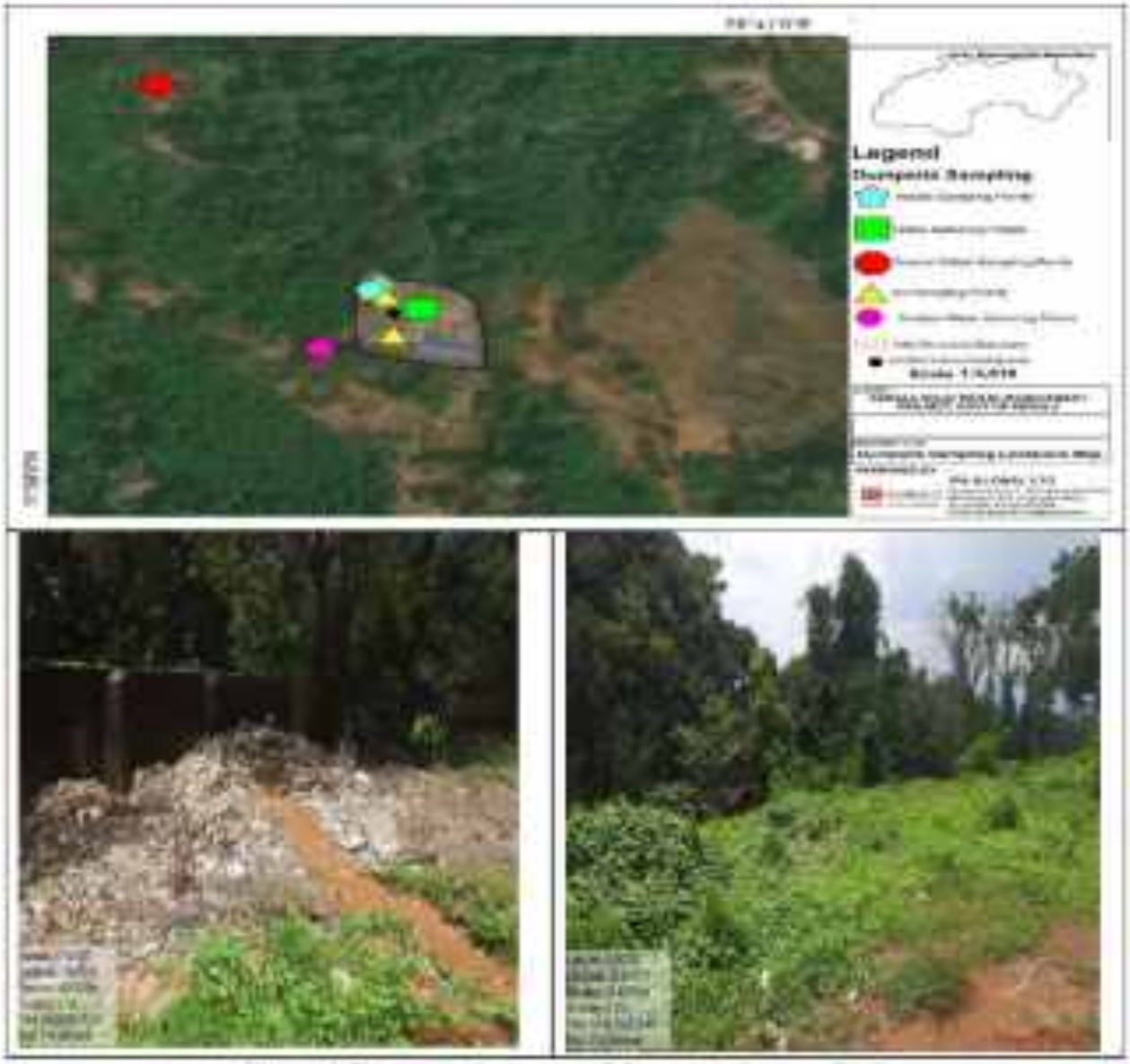



*Figure 1 Topo map & images of dumpsite (Source: TSC)*

The technology proposed is Bio mining and the valuable fractions other than the bio earth & coarse fraction obtained from this process will be sold to authorized recyclers. The various phases in the bio-mining process (as per Legacy Waste bio-mining Guidelines of CPCB) are shown below.

*Table 1 Phases of Bio-mining*



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| Phases of Bio-mining | |
|---|---|
| **Phase 1:** Stabilization | The legacy waste is formed into equal-sized windrows and which are turned frequently, bio-culture is added and de-odourizer (an odour-controlling agent) sprayed. This phase removes stench, reduces moisture and eliminates pathogens. |
| **Phase 2:** Sorting & Segregation | In this phase, stabilized legacy waste is sorted/segregated into bio earth, recyclables, refused derived fuel (RDF) and C&D through series of various sizes of Trommels/circular rotatory sieves and manpower. |
| **Phase 3:** Disposal & Utilization | In this phase, the non-combustible fractions such as soil and stones are disposed of for further processing into finer aggregates or for earth filling. The combustible fractions are called refuse-derived fuel (RDF) are sent for co-processing in cement industries. |

### 1.5 Site management plan

The plan aims to minimize potential adverse impacts on sensitive receptors while maximizing the recovery of valuable resources and promoting site restoration.

Mobile machineries will be used for bio-mining of Iritty dumpsite, and they do not require a separate area for erection. The waste will be excavated and directly fed into mobile screeners for processing. This approach minimizes the need for additional infrastructure and optimizes the efficiency for the bio-mining process. The proposed plan is as follows



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*Figure 2 Site Management Plan for Iritty*



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### 1.6 Structure of the report

*Table 4 Structure of the report*

| Chapter | Structure |
|---|---|
| 1 | Introduction |
| 2 | Policy and Regulatory Framework |
| 3 | Environment and Social baseline |
| 4 | Analysis of Alternatives (technology and site) |
| 5 | Assessment of Environmental and Social Risks and Impacts |
| 6 | Environmental and Social Management and Monitoring Plan |
| 7 | Institutional Arrangements |
| 8 | Public consultation and Information Disclosure |



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## 2. POLICY AND REGULATORY FRAMEWORK

### 2.1 National, State Legislations and Technical Guidelines related to dumpsite remediation

*Table 5 Applicable rules and regulations for Iritty dumpsite remediation*

| S. No | Rules and Regulations | Relevance |
|---|---|---|
| 1 | The Motor Vehicle Act. 1988 | All vehicles used for installation and operation will need to comply with the provisions of this act and should have valid Pollution Under Control Certificate. |
| 2 | Authorization from PCB for storing Hazardous material like diesel for DG sets as per Hazardous and Other Wastes (Management & Trans boundary Movement) Rules, 2016 | Hazardous waste (used oil from DG Sets) is likely to be generated during the erection and operation stage. Hence, authorization under the purview of the rule shall be requiring. |
| 3 | Labour Act. | Occupational safety and health administration. |
| 4 | Solid Waste Management Rules, 2016 (MSW Rules) | To operate the mobile Bio mining plant, it is necessary to follow the existing MSW rules. |
| 5 | World bank guidelines with reference to Project Implementation Manual and Environmental Social Management Framework | Processing waste and completing the Bio mining project requires strict adherence to the World Bank guidelines. |
| 6 | The Water (Prevention and Control of Pollution) Act, 1974 | Consent to Establish and Consent to Operate to be obtained during the construction phase and operation of waste recycling/disposal facilities |
| 7 | The Air (Prevention and Control of Pollution) Act. 1981 | Consent to Establish and Consent to Operate to be obtained during the construction phase and operation of waste recycling/disposal facilities |
| 8 | Contractor shall comply with the requirements for the safety of the workers as per the ILO Convention No. 62 | Safety aspects |
| 9 | NOC from fire department | Safety aspects |
| 10 | Tree felling permission:<br>If felling of trees as defined in Kerala Preservation of Trees Act, 1986 | If any tree needs to be cut or replanted concerned permission is required from Forest Dept. Government of Kerala. The ULB will take the necessary permission. |



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| S. No | Rules and Regulations | Relevance |
|---|---|---|
| 11 | NGT guidelines upto date | Relevant to the subproject to be considered for the successful implementation of the project. |
| Other applicable Rules & Regulations | | |
| 12 | Solid Waste Rules, 2016 (MSW Rules) | |
| 13 | Plastic waste Management Rules, 2016 | |
| 14 | Construction & Demolition, Waste Management Rules, 2016 | |
| 15 | Batteries (Management and Handling) Rules, 2001 | |
| 16 | E-Waste (Management) Rules, 2016 | |
| 17 | SBM guidelines 2.0 | |
| 18 | Kerala Municipality Act, 1994 & Rules | |
| 19 | Technical EIA Guidance Manual for Common Municipal Solid Waste -MoEF&CC | |
| 20 | Guidelines on the provision of the buffer zone around waste processing and disposal facilities, April 2017; amended in March 2019 -CPCB | |
| 21 | World bank guidelines with reference to Environmental Social Management Framework | |
| 22 | Contractor shall comply with the requirements for the safety of the workers as per the ILO Convention No. 62 | |

## 2.2 The World Bank Safeguards Policies

*Table 6 World Bank Safeguard Policies*

| S.No. | WB Policy | Safeguard policy applicable | Description |
|---|---|---|---|
| 1 | Environmental Assessment (OP/BP 4.01) | Yes | The project has potential impacts and pose risks to various environmental factors during the implementation phase. Consequently, this policy is implemented, necessitating a structured approach to safeguard management for risk mitigation in alignment with regulatory requirements, and Environmental and Social Management Framework (ESMF). |
| 2 | Natural Habitats (OP/BP 4.04) | Yes | Though the project will not support any activities that involve conversion or degradation of natural habitats; but in turn by improving SWM in ULBs; |



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| S.No. | WB Policy | Safeguard policy applicable | Description |
|---|---|---|---|
| | | | ensure their long-term sustenance by preventing impacts due to waste, leachate, and landfill gas generation. |
| 3 | Pest Management (OP 4.09) | Yesz | Considering the possible pest related issues as the project deals with wastes and improvements to dump sites, OP 4.09 Pest Management is triggered. As per this policy the banned pesticides/insecticides listed by the Nation / State and the World Health Organization (WHO) should not be used in the project, and as much as possible Integrated Pest Management Options shall be followed |
| 4 | Physical Cultural Resources [PCR] (OP 4.11) | Yes | The proposed project will not support any activities that could potentially harm nearby cultural heritage, archaeological sites and physical resources valuable to the community |

## 3. BASELINE ENVIRONMENTAL SCENARIO

### 3.1 Project location of the site

The Iritty municipality has a dumpsite situated in Ward 12 at Athithattu, with GPS coordinates Lat-11°58'04.5"N, Long-75°40'53.9"E. The total quantity of legacy waste is 2023 Cum. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes.

*Table 7 Environmental Features around the Dumpsite*

| S.No | Sensitive Receptors | Distance |
|---|---|---|
| 1 | Residential buildings | 02 households are located within 200 m radius of the dumpsite |
| 2 | Educational institutions such as Global India Public School | 1.20 Km |
| 3 | Baveli river | 1.25 Km |
| 4 | Nearest Tourist place | |
| | Athithattu hill view | 800 m |
| | Kolly waterfall | 1.8 Km |
| | Poonthurutti kunnu (hiking area) | 2.1 Km |
| | | |



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### 3.2 Methodology for Environmental Baseline studies

Baseline Study in ESIA process usually includes data collection and analysis on various aspects of the project area, such as: Physical Environment (e.g., topography, geology, soil, water, air quality, and climate). Biological Environment (e.g., flora and fauna, Land, habitat, biodiversity, and ecological processes). The overall methodology of ESIA

1) Scoping, Environmental Screening, Exclusion and Categorization
2) Environmental Baseline study like analysis of Air, Water, Soil and Noise/Vibration and impacts on biodiversity, workers and people around
3) Environmental Impact Assessment
4) Avoidance of adverse impacts, minimization, mitigation and management measures
5) Environmental Management Plan (EMP)
6) Environmental Monitoring Plan (EMoP)
7) Budget for implementation of EMP and EMoP

The below table indicates the environmental attributes and frequency of monitoring

*Table 8 Environmental Attributes*

| S. No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| 1 | Meteorology | Temperature humidity and rainfall | - | Study area | Data collected from IMD |
| 2 | Ambient air quality | $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$, VOCs | A1 – 11°58'04.41" N, 75°40'54.066" E<br>A2 – 11°58'03.384" N, 75°40'53.94"E | 2 | 24 hourly samples |
| 3 | Noise levels | Noise levels in dB(A) Leq | N1 – 11°55'04.116" N, 75°40'54.509" E | 1 | Once |
| 4 | Surface water quality | Physical, chemical and biological parameters including pH, temperature, turbidity, | S1- 11°57'49.198" N, 75°41'11.609"E | 1 | Once |



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| S. No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| | | magnesium hardness, total alkalinity, chlorides, sulphates, fluoride, Copper, DO, BOD, COD, salinity, Zinc, Lead, Arsenic. | | | |
| 5 | Groundwater quality | Physical, chemical and bacteriological parameters including pH, temperature, turbidity, magnesium hardness, total alkalinity, chlorides, sulphates, fluoride, Copper, DO, BOD, COD, salinity, Zinc, Lead, Arsenic. | G1- 11°58'02.844" N, 75°40'53.189" E<br><br>G2- 11°58'09.276" N, 75°40'50.453" E<br><br>G-3- 11°57'50.389"N, 75°39'20.761"E | 3 | Once |
| 6 | Leachate | pH, BoD, CoD, TSS, TDS, Fluoride, Cyanide, Nickel, Cadmium, Lead, Copper, Mercury, Zinc | Location -1: 11°58'04.452" N, 75°40'53.753"E | 1 | Once |
| 7 | Biological environment | Existing flora and fauna | - | Study Area | Through field visits and substantiated through secondary data sources. |
| 8 | Soil characteristics | Physical, chemical and biological parameters to | - | - | Once |



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| S. No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| | | assess agricultural and afforestation potential including pH, Total Hardness, Nitrites, Phosphates, Organic matter, Fluorides, Total Iron, Nickel, Copper and Lead, TOC, Permeability. | | | |
| 9 | Land use/land cover | Land use for different land use Classifications. | - | Study Area | Land use / Land Cover Analysis using satellite imaging and GIS Technique |
| 10 | Socio-economic Environment | Socio-economic characteristics, population statistics existing amenities and quality of life | - | Study Area | Based on field survey and data collected from Census of India |

### 3.3 Existing Facilities on site and its Environmental Audit

There is a functional MCF and organic composter units (Windrow Composting and Thumboormuzhi) for dry and wet waste present on a part of the Athithattu dumpsite, Iritty.

The MCF and composting units are not supported under KSWMP under this subproject. However, an environmental audit of the facility is important as this is an associated facility to which organic waste treatment mechanisms and some recyclables may be channelized to and is situated at the same site and might be impacted by the booming activities.

*Table 9 Environmental Audit of MCF and Organic waste treatment facilities*

| S. No | Aspects | Remarks |
|---|---|---|
| A | MCF | |



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| S. No | Aspects | Remarks |
|---|---|---|
| 1 | Structural Characteristics | Area –752.88 (in Sqft)<br>Buffer/setback around the MCF – 35 mtr<br>Distance from waste pile of dumpsite<br>Roof: Tin shed (Steel) Roofing<br>Floor: Concrete Flooring<br>Walls: Brick wall and Mesh<br>Doors & windows: Available<br>There will be the dust emission and odour can impact the MCF facility. |
| 2 | Functional Characteristics | Activities in the MCF: Storing of waste<br>Materials and condition of stacking: NBDW<br>Activities spilling out onto the dumpsite: NIL<br>Access to the MCF: Common access for MCF & Dumpsite<br>No: of workers: 5-7 Kudumbashree workers are engaged (as per requirement) |
| 3 | Facilities | Parking area-120 sqm<br>Loading/unloading area-1200 sqm<br>Storage room & area: NIL<br>Worker snack/rest areas: NIL<br>Worker / other washrooms & sewerage: NIL<br>Water supply for Cleaning, Washroom: Available<br>Greenbelt: Nil |
| **B** | **Windrow Composting Unit** | |
| 1 | Structural Characteristics | Area –3028.13 (in Sqft)<br>Buffer/setback around the treatment unit – 50 m<br>Distance from waste pile of dumpsite<br>Roof: Tin shed (Steel) Roofing<br>Floor: Concrete Flooring<br>Walls: Brick wall and Mesh<br>Doors & windows: No doors and windows<br>There will be the dust emission and odour can impact the Windrow Composting Unit facility. |
| 2 | Functional Characteristics | Activities in the unit: Organic waste decomposition<br>Materials and condition of stacking: BDW<br>Activities spilling out onto the dumpsite: NIL |



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| S. No | Aspects | Remarks |
|---|---|---|
| | | Access to the Windrow composting unit: Common access for Windrow composting unit& Dumpsite<br>No: of workers: 5-7 Kudumbashree workers are engaged (as per requirement) |
| 3 | Facilities | Parking area- 200 sqm<br>Loading/unloading area-2000 sqm<br>Storage room & area: NIL<br>Worker snack/rest areas: NIL<br>Worker / other washrooms & sewerage: NIL<br>Water supply for Cleaning, Washroom: Available<br>Greenbelt: Nil |
| C | **Thumboormuzhi Unit** | |
| 1 | Structural Characteristics | Area - 281 (in Sqft)<br>Buffer/setback around the treatment unit – 40 m<br>Distance from waste pile of dumpsite<br>Roof: (Material, condition)<br>Floor (Cement Floor, Good Condition, Condition)<br>Walls: Concrete, Good Condition)<br>Doors & windows:<br>There will be the dust emission and odour can impact the treatment facility. |
| 2 | Functional Characteristics | Activities in the unit: Currently not functional<br>Materials and condition of stacking: BDW<br>Activities spilling out onto the dumpsite: NIL<br>Access to the windrow composting unit: Separate access for IRF & Dumpsite<br>No: of workers: NIL |
| 3 | Facilities | Parking area- 200 sqm<br>Loading/unloading area-2000 sqm<br>Storage room & area: NIL<br>Worker snack/rest areas: NIL<br>Worker / other washrooms & sewerage: NIL<br>Water supply for Cleaning, Washroom: Available<br>Greenbelt: Nil |



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### 3.4 Analysis of Environmental Baseline

*Table 10 Baseline Condition of Iritty Dumpsite*

<table>
<tr><th>S No</th><th>Environmental Aspect</th><th>Discussion on Baseline Scenario</th><th>Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject</th></tr>
<tr><td>1</td><td>Topography</td><td>The elevation of the Athithattu site is MSL +39(m), gentle. The land falls under midlands of Kerala. Soil is predominantly lateritic in nature. The legacy waste is spread over an area of 0.11 acres with an average height of 4.5 m, having a portion of the dumpsite which is 2,023 cum of waste being capped. In accordance with the directive from the National Green Tribunal (NGT), the bio-mining process is mandated to remediate all deposited waste within the premises, encompassing both current and pre-existing accumulations.</td><td>Leachate from the dumpsite drains out to Northeast side, to by natural slope. Which can affect the thick vegetation in the downside.</td></tr>
<tr><td>2</td><td>Climate</td><td>Iritty site falls within the tropical to sub-tropical climatic region. The maximum temperature in the region varies almost between 28.6°C to 33.9°C and minimum temperature ranges from 21.4°C to 25.7°C. The average annual rain fall is 238 mm.</td><td>Rains are heavy, and the site is at an elevated draining out of stored waste and leachate during dumpsite bio-mining& bioremediation works.<br>The bio-mining project has been scheduled during the off-season for rainfall in anticipation of reduced precipitation.</td></tr>
<tr><td>3</td><td>Hydrology/Hydrogeology & Soil</td><td><table><tr><th>Pre-monsoon (m) *</th><th>Post-monsoon (m) *</th><th>Avg. Fluctuation (m)</th></tr><tr><td>6.49</td><td>5.57</td><td>0.93</td></tr></table>*Groundwater level</td><td>Lateritic soil is porous and may lead to contamination of nearby wells. Hence, any waste below 9 m depth need to be remediated; and adequate measures are necessary to collect and</td></tr>
</table>



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<table>
<tr><th>S No</th><th>Environmental Aspect</th><th>Discussion on Baseline Scenario</th><th>Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject</th></tr>
<tr><td></td><td></td><td></td><td>manage leachate during all times</td></tr>
<tr><td>4</td><td>Forests and Ecology</td><td>Site is not located in forest area. Distance to nearest A variety of flora and fauna is observed near dumpsites. Due to the organic contents, mainly dogs, rodents and flies are seen near dumpsite. Also, crow, egrets, and other birds are seen feeding on the wastes. Some of the common flora and fauna found near the site.
<table>
<tr><th>S.no</th><th>Scientific name</th><th>Common Name</th><th>Flora /Funa</th></tr>
<tr><td>1</td><td>Semnopithecus entellus</td><td>Langur</td><td>Funa</td></tr>
<tr><td>2</td><td>Trachypithecus johnii</td><td>Nilgiri Langur</td><td>Funa</td></tr>
<tr><td>3</td><td>Macaca Silenus</td><td>Lion-tailed Macaque</td><td>Funa</td></tr>
<tr><td>4</td><td>Macaca radiata</td><td>Bonnet Macaque</td><td>Funa</td></tr>
<tr><td>5</td><td>Panthera tigris</td><td>Tiger</td><td>Funa</td></tr>
<tr><td>6</td><td>Panthera pardus</td><td>Leopard</td><td>Funa</td></tr>
<tr><td>7</td><td>Cuon alpinus</td><td>Wild Dog</td><td>Funa</td></tr>
<tr><td>8</td><td>Artocarpus heterophyllus</td><td>Moraceae</td><td>Funa</td></tr>
<tr><td>9</td><td>Felis chaus</td><td>Jungle Cat</td><td>Funa</td></tr>
<tr><td>10</td><td>Melursus ursinus</td><td>Bear</td><td>Funa</td></tr>
<tr><td>11</td><td>Sus scrofa</td><td>Wild Boar</td><td>Funa</td></tr>
</table></td><td>The species listed were not classified as Critically Endangered by the IUCN. (INTERNATIONAL UNION FOR CONSERVATION OF NATURE).<br><br>Note: The species mentioned are present in nearby wildlife sanctuary.</td></tr>
</table>



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| S No | Environmental Aspect | Discussion on Baseline Scenario | | | | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|---|---|---|
| | | 12 | *Elephas maximus* | Asian Elephant | Funa | |
| | | 13 | *Moschiola meminna* | Mouse Deer | Funa | |
| | | 14 | *Muntiacus muntjac* | Indian Muntjak | Funa | |
| | | 15 | *Lepidopter: Insecta* | Butterflies | Funa | |
| | | 16 | *Odonata: Insecta* | Dragonflies and damselflies | Funa | |
| | | 17 | *Rhacophorus malabaricus* | Malabar gliding frog | Funa | |
| | | 18 | *Pedostibes tuberculosus* | Malabar tree toad | Funa | |
| | | 19 | *Raorcheste s glandulosus* | Glandular bush frog | Funa | |
| | | 20 | *Dipterocarpus-Mesua-Palaquium* | Tropical Evergreen Tree | Flora | |
| | | 21 | *Dipterocarpus bourdillonii* | Karanjili | Flora | |
| 5 | Socio Economic Aspects | About 2 households residing within the 200m vicinity who are from middle-income and low-income group families. The primary information on socio-economic profiles is collected from the ULB documents and through field visits. | | | | The dumpsite remediation process is anticipated to pose social risks, including pollution of food and beverages in nearby establishments and |



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| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | | Families residing near to the dumpsite, in the vicinity of 200m, fall in different socio income groups.<br>Currently, there is no system in place for leachate drains or management because biodegradable waste was not dumped at site. However, during bio-mining activities, provisions for drains and leachate management will be established. | potential health issues for local residents, workers, Labourers, and students. A Social Management Plan, based on social screening and transect walk findings, is essential to mitigate these risks. Furthermore, the proposed remediation will have a positive impact on nearby residents, as it will lead to the removal of legacy waste, improving both environmental and social conditions. |
| 6 | Land use, Development Pattern and Key Projects | Surrounding land uses are mostly residential. The working MCF and two units of organic waste composter are available at site. There are no structural damages in this building. | Odour, leachate, and visual impacts on the surrounding land uses (residential, temples) and MCF |
| 7 | **Infrastructure and Services** | | |
| 7.1 | Traffic and Transportation | A detailed incremental load by vehicles during the operation phase is assessed and given under the traffic assessment report. Through assessment it is identified additional 9.4 trucks/day will be the traffic load due to the activity. | The implementing agency shall ensure staggering of the traffic movements from site considering peak hours/school timings. Also, nighttime vehicular movements can be implemented More accurate information shall be available once Contractor is being onboarded. EIA to be |



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| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | | | updated by the contractor based on his work plan |
| 7.2 | Water Supply<br>a) Surface water<br>b) Ground Water | A) Surface water: Bavali river is 1.5km from the site. No connectivity between dumpsite runoff water and river. And the sample collected from nerby pond.<br>B) Ground Water collected from 3 different locations (Residences within 200m radius)– all parameters are well within limits except for pH. | Site Drainage & leachate Impacts due to of bio-mining activity (esp during any seasonal rain) is important with respect to nearby soil & water environment |
| 7.3 | Drainage, Sewerage and Sanitation | Region has an unplanned network of drains eventually leading to Bavali River and there is no water connectivity from the site to river<br>Leachate samples collected at site, showed BOD value exceeding the limit and all other parameters were within limits | |
| 7.4 | Air Quality | Air Samples collected from 2 locations within the dumpsite and results found to be well within the permissible Limits. | |
| 7.5 | Noise Level | Noise Level monitoring samples collected within the dumpsite in order to identify the present noise level and results found well within permissible limit | Proper remedial measures for increased noise level shall be ensured by the contractor while bio mining activity. |

### 3.5 Description of Environmental Parameters

Under this baseline environmental attributes are arrived at after analysis of samples taken from the dumpsite and surroundings viz ground water, surface water, noise level and air. The map showing sampling locations and the analysis with observations are given below:



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**Distance of the sampling locations**

*Table 11 Distance of Sampling locations*

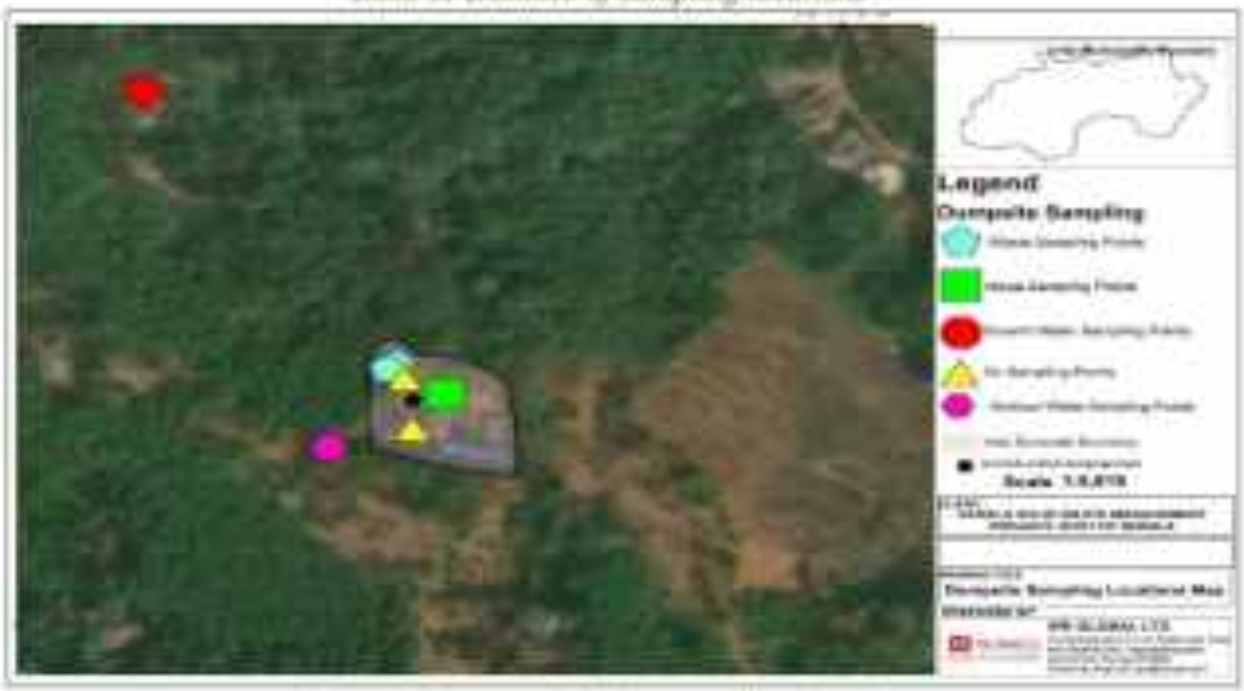



*Figure 3 Topo map showing sampling locations*

| S. No. | Description | Direction | From Centre of the Dumpsite | From Boundary of the Dumpsite (m) |
|---|---|---|---|---|
| 1 | Surface Water | Southwest | 714 m | 640 m |
| 2 | Ground water 1 | East | 75 m | 10 m |
| 3 | Ground water 2 | Northeast | 175 m | 118 m |
| 4 | Ground water 3 | Northwest | 2.87 Km | 2.82 Km |
| **Note:** Air and Noise Monitoring are monitored inside the Yard | | | | |

**3.6 Identification of sampling location:**

*Table 12 Identification of sampling location*

| S. No | Description | Place identified | Justification |
|---|---|---|---|
| 1 | Air sampling (2 Locations) | Inside dumpsite | As per the wind rose diagram, the direction and speed of the wind are determined and based on the existing wind rose data, the air sampling sites were fixed at two locations inside the premises. |



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| | | | |
|---|---|---|---|
| 2 | Noise (1 Location) | Inside the dumpsite | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. The adjacent MCF and organic processing units. |
| 3 | Surface water (1 Location) | Surface water near to the dumpsite [stream] | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope. This steep slope possesses a potential risk of leachate runoff, which could result in the contamination of surface water on that particular side of the site. So, the location of surface water is taken on the southeast direction. |
| 4 | Ground water (3 Locations) | 3 wells identified near the dumpsite area | Considering the sites geographical features, it is situated in a predominantly. The infiltration of leachate which could result in the contamination of ground water.<br>Based on the possible infiltration and slope direction the ground water samples were collected within dumpsite. |

### 3.7 Sampling Methodology

*Table 13 Sampling methodology*

| S.No | Description | Method |
|---|---|---|
| 1 | Air sampling | Calibrated High Volume Sampler, Calibrated rotameter & calibrated Dry gas maters and sampling locations selected based on wind rose and impacts on surrounding land uses. |
| 2 | Noise | Calibrated sound level meter and sampling locations selected based on highest noise level on site and impacts on surroundings. |
| 3 | Ground water | Water collected in polyethylene and sampling locations selected based on leachate and run off flow and impacts on surroundings. |
| 4 | Surface water | Water collected in polyethylene bottles and sampling locations selected based on leachate and run off flow and impacts on surrounding surface water bodies and drains (line sources of pollution) used be communities |



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### 3.8 Site Connectivity

The Athithattu dump site is located in Ward No. 12 of Iritty Municipality. The site is at a distance of 3 km from the Iritty – Peravoor Road.

### 3.9 Traffic Assessment

Traffic assessment refers to the process of evaluating and analyzing the flow of vehicles, pedestrians, and other modes of transportation on roadways, intersections, or specific areas. This assessment helps in understanding current traffic conditions, identifying potential issues, and developing appropriate strategies to improve traffic flow, safety, and efficiency.

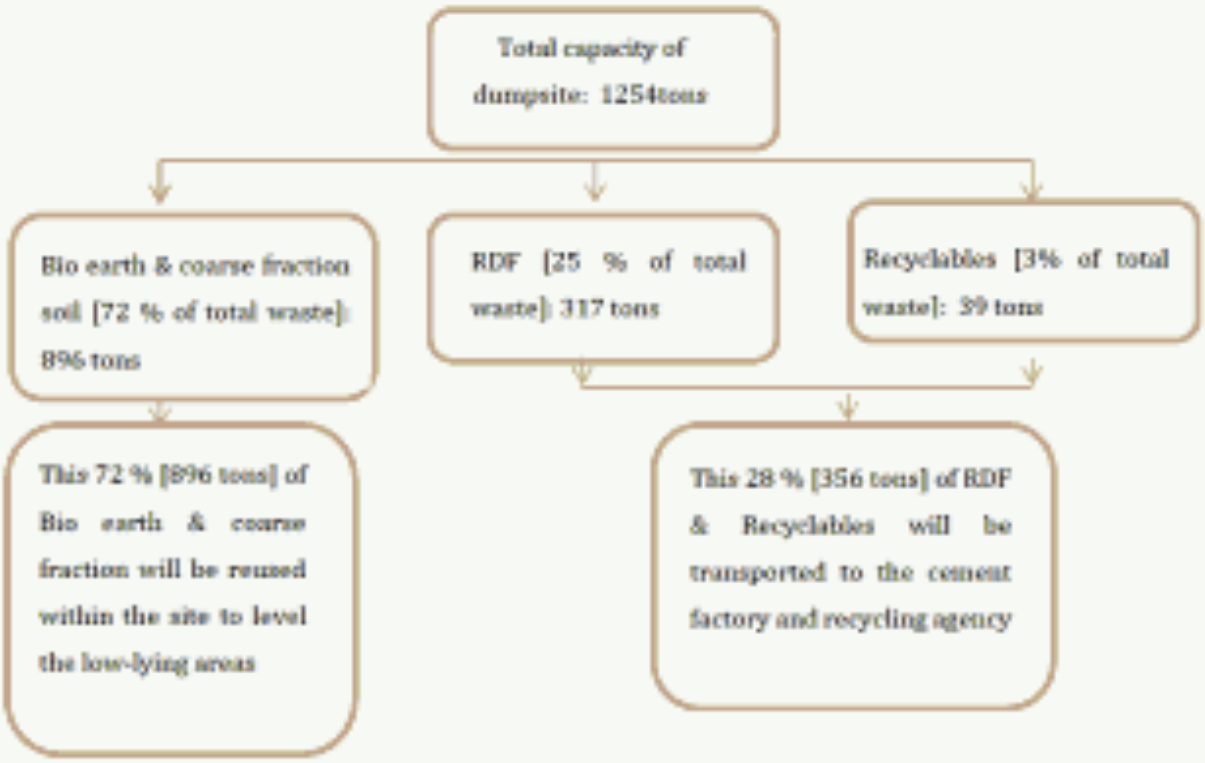



*Figure 4 Traffic Load*

*Table 14 Truck Capacity*

| S. No | Materials | % of Materials | Weight of each material (tons) | Vehicle Type | Max Capacity of load carrying Truck (tons) | No. of Trips |
|---|---|---|---|---|---|---|
| 1 | RDF | 87 | 311.62 | 12-Wheeler Dumper | 18 | 18 |



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| S. No | Materials | % of Materials | Weight of each material (tons) | Vehicle Type | Max Capacity of load carrying Truck (tons) | No. of Trips |
|---|---|---|---|---|---|---|
| 2 | Glass | 6 | 21.95 | 12 Wheeler Dumper | 25 | 1 |
| 3 | Rubber | 2 | 5.58 | 10 Wheeler Dumper | 8 | 1 |
| 4 | Metals | 5 | 17.87 | Goods Truck | 2 | 9 |
| **Total Weight** | | | **357.02** | **Total No. of Trips** | | **29** |

*Table 15 Total Trips Planned*

| S.No. | Materials | Total Trip | Total Days for Disposal | Trip/Day | Remarks |
|---|---|---|---|---|---|
| 1 | RDF | 18 | 90 | 0.2 | Two Trips per 10 day |
| 2 | Glass | 1 | 90 | 0.01 | Once while complete remediation |
| 3 | Rubber&Foot wear | 1 | 90 | 0.01 | Once while complete remediation |
| 4 | Metals | 9 | 90 | 0.1 | Once in Ten Days |



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## 4. ANALYSIS OF ALTERNATIVES

### 4.1 Alternative 1: No project (without project scenario)

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevent further contamination of the site.

If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows;

1. Foul Odor Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.

2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.

3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.

4. Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the local ecosystem, disrupting natural habitats and potentially causing long-term ecological imbalances.

5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

### 4.2 Alternative 2: Mode of execution / Management Alternative

Regarding the execution strategy, the outcomes of a Transect walk have substantiated the impracticality of waste transfer between Urban Local Bodies (ULBs). As a result, the imperative is for the waste remediation procedure to take place on the premises, allowing only the byproducts to be considered for potential transfer.

The logistical aspects of arranging machinery and designating storage space for these byproducts will hinge upon the extent of land available. At the outset, the existing underutilized, MCF and organic waste treatment facilities will be employed to cater to the initial storage requirements.



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### 4.3 Technology Alternative

The selection of the appropriate method or technique for remediation is determined by considering several parameters. These include the significant aspects and suitability of remediation types such as

1. Capping without land recovery,

2. Bio-mining – reclamation/recovery of 100% land

3. Capping with partial land recovery.

Additionally, factors like available resources such as manpower, machinery, finances, and physical site conditions, including the quantity and characteristics of legacy waste, Environmental baseline, social concerns, regulatory compliance (KSPCB/NGT), the need for complete land recovery, and opportunities for utilization of processed aggregates/byproducts are taken into account.

After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.



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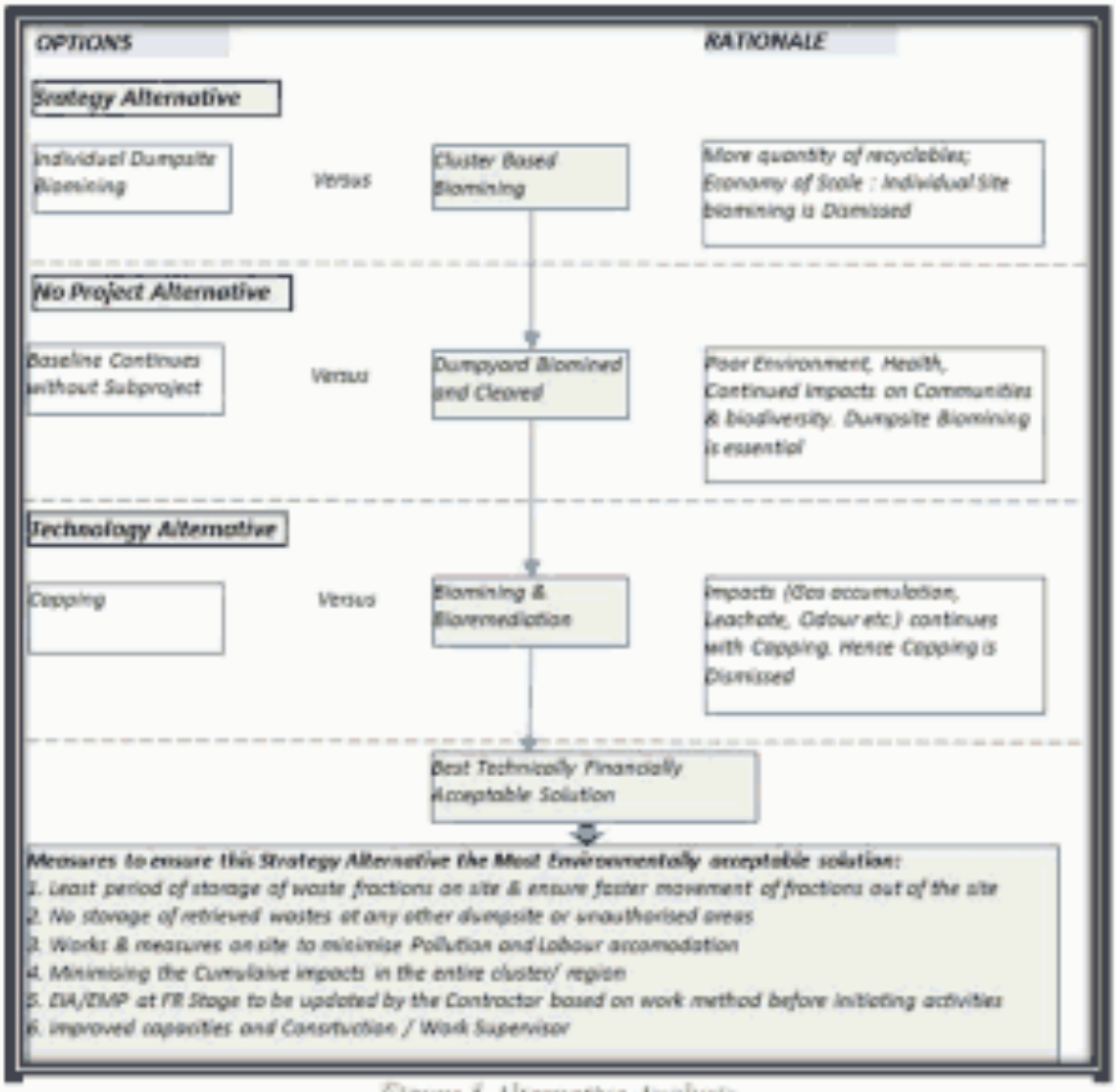



*Figure 5 Alternative Analysis*



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## 5. ASSESSMENT OF ENVIRONMNETAL AND SOCIAL RISK IMPACTS

Bio-mining and bioremediation of existing legacy dumpsites brings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more man-days at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, bio-mining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration) are important in this case. In addition, cumulative impacts of simultaneous bio-mining of multiple such legacy waste sites on the environment is important. Especially with respect to

- Drainage and leachate flow into regional waterbodies (& esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies,
- Pollution on land/soil, dust and odour nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks,
- Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and
- Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at this stage, while some would be known only based on the project details that would be known from the work plan of the contactor once on board.

### 5.1 Impact Assessment Methodology

Impacts are assessed based on Magnitude, Duration, and Significance of the impacts and sensitivity of the receptors present within the 500 m aerial distance of Iritty dumpsite.

#### 5.1.1 Magnitude and Duration of Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Bio-mining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;



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- The spatial extent of the potential impact;
- Reversibility of the Impact;
- Legal standards and established criteria.
- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table 1 - Aspects for Determining the Magnitude of Impacts. Magnitude is assessed as medium, considering shorter duration of the activity However, magnitude of cumulative impacts of various dumpsite remediations might be High.

| Aspects | Large | Medium | Small | Negligible |
|---|---|---|---|---|
| **Duration of the potential impact** | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or less than the lifespan of the program | Temporary with no detectable potential impact |
| **Spatial extent of the potential impact** | Regional – much beyond project boundaries | Beyond immediate Program components, site boundaries or local area | Within program boundary (but cumulative impact of various dumpsite bio-mining activities will be on larger extent) | A specific location within program component or site boundaries with no detectable potential impact |
| **Reversibility of potential impacts** | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months | Baseline remains constant |
| **Legal standards** | Against | Complies with limits | Meets minimum | Not applicable |



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| Aspects | Large | Medium | Small | Negligible |
|---|---|---|---|---|
| and established professional criteria | national/approved standards and or international guidelines/obligations | given in national standards but not confirming to international lender guidelines in one or more parameters | national standard limits or international guidelines | |
| Likelihood of potential impacts occurring | Commonly occurs under typical operating or construction conditions (Certain) | Usually seen occurring under most situations (Likely) | Occurs under abnormal, exceptional or emergency conditions (Occasional) | Unlikely to occur |

**NOTE:** Anticipated Project Duration – 5 to 6 months

### 5.1.2 Sensitivity of Receptor

The dumpsite is surrounded by residential buildings and some commercial establishment, during the time of site assessment the experts observed, some sensitive receptors within 500m from the site. Namely some schools, religious places and households. The project's lies near residences, within a 200-meter radius, and its potential air, odour, fire, noise, vibration, ground water impact on over 2 families over a duration of 5 to 6 months. The sensitivity of these receptors is High.

### 5.1.3 Significance of the impact

- Significance if the impact is high as it would even result in community resistance to bio-mining and bioremediation.

Since the project operational time 5 to 6 months, then the magnitude of the negative impact can be considered as small and medium sensitivity. In other hand magnitude of the positive



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impact, after the bio-mining of the existing land can be used for the recreational park for the public use.

### 5.2 Cumulative Impacts in the Region / Cluster

The impacts that may arise due to clustering of different dumpsites. The following impacts could result from the clustering while implementation, requiring thorough assessment.

1. If a sensitive environmental component (River, mangrove, wetland, etc.) is served by the leachate/drainage from one or more nearby dumpsites, the impacts can be regional.
2. Presence of other projects outside KSWMP; existing or forthcoming landfills, transfer stations or those considered under Track one investments may together create a cumulative impact with this activity.
4. Impact of vehicular movement from various subprojects on bio-mining of dumpsites may have cumulative impacts on air, odour, traffic issues, and pollution in case of spills/accidents/emergencies due to this clustering approach.
5. Storage of materials if any at common sites, impacts during rains, floods/emergencies in multiple sites of same water/airshed

However, such impacts will be known only based on final work plan, location and schedule for disposal of Legacy Waste once Contractor is on board. The need to update EIA/EMP based on this will be included in the Bid & Contract Documents.

### Source-Pathway-Receptor Analysis

**A) Source**: The source of contamination is the legacy waste remaining and being deposited at the Athithattu closed dumpsite, more specifically the landfill gas and leachate generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. In this case the waste is 20 years old, as dumping had started in year 2000 and closed in 2020. Initially the dumpsite was acting as a trenching ground, depositing sewage from pit latrines. The total waste volume is 2,023 cum with the dumpsite spread over 0.11acre and rises to a height of approximately 4.5 m from the base. Waste is seen 4 m above ground level and 0.5 m below ground level. In addition to the landfill gas and leachate, material spill over the land in the compound and windblown dust and litter are also considered as sources of contamination.

**B) Pathways**: The following pathways for migration of contaminants have been identified: ***Wind***- The main pathway for litter and dust dispersion is the wind. As long as the waste is kept uncovered, the dust and litter will continue to be blown off the dumpsite to the surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. Rainwater runoff through the dumpsite acts as a pathway for



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transport of leachate to the soil and groundwater. The rainwater flowing off the dumpsite along the slope towards low laying area acts as a pathway for the uncovered waste to flow into the unlined drainage canal along the boundary to low laying side, which runs through the residential areas.

***Lateritic Soil:*** The lateritic soil acts as a pathway for transport of leachate to the groundwater and for uptake of contaminated surface run-off.

***Leachate:*** The leachate flows with groundwater and acts as the pathway. Surface water Contaminants like run-off from the dumpsite, leachate and windblown dust and litter that reach nearby surface water bodies like canals, rivers and streams are further transported by surface waters and in this case the surface water acts as the pathway.

**Receptors:**

Receptors are air, surface water and ground water. For drinking purpose, they mainly use municipal water supply. (Nearby Households, industries and shops within 200 m), soil, flora, fauna and humans. In the case of remediated dumpsite, the most prominent group of receptors are the residences and people involved in industrial activity and shops. As the dump is not contaminated, remediation would improve the pollution scenario provided the bio-earth used is pollution free and of good quality. However, other impacts are expected on the final destinations of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF in the region. Depending on the locations of end use of fractions retrieved from bio-mining, the contractor shall assess the impacts on communities and workers on site & nearby and near locations of end-use. Key impacts may result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after bio-mining activity, activities in bio mined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post bio-mining activity.

### 5.2.1 Impacts on Air Environment

Key impacts on air include:

- Emission of Methane and other Greenhouse gases; and its impacts on scavengers, workers on site/other facilities on site (MCFand Organic Waste Treatment units in this case), nearby communities of Ward 12.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odour, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.



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- When the legacy site is opened, existing gases would get emitted. Further, any delay / unexpected stoppage of bio-mining activity, might further the process of gas formation depending on waste composition, odour and fire risks. In the case of Athithattu, since the analysis of wastes shows calorific value of 2000 for combustibles with around 21.3% plastics (include MLP/SUP also) and3.55% cloth rags, it's well combustible; and the risk of fire is high during summers and incidents

### 5.2.2 Impacts on Water Environment

**Groundwater**

- Post and pre-monsoon water levels are 6.49 and 5.57mbgl. Borehole data indicates waste upto depth of 4.5 m with hard lateritic strata after that. Hence it is expected that the ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. With the slope of the ground of the dumpsite, this tends to get accumulated at low-lying gradients. High BOD levels of the drain and ground water wells around are indicative leachate and runoff pollution. Oozing & Pooling of leachate & it draining to nearby areas during rains would be an important aspect to be managed during bio-mining to prevent ground water contamination.
- Leachate samples: BOD, COD, TDS, E.coli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution.
- Borehole data: Dump below water table; impacts on water resources, wells nearby
- Ground beneath the dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. There is no parameters exceeding the permissible limits for heavy metals.

**Surface water**

- The dumpsite experienced flooding during 2018 floods. The site is at a higher elevation, and hence no submergence was experienced at the site during the floods. The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas.
- There are no surface waterbodies near the site, except at 1.2 km distance from dumpsite.
- At East and West direction, (end direction) there are residential households and mixed vegetation are seen. The leachate from the site may flows through natural slope which ends in residential areas. It is important to contain and treat leachate from the proposed bio-mining activities on site. Treated leachate may be recirculated or used for other purposes.



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### 5.2.3 Impacts on Land/Soil

- Historic land use assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it shall be excluded from the site as bio-mining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.
- Spillover of activities to nearby road, and land would result in pollution of all types on these areas. Hence it is important to restrict all activities to the site for legacy waste bio-mining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.
- Ground beneath dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. In Athithattu, all heavy- metals are falling within the limit as per Fertilizers Control Order 1985 and its amendments. Athithattu does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste (including legacy asbestos), e-waste or biomedical waste is found while bio-mining, same shall be retrieved, transported, treated and disposed as per specific waste guideline of the Central Pollution Control Board, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste),Feb 2019 and World Bank EHS Guidelines. A plan shall be auditing of all wastes, management, eliminating pollution & OHS risks; and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.
- Wherever fuel, combustibles and retrieved waste is stored, it shall be on impervious surface, at appropriate elevation, protection against rains, flooding (such as cut off drains, berms etc.), wind and fly / pest menace (screens, green cover etc), intruders (compound wall existing at Athithattu), watch and ward, lighting, remote monitoring measures etc). Risk of fire, dust and leachate contamination shall be well assessed by the contractor. Emergency Action Plan shall be prepared and mitigation measures shall be updated based on work plan/DPR, and implemented. Communities shall be made aware of works and advice to follow measures such as use of fly/dust covers/nets on wells etc.
- Of the waste samples analysed, 49% comprises of Bio earth; 32.5 % being <4.75mm size; C/N ratio (14.2:1) indicating slight unpleasant odour (high Nitrogen; releasing ammonia) less than that suitable for good compost.



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### 5.2.4 Impacts due to Noise and Vibrations

Various machines vehicles and activities contribute to noise and vibration on and off site. This includes vehicles carrying recyclables, operation of JCB, and other machines, diesel generator sets, motors on site, etc. In addition, activities on the site and in relation to the existing MCFs such as vehicles transporting the dry waste from households to MCF, loading / unloading of collected waste materials, and workers activities on site would add to noise and vibration. Impacts include disturbance to fauna flora on site, health impacts on communities around due to exposure to large volume of sound.

### 5.2.5 Other impacts on Biodiversity - Fauna/Flora

- There are no sensitive biodiversity areas within 10 km of the site. However, since the project involves transport of wastes, it is important to consider the impact beyond the project boundaries. Depending on the contractors plan for disposal of retrieved waste fractions, EIA shall be updated for biodiversity impacts.
- Fauna: impacted by direct consumption of the solid wastes, sharps, entanglement, or by consumption of plants and/or animals contaminated by wastes, or as a result of leachate effects on groundwater and surface water.
- Flora Plants near open dumpsites can be impacted directly by the waste, dust or smoke from burning. Disturbance to vegetation due to machinery, trampling by foot, vehicle or animals, or contamination by waste or leachate, the migration of landfill gas, or as a result of burning or smoke effects
- Disturbance to other fauna and flora on site: SWM activities onsite including those related to MCF may also impact fauna/flora through high noise levels of pre-construction / construction activities.
- Biodiversity of existing site: Available Biodiversity of existing site is mentioned in the Environmental Baseline session and there is no key species listed by IUCN.

### 5.2.6 Other impacts on Workers and Communities

- Contaminants in soil and water: Direct or indirect contact with polluted soil or water by neighboring water users. Additionally, because of their locations, recovered lands are subsequently used as parks, or for SWM facilities or office spaces etc. This may pose risk of bioaccumulation of metals which can constitute a health risk. Also impacts on buildings due to gaseous emissions, risk of fire etc if used after clearing.
- Health Risks: One of the primary health risks of dumps is the spreading of diseases - diarrhea, hepatitis etc. The ways such infection can be spread are numerous but are often related to direct contact with the waste (e.g., clinical waste, fecal matter) by scavengers and other unauthorized persons being on the site. The other main pathway is by vectors such as, foraging animals, rats, birds, flies and mosquitoes etc.



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- Flies, mosquitoes, rodents, crows, pigeons, pest menace on site, for workers & communities & their assets (such as wells) due to exposure of putrefied wastes

- Impacts if separate common site/s or a site among these dumpsites is chosen to store wastes from other dumps till it is disposed, or as transfer stations or for common processing of certain fractions: Such activities would result in Air, odor, dust, noise, water, vibration, flora, fauna, communities around the new site. There is also risk of contamination due to newly placed wastes, and pollution impacts and disturbances to communities due to works/activities on this site. Such sites and activities shall be avoided, and if quintessential for the project, be carefully chosen and approved only after thorough discussions with KSPCB, and all stakeholders. An assessment of their sensitivity and appropriateness shall be undertaken considering the environmental risks. They shall be audited and assessed for existing and future environmental impacts of such activities and mitigation shall be implemented. However, details on such sites shall be known only based on the final schema of implementation proposed by the contractor. Hence, the Contractor shall update EIA based on this before starting any activity on site.
- OHS impacts: Infectious wastes, fecal matter, clinical wastes and sharps; batteries, e-waste and possible bursting; Hazardous wastes like asbestos and other chemicals dumped; pesticides / insecticides, inoculum storage, handling and use on wastes/land leading to diarrhea, hepatitis, insect & reptile bites, interactions with foraging animals like rats, dogs, cattle, vector (mosquitoes, flies etc) transmitted diseases etc.
- This activity would result in large influx of workers from the region. Worker facilities in the labour Camp if any, & site are important, as the density of population is high in Kerala. It is important that camp sites are not set up in the land to be remediated. Periodic health checkups (once a week) are very important as the work involves handling of waste. It is important to also provide periodic health checkup and co-ordination with local Primary Health Center/Central Health Services for medical camps for residents, schools and others during the bio-mining period.
- Risk of Fire during bio-mining and due to retrieved material storage; possible Burning of retrieved materials; storage and use of firewood for various purposes, fuel for vehicles. The smoke from burning solid waste can result in respiratory complaints, dizziness, and headaches in the short-term, as well as potentially more serious diseases such as cancers and heart disease in the long term.
- Impacts of other site development works shall be well assessed, EIA/EMP updated, and mitigation measures included in Project costs and implemented by the contractor/ULB (whoever is responsible as per FR/Final Bid document)



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### 5.2.7 Visual impacts, Noise, Odour, Vibrations

- Odour & impacts on workers and communities during bio-mining, storage and Transport are key determinants of community agreement to the activity. Such odour would attract flies and vectors in large numbers, who may also contaminate the food, and water sources of nearby communities. It is important to minimize odor emission as guided by the CPCB Guidelines on Legacy Waste Bio-mining, 2019. also provide periodic health checkup and co-ordination with local PHC/CHS for medical camps for residents, schools and others during the bio-mining period.
- Visual impacts of the waste being dug up, screened ad heaped/stored is not appealing. It is important to mask this appropriately.

### 5.2.8 Traffic Impacts

- Impacts due to new access road construction/upgradation. Access road to the site is unpaved and slushy during rains. It is important to minimize temporary pollution due to increased movement men, and materials from and to the site during bio-mining activity and beyond as it is proposed to store material on site including air and noise pollution, access restrictions to properties nearby, and vehicular conflicts
- Large vehicles moving in and out of the site carrying materials, tools, equipment & pedestrian/worker -vehicular conflicts; increased traffic on roads, large equipments & vehicles, noise, air pollution: vehicle emissions, DG sets
- Vehicles, equipment's not adhering to pollution standards

### 5.2.9 Other Impacts on existing or proposed activities on site/s

- There may be approvals from various agencies for bio-mining activities and associated facilities; depending on utilities and uses on site. & associated activities. These permits shall be obtained prior to initiating activities on site.
- Impacts of bio-mining on existing facilities on site such as MCF and composting yard etc (disturbance to activities & people due to dust, leachate, noise, odour; additional load of wastes to these facilities, vibration impacts & structural damage, etc).
- Post bio-mining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped & impacts if this is dumped elsewhere or not processed. This alternate location, being associated facility need mitigation measures to avoid/minimize pollution, Health &Safety impacts on workers, communities. Also forward linkages are considered as associated facilities/linked activities. Impacts of Transportation of



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these fractions (traffic increase, odor, leachate, dust) impacts during rains & emergencies, and its handling, storage at the identified locations, reuse etc. shall be mitigated.



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## 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT & MONITORING PROGRAM

### 6.1 Scope of Environmental Management & Monitoring Plan

An Environmental Management Plan (EMP) is a comprehensive strategy designed to manage and mitigate the impacts of activities on humans and the environment, particularly concerning air, water, soil, land, and noise and vibration, and impacts on biodiversity and people.

### 6.2 Environmental Management Plan

The detailed anticipated impacts and corresponding mitigation measures/management of the impacts are given below

*Table 16 Impacts & mitigation measures on Planning and installation phase*

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| A | | **Planning and Pre-Construction Stage** | | |
| 1 | | ***Planning for bio-mining facility*** | | |
| 1 | Bio-mining& Bioremediation Plan & Capacities | • Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / biomined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these biomined material in line wit the agreements with such facility owners and National, State regulations and WB EHS<br>• Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate management Plan.<br>• The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers.<br>• Contractor to get all required licenses & permits before start of any activity on site | Contractor | DPMU/ULB |
| 2 | Site Access Closure | • The total cessation of dumping in the site will be implemented before any works.<br>• All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public.<br>• The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance to indicate that the waste dump has been closed from the operation.<br>• To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground. | ULB or Contractor as per Bidding mechanism | SPMU/DPMU/ ULB |



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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • Grading shall be performed where necessary to provide a neat appearance | | |
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – *Impact on air quality, odor, water contamination due to leachate, health and safety impacts of the people working in the site assesment* | • Carry out site assessments as per Guidelines for Bio-mining of Legacy waste Dumpsites of CPCB<br>• Consider safe bio-mining& gas / leachate generation from existing capped portion of the site<br>• Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means<br>• Provision of appropriate PPE's to the team undertaking the site assessments<br>• Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits<br>• Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>• Plan for machinery operated which will be operated by skilled operators at all times.<br>• Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures.<br>• Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | TSC, ULB, Contractor | DPMU/ULB |
| 4 | Absence / Delay in Permissions for Developing the bio-mining facility and associated works as per National regulations | • Required permissions for undertaking bio-mining at the existing dumpsite and assessments conducted for undertaking bio mining as per existing Laws, Regulations, including for associated infrastructure, DG Sets, Consent to Establish; and other licenses including those as per Labour Laws, before the start of works on site | Contractor, ULB | SPMU/DPMU/ ULB |
| 5 | Dust impacts due to Site works, screening & stacking of retrieved wastes *(Air Pollution) and Visual Blight due to excavation* | • Plan to Provide temporary high screen, buffers around the site before the start of work to curtail dust emissions<br>• Arrange a green belt as early as possible on the area of the site with no / less dump. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers)<br>• PPEs to be used by workers<br>• Awareness to communities & suggest to use PPEs | Contractor and or ULB depending on agreement on bidding mechanism/DPR | SPMU/DPMU/ ULB |



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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 6 | Material sourcing, transport, and stacking of construction materials *(Occupational Health and Safety issues and Air noise pollution)* | • Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism<br>• Prior intimation to nearby Primary Health Centre on work activities need for medical support, emergency support needs, type of Labourers on site and Labour camp if any<br>• Materials shall be sourced only from approved quarries<br>• Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions.<br>• The driver should be with required license and follow speed regulations<br>• Materials shall be transported preferably through well-surfaced roads. If road it kachcha, water sprinkling shall be done to prevent dust emission before and after truck passes<br>• Material transport and unloading activities should not result in noise disturbance to locals and should be during day time<br>• Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors.<br>• Provide vehicle wheel wash area on site<br>• Workers to be provided with Personnel Protection Equipment (PPE) including safety boots, jackets, ear muffs, gloves.<br>• Proper rest area on site shall be provided with water, first aid, toilets | Contractor | SPMU/DPMU/ ULB |
| 7 | The layout of Labour camp *(Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)* | • Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp<br>• Nearby health center shall be informed about the Labour camps appropriate medical checkup shall be arranged periodically<br>• Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters)<br>• It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with land owners wherever the labour is accommodated<br>• Camp must not be provided in an area prone to Hazards<br>• Camp should be adequately at higher plinth levels to prevent water intrusion<br>• Rooms shall be of appropriate sizes with adequate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG) | Contractor | Site engineer of SPMU, Labour Commissioner, PCB |



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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female labourers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc.<br>• The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security<br>• (Refer ESCOP section D6 and section 11 of EMF for KSWMP) | | |
| 8 | Nearness/disturbance to sensitive areas such as forests, wildlife habitations, etc. especially in case of providing support facilities *(Impacts on Fauna / Flora)* | • Ensure site selection for any support facilities or activities (such as vehicle storage etc. if no in bio-mining site) based on the screening checklist and the master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate, Reduce. Obtain requisite permissions from respective authorities such as Pollution Control Board, ULB etc.<br>• Identify appropriate government site to avoid land acquisition and resettlement impacts<br>• Covered and well-marked storage area with cut off drains & odour/fly/dust/ fire prevention shall be ensured for excavated wastes and washing, segregation of the same are to be arranged with due consideration to nearby residences other landuses | Contractor | SPMU/DPMU/ ULB |
| 9 | Contamination of groundwater due to leaching. Leachate parameters: BOD, COD, TDS, EcoIL Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution | • During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant<br>• Depending on the contractors plan for bio-mining of the capped area on site, adopt plans to manage leachate | Contractor | SPMU/DPMU/ ULB |
| 10 | Impacts on flora, fauna" consumption of wastes, leachate impacts, dust smoke – burning, trampling/machinery | • Movement routes of vehicles to be planned to avoid key fauna/flora on site such as *Alstonia* sp.(Tree) &*Funambulus tristriatus* ( Jungle Palm Squirrel)<br>• Leachate collection & storage/treatment and recirculation shall be planned to avoid impacts on flora, fauna | Contractor | SPMU/DPMU/ ULB |
| 11 | Nuisance hazards to neighboring areas | • Ensure proper design and adequate compound wall; high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements | Contractor | SPMU/DPMU/ ULB |



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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • In case of waste mound and site edges are sliding or unsafe; provide engineered retention walls | | |
| 12 | Treatment & Disposal of wastes and rejects | • Contractor to Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & inert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventorised and quantified, including Bioearth, rejects, inerts. These shall be tested and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertiliser Control Order 1985 and their amendments. Asbestos Management Plan shall be prepared for management if Asbestos wastes retrieved if any<br>• Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period. | | |
| **B** | **Implementation or Bio-mining& Bioremediation stage and Construction of ancillary facilities such as access road improvements, compound walls, greenbelts, drainage etc.** | | | |
| | **Implementation of bio-mining of the dumpsite** | | | |
| 1 | Impact due to the vehicular movement *(Air and noise environment&Vehicular - Vehicular & Vehicular - Pedestrian Conflicts)* | • Vehicles and machinery are to be maintained so that emission conforms to National Ambient air quality standards.<br>• All vehicles and machinery should obtain Pollution Under Control Certificates<br>• HORN PROHIBITION signpost to be erected.<br>• Rumble strips/speed breaker to be provided on access roads.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed.<br>• Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle<br>• Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements.<br>• Avoid heavy vehicle movement through Iritty roads during peak hours 7 a.m to 10 a.m mention: school hrs / peak hrs: and during important period / festivals when people use the road to access temple<br>• Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents. | Contractor, ULB | SPMU/DPMU/ ULB |



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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 2 | Impact due to the use of heavy vehicle and equipment *(Air and Noise environment)* | • Mixing equipment (in case of construction of ancillary facilities) should be well sealed and be equipped with a dust-removal device.<br>• Equipment Operators & labourers should wear dust masks, ear protection, and hard hats.<br>• Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load.<br>• Labour to be provided masks / PPEs.<br>• Construction / Bio-mining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spreading into neighbering sensitive land uses<br>• Noise standards at operation machines are to be strictly monitored to prevent exceeding of GOI noise standards.<br>  ▪ Strictly adhering to designated working hours (day time); Sensitising construction truck drivers and equipment operators to switch off idle engines.<br>  ▪ Using modern, well-maintained and regularly serviced vehicles.<br>  ▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>  ▪ Provision of earmuffs and ear protection to workers and employees in high noise areas.<br>• Workers in the vicinity of strong noise to wear protectors and their working time should be limited as a safety measure.<br>• AsAthithattu dumpsite has sensitive receptors and settlement areas within 150m of it, noisy works shall be stopped from 22:00 to 06:00.<br>• Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum.<br>• Avoid noisy activities/machines near nearby household area of the site where settlement exist within 50m. Noise barrier shall be provided at all noise-sensitive locations / for noise generating equipment such as DG sets, mixers (for ancillary facilities) especially near South side of the dumpsite<br>• Adopt required measures as per CPCB guidelines, and site & work specific safety requirements | Contractor | SPMU/DPMU/ ULB |
| 3 | Impact during the construction activities *(water environment)* | • Labour camps if any (depending on Contractors work plan & arrangements) are to be located away from water bodies.<br>• Vehicle washing or maintenance near water bodies are to be avoided.<br>• Contaminated water from construction / bio-miningactivities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated on site. | Contractor | DPMU/ULB |



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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 4 | Leachate and Runoff from bio-mining activities *(Soil contamination and groundwater contamination)* | ▪ Provide site cut off drain around the site to divert off stormwater from entering the site, and to prevent contaminating downstream resources with run off from the dumpsite<br>▪ Depending on the contractors plan for bio-mining of the capped area on site, implement leachate management to cause no harm to communities & environment<br>▪ Ensure stormwater drains will lead to drain outlets (along the south east boundary of the site) on roads adjoining the dump yard<br>▪ Provide leachate drains lined from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area.<br>▪ Provide proper treatment of leachate and stormwater that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by bio-mining activities like excavation and waste segregation and stabilization<br>▪ The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB.<br>▪ The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata<br>▪ Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff and hence reduce infiltration<br>▪ Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism<br>▪ Plan the works on site only during non-rainy seasons and to complete the works before rains<br>▪ Store leachate preferably in aboveground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide for emergency containment additionally | Contractor | SPMU/DPMU/ ULB |
| 5 | Soil decontamination from accumulated waste levels *(Impact on leachate, odor)* | ▪ Decontaminate the soil / stabilized layers remaining after storing out wastes using windrow and bio-culture of appropriate quality in line with standards / regulations or appropriate means as per CPCB Guidelines<br>▪ Vegetative layer using contaminant absorptive root varieties like Vetiver may be tried on soil and along the edge of the green belt or floating wetlands may be deployed in water channels | Contractor | DPMU/ULB |



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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | nearby to maximize absorption of leachate in the soil by root-zone phytoremediation<br>• Soil and water testing shall be done and changes in contamination shall be noted. | | |
| 6 | Excavation of waste from the waste mound *(Health and safety impacts)* | • The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound.<br>• Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided<br>• Machinery operated for excavation should be operated by skilled operators at all times.<br>• Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on wastes.<br>• Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound<br>• In case of the waste mound and site edges are sliding or unsafe; provide engineered retention walls or string boundaries.<br>• When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection &treatment mechanism. | Contractor | SPMU/DPMU/ ULB |
| 7 | Transportation of wastes or retrieved or other material in overloaded and open vehicles *(Air, Odour nuisances: spills and littering impacts on Air, Water, Land)* | • All vehicles shall carry only approved load of weight<br>• Regular cleaning of roads & drains and removal of spills if any.<br>• All waste transport vehicles shall be covered and movement shall be during non-peak hours.<br>• Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities.<br>• Adopt required measures as per CPCB guidelines, and site specific safety requirements. | Contractor | SPMU/DPMU/ ULB |
| 8 | Spreading and compaction of waste *(Safety)* | • Follow technical details in line with CPCB Guidelines<br>• The active working face should be minimized as much as practical an appropriate size is about 2 to 3 times the width of the compactor vehicle.<br>• Waste should be spread and compacted in layers not greater than 0.6m (2ft.) after compaction.<br>• Compaction of the waste should be on a slope of about 20-30% as guided via the permissible levels and worked from the bottom of the slope to the top | Contractor | SPMU/DPMU/ ULB |



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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 9 | Occupational health and safety impacts of the workers during the bio-mining & construction of support facilities:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage of chemicals/other materials, bicultures or wastes etc; by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | • Avoid direct & double handling of wastes through avoidance measures (suitable planning & equipments), engineering controls & use PPEs<br>• Work area & Labour camps shall be provided with First Aid and other related activities.<br>• Emergency Preparedness plans shall be prepared and implemented for all manpower working centers and its field extension centers.<br>• An Environment Health & Safety policy shall be prepared and implemented<br>• Adequate manpower shall be provided &manager & staff shall listen and act upon the manpower related grievances.<br>• Workers will be provided with PPE such as face mask, gloves, shoes, nose masks & goggles<br>• Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed without slip, trip, fall especially on waste, leachate or trenches<br>• Proper training will be provided regarding the maintenance of health<br>• Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks& water supply), food, and water in a hygienic environment (with proper handwash). Provide clean eating areas where workers are not exposed to contaminated, hazardous or noxious substances.<br>• First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus<br>• Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health checkups. Arrange daily health checkup for workers working on waste heaps<br>• Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals.<br>• Measures such as deferred timings and stretch break to be adopted<br>• Secure all installations from unauthorized intrusion and accident risks.<br>• Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every days start of works / activities. Key hazards would be (but not limited to) are flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and leachate from existing capped area on site, electric shocks, works with heavy machines & equipments, slips of men & material (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc.<br>• EHS specialist with adequate experience & third party supervision are important for bio- | Contractor, ULB | SPMU/DPMU/ ULB |



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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | mining activity<br>• Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites<br>• Provide visitor orientation if visitors to the site need to gain access to areas where hazardous conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible<br>• Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;<br>• Ensure moving equipment is outfitted with audible back -up alarms& flag men with whistles or speakers;<br>• Electrical wires should be properly insulated and earthed, no exposed wires and no overloading than it will reduce the accidents due to electrical short circuit.<br>• Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenanceto be marked well & safe kept before activity start near thoselin close proximity to this location, there is a transformer.Disallow worker exposure to noise level greater than 85 dBA for more than 8 hours a day without hearing protection<br>• All workers shall be registered as per prevalent Labour laws (including a workforce of subcontractors) and provided insurance cover& others as per existing acts/laws<br>• Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractors person/Insurance agent<br>• While using heavy machinery like JCB, cranes, etc. inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle.<br>• While using heavy machinery like JCB, cranes, etc. inform communities to prevent children and others from going near operating / movement areas including roads.<br>• Flagmen shall be arranged if work is near schools, hospitals, major roads, and trafficcontrol is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if | | |



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| | | possible<br>• A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs.<br>• No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor<br>• All works related to working at heights will be undertaken only during the daytime when sufficient sunlight is available;<br>• Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done;<br>• All excavation activities to be conducted in supervision of the site contractor;<br>• Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured.<br>• All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans prepared and implemented, as per Banks Incident Reporting Tool | | |
| 10 | Risk of fire due to conditions leading to spontaneous combustion<br>*(Air environment, disturbance to communities and workers, health impacts, safety issues)* | • Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for Implementation of SWM Rules 2016 – regds Fire Incidents at MSW Dumpsites (https://cpcb.nic.in/openpdffile.php?id=UEFDVHlpZjFOXRpb25GaWxlLnBkZiMzdk3N19nZWRnYXBpb3RvNzOxMI5uZGFu ), LSGD Kerala Government GO on Fire Safety of MRF, MCFs (for the MRF on site if used for storage of wastes)and other Regulations, guidelines applicable<br>• Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3; and National/State regulations & WB EHS<br>• Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes<br>• Avoid conditions that can lead to spontaneous combustion such as:<br>o Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard.<br>o Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.<br>• Design the facility for access by firefighting equipment, including clear aisles among waste heaps or work areas and access to adequate water supply. | Contractor, ULB | SPMU/DPMU |



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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | • Ensure workers are briefed of fire hazard & its management<br>• No unauthorized entry shall be permitted to the site; including of workers during holidays, night time, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating "trespassers not allowed"<br>• The following activities should be implemented to prevent fires from occurring at the facility<br>o adequate fire-fighting equipment should be made available on-site and stored in an accessible manner.<br>o all operating staff should be trained and able to manage fire outbreaks at any part of the facility.<br>o clear signage should be established to inform workers and the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area.<br>o Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows.<br>o all fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the bio-mining, storage, and processing areas.<br>o all flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating stormwater.<br>• The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the bio-mining activity in line with National State regulations, guidelines and international good practices<br>• Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.<br>• Contain all local smokes/small fires inside the dump asap. Fire brigade help shall e sought on all smokes/fires outside the dump asap<br>• Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured.<br>• Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers | | |



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| 11 | Construction of new facilities in retrieved land | • The excavated site shall be protected from any dumping during or after the bio-mining activity and shall be reserved for SWM activities in line with SWM Rules 2016<br>• Any new facility under KSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations | ULB | DPMU |
| 12 | Pest / Vermin Control & Visual impacts (Odour, flies, rodent / other pest menaces) | • Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center<br>• Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups<br>• Biopesticides / biological control shall be followed. However, biopesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials<br>• Banned pesticides/insecticides shall not be used.<br>• Workers shall be made aware of storage and use of pestcontrol measures and PPEs to be used<br>• Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate management | Contractor, ULB | DPMU, SPMU |
| 13 | Odour nuisance | • Waste with a strong odor to be covered immediately they are emptied from vehicles.<br>• Control and manage leachate treatment to minimize odor.<br>• Provide buffers screens to curtail oder from reaching surrounding communities especially to North side of site.<br>• Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor. | Contractor, ULB | DPMU, SPMU |
| 14 | Storage, Collection, Transport, Treatment & Disposal of wastes and rejects | • Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste<br>• Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters<br>• Waste handling shall be inline with existing regulations & guidelines & avoid health & safety impacts<br>• No material is allowed to remain on site after the contract period<br>• Adequate fire safety arrangements & awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported<br>• Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/inerts in designated or agreed area & are in line with schedule: using GPS. | Contractor, ULB | DPMU, SPMU |



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| | | • Given that the access road is used by the public, it is imperative to implement the required safety precautions and environmental protection measures when transporting the waste. | | |
| 15 | Other activities | • No activity other than bio-mining shall take place on site & any activity shall cause no adverse impacts on the environment or people<br>• If existing MCF shall be used for storing bio-mining wastes, its safety shall be ensured in terms of fire & structural safety before starting to use the facility. Further usage of the MCF after bio-mining works shall be after proper cleaning / washing & disposal of all rejects/inerts & tools to ensure good housekeeping & no H&S impacts<br>• If existing MCF shall be used by the ULB for storing dry wastes from Town, during bio-mining period, alternate access shall be arranged & workers shall be adequately protected against any health & safety impacts | | |
| 16 | Energy Efficiency & Water Use efficiency | • All activities to consider energy efficient & clean fuels; and use of energy efficient equipment &bio-mining / construction techniques<br>• Landscaping & green belts to use local / indigenous plants & trees<br>• Waste water and Leachate to be treated & recycled/reused | Contractor | ULB |
| C | **Future Site Usage (EMP shall be updated in line with EMF & used if future site usage is proposed under KSWMP). This section is not the responsibility of the Contractor for Bio-mining, but of the future facility operator & ULB** | | | |
| 1 | Future use of the biomined site: Green Park, MCF, MRF, RRF, Treatment plants, landfill cell or any other, preferably for SWM | • ULB to ensure that the site will not be used for future dumping.<br>• Activities at existing MCF to be upgraded to ensure that no waste (even dry wastes) gets dumped around.<br>• ULB shall plan the future use of the site shall be in consultation with the communities.<br>• Phase 1 Environmental Assessment to be carried out, EA for existing facilities & EIA for proposed development in line with EMF in case this is proposed to be developed under KSWMP<br>• All applicable clearances, permits shall be arranged in line with applicable regulations for the proposed new use of the site, and appropriate designs/plans to be prepared & implemented | Future Facility Developer/ Operator & ULB | ULB (SPMU in case it is under KSWMP) |
| 2 | Vehicle movement for new activities: MCF/MRF, RRFs, Treatment plants, landfill cell<br><br>*(Air, water environment, a nuisance to* | • The movement route shall be scheduled for each vehicle.<br>• Enforce speed limits applicable and make drivers aware of this<br>• Vehicles movement shall be tracked by Health Supervisors to ensure keeping up to schedule; preferably using GPS<br>• Any adulterated fuel shall be avoided. There shall be periodic emission tests for vehicles<br>• Provision of Personal Protective Equipment such as face mask, gloves, nose masks & goggles to all workers in C&T vehicles, Maintenance yards<br>• Proper lubrication shall be provided to minimize squeaking noise due to friction | Future Facility operator | ULB |



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| | Biodiversity, communities, Health impacts) | • Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br>• The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public<br>• Traffic will be managed at the site by providing adequate space for parking of vehicles<br>• Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design<br>• No waste or material shall be disposed in any place other than the designated area; including water bodies, coasts/forests, or sensitive areas. | | |
| 3 | Exhaust emissions (Air Impacts) | • No idling of vehicles on site.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed | Future Facility operator | ULB |
| 4 | Plying of vehicles through kutcha / unsurfaced roads and idling (Air pollution: SPM, CO, CO2) | • Vehicle movement shall be well planned – through topped roads. In case of necessity to move through Kutcha roads, ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Future Facility operator | ULB |
| 5 | Odor (Nuisance, Air) | • Daily soil covers to compacted wastes to manage odors.<br>• Waste with a strong odor to be covered immediately they are emptied from delivery vehicles;<br>• Control and manage leachate treatment plant to minimize odor.<br>• Adhere to air quality regulations with quarterly air quality monitoring Maintenance of the buffer zone and protective berms<br>• Provide buffers screens to curtail odor from reaching surrounding communities | Future Facility operator | ULB |
| 6 | Impact on the ambient noise quality during the operations (Noise, nuisance to sensitive receptors, Health impacts) | • Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines;<br>• Using modern, well maintained and regularly serviced vehicles;<br>• Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>• Provision of earmuffs and ear protection to workers and employees in high noise areas | Future Facility operator | ULB |



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| 7 | Occupational health and safety impacts of the workers:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | • All OHS and CHS measures to be followed in line with applicable regulations, guidance<br>• Workers & communities shall be made aware of OHS, CHS risks and impacts & mitigation measures adopted<br>• Emergency management plan to be prepared & followed<br>• Workers shall be appropriately trained on OHS during construction & Operation of all future facilities | Future Facility operator | ULB |
| 8 | Pest / Vermin Control (Odour, flies, rodent / other pest menaces) | • Regular cleaning and approved pest control measures to be adopted<br>• Biopesticides / biological control shall be followed.<br>• Banned pesticides/insecticides shall not be used.<br>• Workers shall be made aware of storage and use of pestcontrol measures and PPEs to be used | Future Facility operator | ULB |
| 9 | Fire Safety | • The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented in line with National State regulations, guidelines and international good practices | Future Facility Operator | ULB |
| 10 | Energy Efficiency & Water Use efficiency | • All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & construction techniques<br>• Landscaping & green belts to use local / indigenous plants & trees<br>• Waste water to be treated & recycled/reused | Future Facility Operator | ULB |



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**Disposal phase of By-products from Bio-mining process**

The bio-earth and coarse fraction soil recovered from dumpsite will be used for filling low lying areas. The RDF material recovered from dumpsite will be transported to nearby cement factory and recyclable material will be handed over to the authorized recycling agency. If the by-products are not removed from the site within a three-month period, penalties will be imposed on the contractor



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## 6.3 Emergency & Disaster Management Plan

### Hazards Associated with Dumpsite Activities

The Disaster Management Act, 2005 mandates every Government Department to prepare, review and update Disaster Management Plan

### 6.3.1 Identified Emergency Situations

*Table 17 Hazards associated with Dumpsite Activity*

| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| As per World Bank EHS Guidelines | |
| Waste Storage | **Regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases** |
| Waste Segregation | **Regular audits of waste segregation and collection practices** |
| Monitoring records for hazardous waste collected, stored, or shipped should include | **1. Material Identification:**<br>- Name and identification number of the hazardous material(s) present in the waste.<br>**2. Physical State:**<br>- Indicates whether the waste is in a solid, liquid, gaseous form, or a combination of these.<br>**3. Quantity:**<br>- Specifies the amount of hazardous waste, typically measured in kilograms or liters, or by the number of containers.<br>**4. Waste Shipment Tracking:**<br>- Documentation tracking details include:<br>- Quantity and type of hazardous waste.<br>- Dates of dispatch, transportation, and receipt.<br>- Records of the originator, receiver, and transporter involved in the waste shipment. |



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| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| | **5. Handling and Treatment:**<br>- Describes the method and date of various actions taken with the hazardous waste, such as storing, repacking, treating, or disposing of it at the facility.<br>- Cross-referenced with specific manifest document numbers relevant to the hazardous waste.<br>**6. Location within Facility:**<br>- Specifies the specific locations within the facility where the hazardous waste is stored or processed.<br>-Includes information about the quantity of waste at each location. |
| Falls and Slips at the dumpsite, Slippery surfaces or uneven surfaces and poor access to work areas climbing on and off plant. | Tidy workplace by maintaining good housekeeping. Handholds wherever necessary and clear/ safe access to work areas with proper PPE to the persons working at the site. |
| Fire Hazard, Fire risk may occur due to the following, Storage of flammable liquids / Gas like LPG, Diesel, Any combustible materials, Sparks, Open flames, Absence of Fire hydrant network may lead to major fire accident | Combustible/flammable materials should be properly managed and stored/used. Fire extinguishers and Fire hydrant Network with reserve water (As per NFPA Code) should be made available. Emergency Plan in case of fire. |
| Absence of Personal Protective Equipment Lack of adequate footwear, Helmets, hearing/ eye protection, gloves & goggles may lead to injuries and death. | Proper footwear, Helmets, hearing/ eye protection, gloves & goggles should be given to the workers at the dumpsite. Proper training should be given to the workers on the use of PPE. |
| Electrical Hazard, Electric wires if any damaged, Poorly insulated, During temporary repairs, Circuits overloaded may lead to major accident | Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit. |



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| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| Ladders, Risk may occur due to the following Not secured against dislodgement, Defective ladders, Not sufficient length, Incorrectly placed | Ladder risk can be mitigated by the following<br>Secured against movement or footed<br>Ladders in good condition<br>Regular inspection<br>Ladder should be extended one (1 m) meter above platform to avoid injuries |
| Excavations<br>Risk may occur due to the following, Trench collapse, Gas emission | Risk can be mitigated by the following<br>Soil stability should be known before excavation<br>No water accumulation<br>V500 mask should be used at the in order to counter the gas emission.<br>Emergency Plan |
| Defective or wrong Hand Tools<br>Wrong/defective tool may end up with injuries to the workers using the tool | Right tool for the job should be used properly and it should be in good condition |
| Accidents due to vehicular movement<br><br>Vehicle movement inside the site | Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents |
| Noise Hazard<br>Noise levels over 85 decibels would cause trouble to the people working at the site | Noise Levels should be maintained below 85 decibels and with proper protection |
| Falling Material<br>Fall during carrying/Lifting of waste and materials from overhead work areas. | Risk can be mitigated by the following<br>Use of hard hats.<br>Person operating the Jcb/machine must be provided with walkie talkie/hand signals to know about the clearance |
| Visitors Presence at site<br>Insufficient fencing may lead to attract pedestrians to enter the site. | Fencing and barricades with proper signage boards indicating pedestrians not allowed |



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### 6.3.2 Proposed Organizational Structure for Disaster Management

The Organizational structure for the Disaster management contains the following team members.

**Emergency Response Team:**

A response team needs to be set in assistance with a senior executive (Site controller), Manager Safety (Incident controller), Shift in charge, and Emergency Coordinators.

Incident controller would be reporting to the Site Controller. Incident Controller organizes a team responsible for controlling the incidents with the personnel under his control.

Shift In-charge would be the reporting officer, who would bring the incidence to the notice of the Incidence Controller and Site Controller.

Emergency Coordinators would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential support services. For this purpose, security in-charge, personnel department, essential services personnel would be engaged. All these personnel would be designated as key personnel.

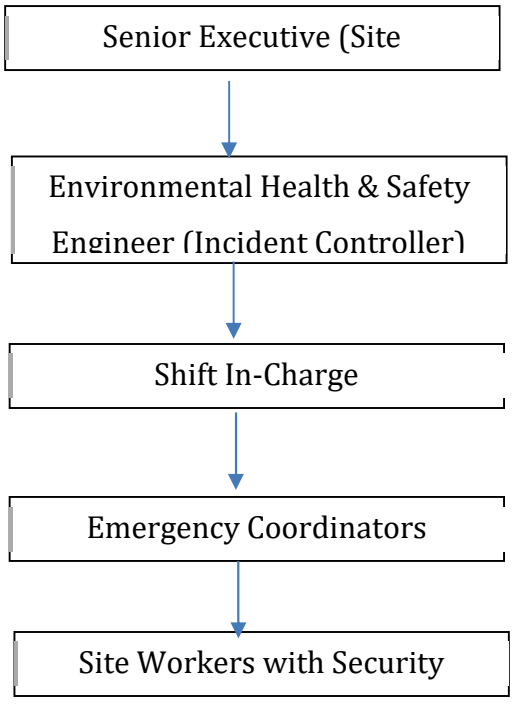



*Figure 6 Organizational Structure for the Disaster Management Team*



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### 6.3.3 Emergency Response Facilities

Emergency Control Center – with access for emergency shutdown procedures, duties and contact details of key personnel and government agencies, emergency equipment, etc.

- Assembly Point – with minimum facilities for safety and rescue
- Emergency Power Supply – connected with diesel generator, flame proof emergency lamps, etc.
- Fire Fighting Facilities – first aid fire-fighting equipment, fire alarms, etc.
- Location of Wind Stock – located at appropriate location to indicate the direction of wind for emergency escape
- Emergency Medical Facilities – Stretchers, gas masks, general first aid, emergency control room, breathing apparatus, other emergency medical equipment, ambulance the medical Center should display poster for treating burns and first aid. Some medicines and facilities to be kept in the medical Center are suggested.

**Health and Safety Measure for the workers**

All workmen employed in working conditions will be provided with adequate personal safety equipment as applicable to the work lies:

- Safety shoes
- Safety Helmets
- Hand gloves
- Ear muffs

**Monitoring Plan**

The considerations in an emergency planning include the following:

- Identification and assessment of hazards and risks
- Hazard consequences analysis
- Alarm and communication procedures
- Identification and equipping emergency control centre identify assembly, rescue points, medical facilities
- Emergency preparedness plan, procedure, steps to be taken before during and after emergency
- Formulation of plan and emergency sources
- Training rehearsal, evaluation and updating the plan
- Machinery should be examined regularly
- Medical examination for every employee shall be examined by doctors at least 3 months in a calendar. Health register should be maintained by the individual industry coming in the project site



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**Emergency Action Plan for Fire**

In case of Fire the immediate plan of action will be "RACE" that stands:

R - Rescue: When you discover a fire, rescue people in immediate danger if you can do so without endangering yourself.

A - Alarm: Sound the alarm by pulling a fire pull station and call fire station, from a safe distance, notify security of precise location of fire

C - Confine: if possible

E - Evacuate: Evacuate the place

Immediately informed the response team. Response team moves to the point of fire and take all necessary steps to stop the fire. If the fire is not controllable and spreads then the manager in charge should inform the district authorities and call for external help. Complete an Incident/Accident Report within 24 hours.

Firefighting system is proposed to prevent and control fire outbreaks for the project. The firefighting system will consist of portable fire extinguishers, hose reel, wet riser, yard hydrant, automatic sprinkler system, and manual fire alarm system.

**Emergency Action Plan for Electric Fire**

- Disconnect the affected areas electric supply
- If fire is small scale than $NAHCO_3$ or Sand will be effective.
- Attempt to extinguish fire with the help of $CO_2$ based extinguisher

Action Plan of on-site Emergency Plan

- The action plan considered is given as follows:
- To constitute Disaster Management Committee under senior officer not below the rank of General Manager
- To identify potential hazards areas in the layout map
- To predict degree of burns and distance of the risk zone by using model
- To evacuate the area within risk zone
- To localize the emergency and if possible, eliminate it
- To minimize the effects of accidents on people and property
- To take remedial measures in the quickest possible time to contain the incident and control it with minimum damage
- To mobilize the internal resource and utilize them in the most effective way



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- To get help from the local community and government official to supplement internal manpower and resources
- To minimize the damage in other sections
- To keep the required emergency equipment in stock at right places and ensure that they are in working condition
- To keep the concerned personnel fully trained in the use of emergency equipment
- To give immediate warning to the surrounding localities in case of emergency situation arising
- To mobilize transport and medical treatment of the injured
- To educate the public in the surrounding village regarding hazards
- To arrange treatment of causalities
- To safeguard the people
- To identify the causalities and communicate to persons known to them
- To render necessary help to concerned
- To rehabilitate area affected

**Urban Floods:**

Floods are extreme events, usually triggered by extreme precipitation (river/inland floods) and/or storms (coastal floods). If these rainfalls exceed the retention capacity of the basins, drainage speed and volume, it causes floods.

**Different Types of Flooding:**

1) Localized flooding due to inadequate drainage

2) Flooding due to overflows from River, where settlements have taken place in the flood plains.

**Stakeholders in Disaster Management:**

The policy also systematizes a framework of operation for the following set of stakeholders that play key roles in disaster management.

- Kerala State Disaster Management Authority
- State and Central Government Departments
- District Disaster Management Authorities
- Local authorities including Municipal Corporations/Municipalities, District/Block/Grama Panchayaths, Taluk/Village Officers etc.
- Voluntary and Civil Society Organizations
- Red Cross, multilateral aid agencies and U.N agencies
- Community – Village Disaster Management Committees / Task Forces
- Public sector Undertakings
- Private sector undertakings



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- Army, Navy, Air Force, Coast guard, Airport Authority, National Disaster Response Force etc.

### 6.4Proposed Environmental Monitoring Plan

Monitoring at a dumpsite site is carried out in four physical zones as follows:

i. On and within the dumpsite
ii. In the unsaturated subsurface zone beneath and around the dumpsite
iii. In the groundwater (saturated) zone beneath and around the dumpsite
iv. In the atmosphere/local air above and around the dumpsite

The Environmental Monitoring Program involves the following:

- Conducting survey and sampling program.
- Analysis of samples and data / information collected, and interpretation of data and information.
- Preparation of reports for submitting to management and statutory authorities.
- Environmental monitoring is carried throughout the project operation to detect changes in the key environment quality parameters, which can be attributed to the project.

The results of the monitoring program used to evaluate the following.

- Extent and severity of the environmental impacts against the predicted impacts
- Performance of the environmental protection measures or compliance with pertinent rules and regulations.

#### 6.4.1 Air Environment

The potential sources of air pollution from the dumpsite include vehicular movement and passive leakage of landfill gas from the disposal site. Monitoring of the air environment will be carried out during the operational phase in and around the project site.

#### 6.4.2 Noise Environment

The operations shall induce noise due to operations of transport trucks, JCB loaders and few other types of machinery required at the dumpsite. Monitoring of ambient noise levels and also the exposure of the workers to that environment is essential.

#### 6.4.3 Water Environment

Water quality to be monitored during the operational phase. The monitoring frequency needs to be increased if higher concentrations are expected. Both groundwater regime and surface water domain is anticipated to be most-affected, through leachate contamination. Therefore, surface water will be periodically monitored for the parameters particularly the heavy metals and the hazardous chemicals



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### 6.4.4 Land Environment

The soil in the neighboring areas will be analyzed for the relevant parameters. The land environment also includes developing a green belt.

The details of Environmental Monitoring Programs are given below:

*Table 18 Environmental Monitoring Parameters*

| Environmental components | Locations | Frequency | Parameters |
|---|---|---|---|
| Ambient Air quality | Nearby habitations and downward locations | Quarterly [1 sample] | $PM_{10}$, $PM_{2.5}$, NOx, CH4, CO, Ammonia |
| Noise | Within the site | Monthly | Noise levels |
| Ground and Surface water | Ground water from the nearest well and streams or river | Quarterly | IS 10500:2012 drinking water parameter if required |
| Accidental release | Chemical, oil and fuel spills | Daily | Nil |
| Health safety Hazards | Medical records, documentation of injuries and accidents, Health and safety assessments | Monthly | Health and safety survey |
| Leachate | 1 point per leachate pond | Quarterly | • pH<br>• Biological Oxygen Demand- BOD<br>• Chemical Oxygen Demand-COD<br>• Nitrogen (Ammonia, Nitrate, Nitrite)<br>• Oxidation-Reduction Potential- ORP |



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| | | | |
|---|---|---|---|
| | | | • Electrical Conductivity-EC<br>• Total Organic Carbon (TOC) Dioxins |

In case of any deviation from FR, this would be updated, and mitigation monitoring measures would be revisited. Currently the location of disposal of bio mined material, or type of transport of bio mined material is unknown & hence, these impacts & mitigation, monitoring requirements will be updated & implemented by the Contractor. This aspect should be made a Bid condition.

### 6.5 Environmental & Social Safeguard Budget

The details of Environmental Budget for Implementation and Supervision of Environmental Management Plan (EMP) is given below:

| S. No. | Description | Frequency | Unit Price | Qty | Amount in Rs |
|---|---|---|---|---|---|
| | **Environmental Safeguards** | | | | |
| 1 | Deodorizer equipment (power sprayer) | Only Once | [redacted] | [redacted] | [redacted] |
| 2 | Green Net (Approx., 250 m Length – Height – 3 m) and installation charges | Based on requirement | [redacted] | [redacted] | [redacted] |
| 3 | Spillage Kit | Only Once | [redacted] | [redacted] | [redacted] |
| 4 | Monitoring of Environmental parameters [Air, Ground water, Surface water, Noise, Soil and Leachate] Actual Noise abatement, odour management, dust management measures to be included in DPR cost | Quarterly, first six months by contractor and next two years by ULB | [redacted] | [redacted] | [redacted] |
| 5 | Gas monitoring to check the gas accumulation at the dumpsite | Gas monitoring should be conducted at | [redacted] | [redacted] | [redacted] |



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| | | | | | |
|---|---|---|---|---|---|
| | | least twice a day for about 7 consecutive days | | | |
| 6 | Personal protective equipment | Entire Process | [redacted] | [redacted] | [redacted] |
| 7 | Training on capacity building | Entire Process | [redacted] | [redacted] | [redacted] |
| 8 | Leachate Management (This is only for incidental mitigation of odur, leaks, spillage, flies etc.) | Entire Process | [redacted] | [redacted] | [redacted] |
| 9 | Site Access Road Improvisation | Onetime | [redacted] | | [redacted] |
| | **Social Safeguards** | | | | |
| 10 | Overall Budget for Social Safeguards | | [redacted] | [redacted] | [redacted] |
| **TOTAL (actual costs for works involved for mitigation measures are to be included by the contractor in DPR costs based on his work method. This is only indicative cost for incidental mitigation & management measures. EHS in Labour camp also not included here; but shall be included by the contractor based on his work plan as this is combined with multiple other dumpsite bio-mining works)** | | | | | [redacted] |



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## 7. INSTITUTIONAL ARRANGEMNTS

### 7.1 Proposed Institutional Arrangements

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of ToR for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation. The support organisation will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments. Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level. The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances. The PIU will submit the compliance reports on clearances, permits, and environmental and social safeguards to D-ESDU

### 7.2 Capacity Building

- Sensitize and orient different stakeholders of the project with adequate communication of benchmark standards on various project components. Ensure up gradation of awareness generation at different levels. Special focus: Health Hygiene and sanitation Sub Activity
- Training program for ULB officials includes elected representatives, municipal officials.



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**Importance of Capacity Building**

Capacity building is defined as the "process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in the fast- changing world. It is the development of knowledge, skills and attitudes in individuals and groups of people relevant in the design, development and maintenance of institutional and operational infrastructures and processes that are locally meaningful.It is generally defined 'capacity building' as the creation of an enabling environment with appropriate policy and legal frameworks, institutional development, including community participation, human resources development and strengthening of managerial systems. It is a long-term, continuing process, in which all stakeholders participate. The main aim of capacity building under solid waste management is to build a basic understanding regarding the solid waste management project at each step of value chain (waste generation, segregation & storage at source, primary collection, secondary collection, transportation, processing and disposal) and importance of their work and develop a sense of belonging towards the work.

### 7.3 Grievance Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizens can lodge complaints either directly to ULBs, toll free number or through digital platforms (website/email – – https://kswmp.org/grievances /grmkswmp@gmail.com / Toll free number-18004250238). The complaint will automatically be recorded and escalated to the further levels. A ULB level GRM system will be established for making speedy solutions.

A municipal level GRM committee is required to constitute during the subproject implementation. It will help to solve the issues locally. The Municipal Chairperson, Ward Councilor, Municipal Secretary, community representatives, contractor, social workers, subject expert etc., are the proposed members in the committee. The municipality can include more members if required.



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# 8 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

"Public Consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate.

Initially the public opposed the dumping of waste at Iritty dumpsite and the same has been inactive from year 2020. Now this proposal is to remediate the existing site in order to protect the environment and human health of the nearby area. The summary of the document will be made available in the website, which will also be featured in a newspaper advertisement in Malayalam language for public disclosure.

## 8.1 Public Consultation

In connection with the dumpsite remediation, a consultation meeting, with respect to transect walk, was conducted on 03.06.2023. Stakeholders from different social entities participated in a consultation meeting followed by a transect walk. Local residents, HKS, municipal workers, Kudumbashree members and officials from DPMU, ULB, PIU and TSC participated.

In the meeting, SWM Engineer explained about the proposed dump site remediation activities with a positive note on how the remediation activities are beneficial to the local community. The local residents extended whole support from the local people for the dumpsite remediation activities. Further, a detailed description on dumpsite remediation was given by the Social and Communication expert, DPMU. Participants expressed their concerns regarding the proposed project activities and its implementation modalities. The participants were happy that the lifelong bad image of 'trenching ground' would get removed since it was highly stigmatized usage.

## 8.2 Information, Education and Communication (IEC) Plan

*Table 19 IEC Plan for dumpsite remediation - Iritty*

| Programme | Methodology | Topic | Responsibility | Monitoring |
|---|---|---|---|---|
| **Sensitization/ Awareness programme** | Meetingwithallconcernedstakeholder'swithpriornotificationtodiscussaboutheprocessandremediationmet | Process of dumpsite remediation Developing as a Recreational Park | Contractor | TSC/DPMU /DPMC |



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| | | | | |
|---|---|---|---|---|
| | hods | | | |
| **Informative standees in all** | Visible places near the dumpsite | Protocol to the public who reside in nearby areas and also trespassers. | Contractor | TSC/DPMU /DPMC |
| **Announcement vehicle** | All across places near the dumpsite | Health and hygiene protocols during the dumpsite remediation process | Contractor | TSC/DPMU /DPMC |
| **Digital campaign (Social media)** | Areas surrounding waste dumping and all affected areas | Arrangement of a public audio system to address all people in the surrounding areas.<br><br>Short video presentations to communicate through different digital platforms like WhatsApp pertaining to the existing scenario and proposal of Recreational Park with self-explanation | Contractor | TSC/DPMU /DPMC |
| **Cautionary notification boards** | About vehicle movement and the transit of waste | precautionary measures should the general public take. | Contractor | TSC/DPMU /DPMC |

**Conclusion**

The dumpsite remediation activity at Iritty municipality falls under moderate social risks. However, a set of risk mitigation activities are mentioned in the scoping of social management plan to overcome the identified risks and its negative impacts. Formation and regular meeting of GRM & stakeholder's committee, awareness generation counseling for the aggrieved parties, gender sensitization, legal awareness, providing safety are the major mitigation measures. This proposal is made to reduce the social risk associated with dumpsite remediation and to minimize the negative social impacts.



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ANNEXURES

## Annexure 1 – Environmental Screening

Environmental Screening

Sub Project Details

| Name of Subproject: | Dumpsite Remediation |
|---|---|
| Sub project Components: | Dumpsite Remediation |
| Subproject Location (City / Town/ Village with ward numbers): | Iritty ULB, Ward 12 Athithattu, Kannur District. |

Stage 1: Exclusion List

| Sl.No | Non-permissible Activities |
|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i) any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to siting criteria as per SWM Rules 2016 (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible) |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides |
| The project does not fall under the above conditions as mentioned under exclusion list | |

Stage 2: Environmental Screening Checklist

| Sl.No | Components | Details |
|---|---|---|
| 1 | Project Components | Dumpsite Remediation |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste management, centralized non-biodegradable waste management facilities, centralized biodegradable waste management facilities, | Bio-mining of dumpsite |



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| | | |
|---|---|---|
| | sanitary landfills, bio-mining of dumpsites, including for Linked activities / associated facilities) | |
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project; including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination) Site Survey No:/s (attach map) with ownership details, Geographical co-ordinates of the site location [including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | Latitude: 11°58'04.5"N, Longitude 75°40'53.9"E<br><br>Land ownership: Iritty Municipality<br><br>Land use: Public<br><br>Disaster Zone: It falls under Zone III (Moderate) |
| 4 | Land Area proposed to be used: Location wise (in sq. km / sq. m) | It is remediation of land and hence no land required |
| 5 | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | Operational phase – 0.5 KL/day<br>Domestic use – 1.0 KL/day |
| 6 | Power Required and Source of Power | Demand load for the proposed equipment during the remediation process is available and additional power required will be made available by DG sets |

Baseline Environmental Conditions

| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| 1<br><br>(i) | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers)<br><br>Critically Vulnerable Coastal Areas (CVCAs), Eco sensitive Areas (ESAs) | | No | The project site is not located near any Critically Vulnerable Coastal Areas (CVCAs), Eco sensitive Areas (ESAs) |



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| | | | | |
|---|---|---|---|---|
| (ii) | Cultural Heritage site, protected monuments - listed by ASI/State | | No | The project site is not located near any cultural Heritage or protected monuments as listed by ASI/state |
| (iii) | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensitive area, with any schedule 1 species? If yes, which is the area? | | No | The project site is not located near Natural Forests / Protected Areas / Bio-Reserves |
| (iv) | Other Wetlands/ Mangrove/ Estuarine Region | | No | The project site is not located near any Wetlands/ Mangrove/ Estuarine Region |
| (v) | Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves | | No | The project site is not located near any Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves<br>There is a river baveli which is located at an Aerial distance of 1.25 Kmaway from the site |
| (vi) | Other Sensitive Environmental Components listed in EMF | | No | No other sensitive environmental components listed in EMF exist nearby the project site |
| (vii) | Drinking water source, upstream and downstream uses of rivers, etc | | No | No river source is resorted for drinking water use<br>Downstream the ground water source is available |



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| | | | | |
|---|---|---|---|---|
| (viii) | Low-lying areas/areas of Tidal Influence (provide CRZ details) | | No | The sea is located 32 km (Aerial Distance) from the project site. There won't be any influence of tidal influence |
| (ix) | Sensitive Receptors – a) Habitations / Households / Hostels, other special areas, etc. b) School c) Religious Places d) Tourist Areas | Yes | | a. Nearest Habitation- 02 houses are located within aerial distance of 200 m<br>b. Religious Place- Temple is located at an Aerial distance of 600 m away from unit<br>c. School – Global India Public School is located at an aerial distance of 1.20 km<br>d. Hospital – Sky super speciality Hospital is located at an aerial distance of 1.60 km<br>e. Tourist Places – Kolly waterfalls is located at an aerial distance of 1.8 km<br>f. Airport – Kannur International Airport is located at an aerial distance of 15.5 km |



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| | | | | |
|---|---|---|---|---|
| 2 | Is the site in Critical / Over Exploited Ground Water Block. Provide the level of the groundwater table | | No | The site falls under safe block |
| 3 | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other (specify) | Yes | | The site does not fall under major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion.<br>There may be chance of fire due to<br>1. Fire breaking due to high temperature<br>2. Electrical short circuit due to poor maintenance.<br>3. Smoking in the premises near the waste storage.<br>4. Burning of the waste by unauthorized persons<br>5. Keeping highly flammable materials like, cooking gas, kerosene, match boxes, etc.<br>6. Not having provision for proper fire/smoke detecting system.<br>Mitigation Measures:<br>1. Proper maintenance and monitoring should be done in and around the site |



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| | | | | |
|---|---|---|---|---|
| 4 | Describe the type of soil and vegetation on site | Yes | | Hard laterite soil with few trees present in the site |
| 5 | Is the site present in the flood plains as recorded in the last 100 years. Provide the HFL level of the site/region | | No | The sea is located 32 km (Aerial Distance) from the project site. |
| 6 | Existing pollution/contamination or degradation on site | Yes | | Dumpsite located in Iritty ULB is the existing contamination and detailed under section 3.11 |
| 7 | Any other remark on baseline condition | Yes | | Based on the test result of environmental baseline for Iritty dumpsite certain parameters exceeds the permissible limits and test report results are given under section 3.11 |

Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology, and Soils

| Sl.No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Total extend of land to be covered/built | Yes | | Total site area: 2.44 acres<br>Waste dumped area: 0.11 acre |
| 2 | Total extend of land where the waste will be dumped openly / or expected to get contaminated by waste or leachate/material storage | Yes | | Due to open dumped area |
| 3 | Extend of Land to be remediated | Yes | | 0.11 acres |
| 4 | Extend of land expected to be under green belt | Yes | | Will be under the scope of contractor |
| | proposed project causes the following on Land / Soil: | | | |



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| | | | | |
|---|---|---|---|---|
| (i) | Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains | | No | There will be no major impact other than the operational phase as this project is remediation project. During operational phase the anticipated impacts are identified and mitigation measures are provided |
| (ii) | Substantial removal of Top Soil (mention area in sqm) | | No | Nil |
| (iii) | Any degradation of land / eco-systems expected due to the project? | | No | There will be no Land degradation instead it will be a remediation of land from further contamination |
| (iv) | Loss or impacts on Cultural/heritage areas/properties | | No | There will be no loss or impacts on Cultural/heritage areas /properties |
| (v) | Does the project activity involve cutting and filling/ blasting etc? | Yes | | The project is to remediate the existing dumpsite and the waste dumped below the ground will be excavated and disposed. The site will be levelled and filling done on the area of excavated waste below ground. |
| (vi) | Will the project cause physical changes in the project area (e.g., changes to the topography) due to excavation, earthwork, or any other activity? | Yes | | The project will have physical change in a positive way by clearing the waste dumped into vacant land |



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| | | | | |
|---|---|---|---|---|
| (vii) | Will the project involve any quarrying/ mining etc? | | No | The project does not involve any quarrying/ mining |
| (viii) | Will the project / any of its component contaminate or pollute the Land? | | No | Presently there is contamination and due to the project activity the further contamination shall be eliminated and natural system shall be restored |
| (ix) | Will the project contribute to any long term significant adverse (negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | No | There will be no negative impact due to the proposed project |
| (x) | Will the Project or related activities cause negative impacts on the land in combination with other anticipated / existing projects in the region? | | No | There will be no negative impact due to the proposed project |

| Sl.No | Impacts on Air and Noise Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the project cause or increase air pollution due to dust and / or vehicle emissions? | Yes | | It will be minimal and adequate mitigation measures will be taken to reduce the impact. |
| 2 | Will the project cause or increase pollution due to GHG emissions? | | No | Nil |
| 3 | Will the project cause or increase odour nuisance? | Yes | | The Bio-mining project will be create odour nuisance but it is temporary and once the process is completed there will be no odour nuisance. |



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| | | | | |
|---|---|---|---|---|
| 4 | Is there a potential for release of toxic gases or accident risks (eg: potential fire outbreaks) | Yes | | There may be chance for any release of toxic gases or potential fire outbreaks which will be mitigated through proper mitigation plan. |
| 5 | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | Yes | | The Bio-mining project will create increase in noise level but it is temporary and once the process is completed there will be no noise. |

| Sl.No | Impacts on Water Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the activities proposed at the site(s) impact water quality (surface or ground) – leachate, runoff, wastes deposition, erosion? | | No | The leachate generated will be properly collected in leachate collection tank and thus avoiding the impact with the surface or ground water |
| 2 | Will the activities proposed at the site(s) impact water resource availability and use - leachate, runoff, wastes deposition, erosion? | | No | The leachate generated will be properly collected in leachate collection tank and thus avoiding the impact with the surface or ground water |
| 3 | Chances of Pollution of Water bodies / groundwater wells, nearby or downstream | | No | There will not be any chance of pollution of water bodies / groundwater wells, nearby or downstream |
| 4 | Will the activities proposed at the site(s) hinder natural drainage | | No | The activities proposed at the site will not hinder natural drainage and the proposed activity will improve |



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| | | | | |
|---|---|---|---|---|
| | | | | the natural pathway without any obstacles. |
| 5 | Will the activities proposed at the site(s) decrease permeability /rainwater percolation | | No | The activities proposed at the site will not decrease permeability /rainwater percolation |

| Sl.No | Impacts on Bio diversity & Host Communities | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the project necessitates cutting of Trees /Loss of Vegetation | | No | There will be no cutting of Trees /Loss of Vegetation due to this project |
| 2 | Will the project necessitate substantial removal of Top Soil (mention area in sqm) | | No | There will be no Substantial removal of Top Soil.<br>During the excavation of waste there is a slight chance of the top soil to get removed and the same will be mitigated with by-product (bio earth) of this activity |
| 3 | Any degradation of land / eco-systems expected due to the project? | | No | There will be no degradation of land / eco-systems expected due to the project activity.<br>Also, the proposed activity will protect the land from further contamination |
| 4 | Will the project result in Health & Safety Risks in the neighbourhood including the release of toxic gases, leachate, accident risks | Yes | | There may be chance of accidental risks due to leachate and toxic gases, which will mitigated by proper |



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| | | | | |
|---|---|---|---|---|
| | | | | lined leachate drain and PPE kits |
| 5 | Potential Noise, Light Pollution/movements causing disturbance to nearby habitats/communities | Yes | | There will be no major impact.<br>During operational phase there will be noise pollution due to movement of vehicles which will be curtailed by adopting mitigation measures. |
| 6 | Potential disruption to common property, accessibility, traffic disruptions, conflicts, or disruption to the local community within the subproject area? | Yes | | There will be no major impact.<br>During operational phase there will be slight increase in traffic due to movement of vehicles which will be mitigated by adopting movement of vehicles during off peak hours.. |

Project Categorization and Need for Safeguards Instruments

| Project category | E1 ☐ E2 ✓ E3 ☐ |
|---|---|
| Key Reasons | During screening, it has found that the proposed subproject is moderately causing impact to the base line environment, land/ soil / water /noise environment, biodiversity or to the community. Hence it is categorized as E2. |
| Safeguards Instruments Required | a) E1: Project-specific EIA (impact assessment considering the project details & location) by Independent Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>b) E2: Project-specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities) |



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| | |
|---|---|
| | c) E3: signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities |

| Status | Agency / Official | Name, Signature with Date and Seal |
|---|---|---|
| Prepared by | PIU or ULB (project in charge) | |
| | Environmental Engineer | |
| Checked, categorised as ___ (E1, E2, E3) & ToR issued by: | DESDU / SESDU | |
| | Environmental Specialist | |



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**Annexure 2 – Fire and Risk Assessment**

A fire and risk assessment is a systematic evaluation of potential fire hazards and associated risks within a particular environment or premises. The assessment aims to identify potential fire hazards, assess the level of risk they pose, and recommend measures to mitigate or manage those risks effectively. Fire and risk assessments are essential for ensuring the safety of the workers, protecting property, and complying with fire safety regulations.

The existing legacy waste dumpsite, occupying about 0.11 acres in ward 12 Athithattu, aims to fully reclaim the land for future development. Bio-mining, a technique chosen after careful evaluation will be used to recover the land and ensure sustainable and environmentally friendly treatment of the waste. The process will yield various by-products, which require immediate attention to prevent fire hazards.

The by-products and their intended use are as follows:

1. The bio earth 897 tons will be utilized for the development of the reclaimed legacy waste dumpsite as a green park/facility.
2. Refused derived fuel (RDF) of 318 tonswill be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the process.
3. Recyclables of 40 tons will be sold to authorized recyclers

The RDF by-product& recyclables, totaling around358 tons, poses a potential fire risk and requires proper handling. To mitigate the risk, a storage and disposal process spanning 3 to 4 months has been devised. During this period, the contractor will implement various protective measures to prevent the possibility of a fire outbreak.These following measures are important for preventing fires, ensuring the safety of workers and nearby communities, and minimizing risks to the environment and property.

Pre-Construction/Planning Stage:

1. Fire Safety and Emergency Plan: Develop a comprehensive fire safety plan and emergency response plan to address potential fire incidents.
2. Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard.
3. Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.
4. Fire Equipment: Ensure that the site is equipped with fire extinguishers.

Storage of Waste & RDF:



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**Fire Standards and Facilities:** Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.

Below equipment and their required quantities should be strategically positioned according to the site's specifications.

- Fire extinguisher (A, B, C powder): It will be used to immediately put off fire caused by wood, Paper and textiles, flammable liquids and flammable gases. Commonly can be placed anywhere inside the site
- Fire extinguisher (Foam spray): Mainly used to put off the fire caused by flammable liquids. It should be placed in diesel storage area, lubricant storage area and DG sets.
- Fire extinguisher ($Co_2$): Mainly used to put off the fire caused by Electrical short circuit. It should be placed near the control panel room/operation room.
- Fire bucket filled with sand: It should be placed near the diesel storage area

To ensure rapid response in case of a fire, it's essential to have a water tanker filled with water, equipped with a fire-fighting hose, readily accessible along with the portable motor. The presence of this equipped water tanker ensures timely and effective action during fire emergencies.

The following points to be considered for assessing the fire risk and procedure to mitigate it.

1. Identification of Fire Hazards: The first step involves identifying potential fire hazards in the premises. These hazards could include sources of ignition (e.g., electrical equipment), combustible materials (e.g., flammable liquids, paper, cardboard), and other factors that could contribute to the outbreak of a fire.
2. Assessment of Risk: Once the hazards are identified, the next step is to assess the level of risk associated with each hazard. This involves evaluating the likelihood of a fire occurring and the potential consequences if a fire were to break out.
3. Escape Routes: Since operational phase occurs in an open environment, the need for conventional escape routes in the event of a fire emergency may not be required.
4. Fire Safety Measures: The assessment reviews existing fire safety measures in place, such as fire alarms, fire fighting equipment, and fire suppression systems. Proper assembly point is required in case of fire break out
5. Emergency Procedures: The assessment evaluates the effectiveness of emergency procedures and evacuation plans in the event of a fire, ensuring that workers can safely evacuate the premises.
6. Fire Training and Awareness: The assessment considers the level of fire safety training provided to workers and the awareness of fire hazards and evacuation procedures.



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7. Record-Keeping: Detailed records of the assessment process, findings, and recommended actions are maintained for future reference and regulatory compliance.
8. Recommendations: Based on the assessment, the fire risk assessor provides recommendations for improving fire safety, which may include installing additional fire safety equipment, conducting training programmes, or implementing any changes to reduce fire risks.
9. Review and Updates: Fire and risk assessments should be regularly reviewed and updated to account for any changes in the premises or regulations.

Fire and risk assessments play a crucial role in preventing fires and minimizing their impact if they occur. They are particularly important for dumpsites and other places with a higher risk of fire hazards to ensure the safety and well-being of workers.



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**Annexure 3- Checklist for screening of dumpsites for potential landfill/ processing facility**

| | |
|---|---|
| Name of the contact person from ULB-Phone number and email Address | Iritty |

| S.No. | Item | Norm | Information |
|---|---|---|---|
| 1 | Land ownership (including that required for approach road) (in line with revenue records) (supporting data to be provided as annex) | | Iritty Municipality |
| 2 | Name of the location of site and Map of the site (include as an annex) | | Athithattu, Iritty |
| 3 | GPS coordinates of site | | Latitude: 11°58'04.5"N, Longitude 75°40'53.9"E |
| 4 | Is there a Pollution Control Board permit for dumping/SWM activity? | | No |
| 5 | Is there a notified no development zone or buffer or green belt around the dump? | | No |
| 6 | Possible area to be kept as buffer green belt around (within / outside the site for purchase) | | Green belt is already available within the site |
| | Site Selection Criteria - give distances, wherever applicable | | |
| 7 | Groundwater (m below liner bottom) | 2m | No |
| 8 | Private water sources (well etc.)- distance from site boundary (to be adjudged based on approx. distances during screening exercise) | 100 m (river) | No |
| | | 200 m (Pond) | No |
| | | 30 m (Local Canal) | No |
| 9 | Env. Sensitive Areas/ Wetlands | Not Permitted | No |



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| | | | |
|---|---|---|---|
| 10 | Site having Rare and Endangered Species | Not Permitted | No |
| 11 | Site should not be within Protected/ Reserve Forests | Not Permitted | Site is Not within the Protected/ Reserve Forests |
| 12 | Residential Development within prescribed buffer zone of 200 m | Not Permitted | Yes. Local Residents nearby Dumpsite within 200 m |
| 13 | Perennial Stream within site | Not Permitted | No |
| 14 | Airport | 20 Km | Yes |

| S.No | Item | Norm | Information |
|---|---|---|---|
| 15 | Distance to the nearest village in the predominant wind (m)direction | | Athithattu |
| 16 | Flood prone site | | No |
| 17 | Accessibility - Road access for heavy vehicles | | 3.5 m wide Approach road. The nearest major road is Iritty-nedumpoil and it is about 980 meters away from the site. This road provides access to the nearby residential areas. |
| | i. Starting point of the access road | | |
| | ii. length and width of the access road | | |
| | iii. Current condition of the access road (visual assessment) | | Tarring Road with good condition. |

| S.No. | Site Description | | |
|---|---|---|---|
| 18 | Is the site that/stopping to nearby uses | | Flat |
| 19 | Soil base-soft soil/murum,soft rock etc | | Hard Laterite soil |
| 20 | Direction of Leachate flow out of the site, if any | | No. The biodegradable waste |



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| | | | |
|---|---|---|---|
| | | | dumping stopped since 2020 |
| 21 | Other uses within the dumpsite(recycling yard, compost pad etc) | | Windrow compost unit is existing. New MRF building constructed but not yet used |
| 22 | Boundary conditions-walls/fence/what land uses along boundary | | Compound wall |
| 23 | Year since the dump site is existing | | 2000 |
| 24 | Is the dumping Operation Ongoing | | Stopped the Biodegradable waste since 2020 |
| 25 | Any underground utilty/gas line etc near the site | | No |
| 26 | Existing power supply, water supply, electric poles going through/over/in the site etc. | | Three phase power available |
| 27 | Are there pools of leachate ,rat and fly infestations, domestic animals roaming freely, odours,dust, vermin and birds,waste being burnt at dumpsites or families of scavangers picking through the wastes | | No |

| Geography and Climatic aspects | | | |
|---|---|---|---|
| 28 | Average annual rain fall | | 4034 mm |
| 29 | Duration of rainfall | | May to October |
| 30 | Whether any incidents of flooding reported at site/other hazards | | |
| | i. No | | |
| | ii. Very Rare | | Very Rare |



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| | | | |
|---|---|---|---|
| | iii. Some times | | |
| | iv. Frequent | | |
| 31 | Any geological fault | | No |
| Waste Characteristics | | | |
| 32 | Characteristics of the dumps, such as the height and area, characteristics of solid waste based on visual inspection and degree of compaction (subjective), and any details of variability of wastes within the site. | | Since the biodegradable waste dumping stopped from 2020. Only the Non Biodegradable waste only present in the dumpsites like Plastic wastes and street sweeping wastes |
| 33 | Type of waste (MSW/HW) (subjective assessment based on visual inspection) | | MSW |
| | i. 100% MSW | | |
| | ii. 75% MSW +25% (domestic and/ or biomedical/ HW/EW) | | Yes |
| | iii. 50% MSW +50% (domestic and/ or biomedical /HW/EW) | | |
| | iv. > 50% (domestic and/ or biomedical /HW/EW) | | |
| 34 | Expected waste contamination (visual check of ground water, littering, dust pollution, Smell/odour, ls the ground water being used for drinking purpose) | | Ground water not used for drinking. |
| 35 | How much quantum of fresh waste is dumped every day? | | Stopped the dumping of waste. |



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<table>
<tr><th colspan="4">General Information</th></tr>
<tr><td>36</td><td>Any reported Environmental and health impacts of existing dump (from ULB eg-media report or complaint)</td><td></td><td>NO</td></tr>
<tr><td>37</td><td>Any ongoing litigation or disputes related to site usage</td><td></td><td>No</td></tr>
<tr><td>38</td><td>Potential for mining decomposed organic materials (compost from the existing dumps (By visual inspection)</td><td></td><td>No</td></tr>
<tr><td>39</td><td>Presence of ragpickers and approx.how many? Male/Female and age group</td><td></td><td>Not available as on visit time.</td></tr>
<tr><td>40</td><td>Number of sensitive receptors close to dumpsite (approx.200 m which is buffer zone criteria) (mention distance to closest residence, social profile of the people, school, religious structure, wetland, forest, river, canal, eco-sensitive area, well, lake/pond)</td><td></td><td>
<table>
<tr><th>Sensitive Receptors</th><th>Distance</th></tr>
<tr><td>Residential buildings</td><td>02 households are located within 200 m radius of the dumpsite</td></tr>
<tr><td>Educational institutions such as Global India Public School</td><td>1.20 Km</td></tr>
<tr><td>Baveli river</td><td>1.25 Km</td></tr>
<tr><td colspan="2">Nearest Tourist place</td></tr>
<tr><td>Athithattu hill view</td><td>800 m</td></tr>
</table>
</td></tr>
</table>



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| | | | | |
|---|---|---|---|---|
| | | | Kolly waterfall | 1.8 Km |
| | | | Poonthurutti kunnu (hiking area) | 2.1 Km |
| 41 | Available open / clean space in the dump yard which can used to develop a treatment facility till such time the dump is cleaned, and land is recovered (percentage of land available for use) | | Yes | |
| 42 | Space / covered shed (which may be renovated to house segregation & storage facility) | | Already space available for storage | |
| 43 | Estimated time for dumpsite capping/ mining/ remediation. Does it fall within the project lifetime? | | 90 days | |
| 44 | Possible Range of solutions: rehabilitate existing open dumps through landfill mining where the resource recovery might serve as a source of energy, recycle and reuse of metals, plastic and glass ware, use of compost as fertilizer for agriculture and as a cover material for future landfills, etc. | | The bio-earth and coarse fraction soil recovered from dumpsite will be used for filling low lying areas. The RDF material recovered from dumpsite will be transported to nearby cement factory and recyclable material will be handed over to the authorized recycling agency. | |



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| | | | |
|---|---|---|---|
| 45 | Is dumpsite remediation likely to benefit in regaining a suitable site for an engineered landfill cell or for setting up any other waste management facility? If yes, what could be set up? | | According to feedback from nearby residents, there is a demand for the establishment of a BioPark. |
| 46 | Likely area of the site which can be salvaged for future use More than 70%, 50-70%, 30-50%, Less than 30% | | 50 %. |

| | | | |
|---|---|---|---|
| **Upstream Linkages required** | | | |
| 47 | Stop the waste coming to the site or delineate a separate area for proper processing of waste. | | Dumping of waste stopped |
| 48 | Intention of anchor ULB (where the site is located) to allow the facility to be used as a regional facility, with other ULBs falling in the region, on a cost sharing basis. | | After thorough stakeholder consultation, the recommendation is to process the waste at a standalone site. |
| **Downstream Linkages required** | | | |
| 49 | Off-take of all the products coming out of the bio-mining - Plastic & RDF - cement factories, soil/bio-earth - farmers or gardens, inert - SLF/closure | | Forward linkage for the RDF yet to be finalized |
| 50 | Any wastewater treatment facility whether available within 10 km where leachate can be transported for treatment. | | No |



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**Annexure 4- Occupational Health and Safety**

Occupational Health and Safety Risk Assessment for Dumpsite Remediation is as follows

**1.Introduction**:

The purpose of this Occupational Health and Safety (OHS) Risk Assessment is to identify, assess, and mitigate potential hazards and risks associated with the implementation of a Bio-mining project for dumpsite remediation. Bio-mining is a sustainable and environmentally friendly method used for the disposal of dumped waste and reclamation of land.

**2. Scope:**

This risk assessment focuses on the occupational health and safety aspects of the Bio-mining process for dumpsite remediation. It covers the potential hazards and risks that workers may encounter during site preparation, Bio-mining operations, and waste disposal activities. The assessment will also outline control measures to minimize or eliminate these risks.

**3. Hazard Identification:**

Bio-mining process identifies potential hazards, which include but are not limited to:

a. Chemical Hazards: Exposure to hazardous chemicals present in the dumpsite waste and chemicals used in the Bio-mining process.

b. Biological Hazards: There is very rare chance of biological hazard in Iritty dumpsite as it is accumulated with majorly municipal solid waste.

c. Physical Hazards: Potential for slips, trips, and falls on uneven terrain or during equipment operation.

d. Mechanical Hazards: Risks associated with operating and maintaining heavy machinery.

e. Ergonomic Hazards: Strain and injuries related to improper handling of equipment or materials.

f. Environmental Hazards: Adverse effects on air and water quality during the Bio-mining process.

**4. Risk Assessment:** The risk assessment will categorize the identified hazards based on their severity and likelihood of occurrence. Each hazard will be evaluated using a risk matrix to determine the level of risk and priority for mitigation.

**5. Risk Mitigation Measures:**



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To ensure the safety of personnel involved in the Bio-mining project, the following risk mitigation measures will be implemented:

a. Engineering Controls:

- Regular maintenance and inspection of machinery to prevent mechanical failures.

- Providing appropriate personal protective equipment (PPE) to workers.

b. Administrative Controls:

- Developing standard operating procedures (SOPs) for Bio-mining operations.

- Implementing a comprehensive training program for all personnel involved in the project.

- Scheduling regular breaks and rotation of tasks to minimize fatigue.

c. Environmental Monitoring:

- Regular monitoring of air and water quality to ensure compliance with safety standards.

- Establishing emergency response protocols in case of any unexpected environmental events.

d. Emergency Preparedness:

- Developing and practicing emergency response plans for potential accidents or incidents.

- Providing workers with first-aid training and easily accessible medical facilities.

e. Personal Protective Equipment (PPE):

- Mandating the use of appropriate PPE, such as respirators, gloves, safety goggles, and protective clothing.

**6. Worker Health Surveillance:**

Implementing a health surveillance program to regularly monitor the health of workers involved in the Bio-mining project. This program may include medical examinations and assessments to detect any health issues related to exposure during the remediation process.

**7. Training and Education:**

Conducting comprehensive training and educational programs for workers and supervisors to raise awareness of potential hazards, proper handling of equipment, and the correct use of PPE.



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## 8. Conclusion:

By proactively identifying potential hazards, assessing risks, and implementing appropriate control measures, this Occupational Health and Safety Risk Assessment aims to ensure the safe and successful execution of the dumpsite remediation Project through Bio-mining. Continuous monitoring and improvement will be essential throughout the project to maintain a safe work environment.



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FEASIBILITY REPORT

# DUMPSITE BIOMINING AND BIOREMEDIATION, ATHITATTU, IRITTY, IMUNICIPALITY

November 2023

KSWMP

LSGD

LSGD

State Project Management Unit

Kerala Solid Waste Management Project (KSWMP)

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## EXECUTIVE SUMMARY

Iritty is a Municipality and a Taluk of Kannur district in Kerala State. Even though he ULB has an excellent practice of waste management, the primary environmental issue currently faced by municipal authorities revolves around a longstanding existing legacy waste dumpsite. Despite discontinuing waste dumping activities, these dumpsites remain as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. As a consequence, these sites pose significant environmental, social, and economic challenges for the communities and ecosystems surrounding them. The SWM Rules 2016 directs all local bodies to identify the legacy dumpsites and to scientifically remediate it in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the project of remediation of legacy waste dumpsites in all the ULBs. As part of the project, in phase -1 the existing dumpsite of Athithattu, Iritty is proposed to be remediated.

The Iritty municipality has an area of 46.65 sq.km with 33 wards. The municipality intend to remediate the existing legacy waste dumpsite at Athithattu and recovery land 100% for development of recreational park for the public. The Athithattu dumpsite is used for dumping of solid waste from the year 2000 to year 2020. The dumping of the solid waste was stopped due to protest from the local residents for addressing the issues of the problems created by odour and leachate from dumpsite and local residents are in demand to remediate the legacy dumpsite and to utilize the remediated land for social cause.The total quantity of legacy waste is estimated to be approximately 1254.02 Tons. Since the cessation of dumping activities in 2020. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes.

To assess the quantity & composition of the legacy waste & also environmental baseline of the dumpsite, the samples from the strategic locations were collected to analyse viz., physical and chemical analysis of Legacy waste, Soil, Air, Noise, leachate, Ground Water and Surface Water. Conducting Detailed Investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Chemical, Environmental Analysis by M/s Poluchem Laboratories. From the results of the investigations, it was found that the waste was found to depth of 4.5 m. The total estimated quantity of legacy waste is 1254.02 Tons.

As per the SWM Rules 2016, selection of the applicable method/type or technique for dumpsite remediation needs to be arrived from the Feasibility study carried out and based on the results, remediation can be done by a) Capping without land recovery, b) Bio-mining – reclamation/recovery of land c) capping with partial land recovery. The selection of technology shall also depend on the available resources viz., manpower, machineries, money and physical site

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conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for 100% land recovery and forward linkages/utilization of processed aggregates/bi- products. Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land 100% is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and 100% land recovery/remediation legacy waste dumpsite.

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land 100%) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31$^{st}$ March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/bi- products as per the requirements of the utilization/forward linkage. Based on the detailed assessment of the selection parameters, mobile/compact screening is the machineries are which shall be the optimum screening machineries for processing the stabilized legacy waste of 2023.11 $m^3$ within the stipulated timeline of 31$^{st}$ March 2024 by NGT for remediation of legacy waste dumpsite.

Environmental & Social safeguards: The project attracts E2 Environmental category based on the project activities and status of the environment baseline. The project attracts moderate risk social category based on the social mapping & transect walk i.e., consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.

Bi-products utilization/forward linkages/Usage

1. The bio earth & C&D quantity 991.32 $m^3$ & 455.50 $m^3$ and waste will be utilized for development of the reclaimed legacy waste dumpsite as recreational park/facility.
2. Refused derived fuel (RDF) of 512.35 $m^3$ will be to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the processes
3. Recyclables of 64.23 $m^3$ will be sold to authorized recyclers and will be collected from the dumpsite.

The activities of the bio-mining will be commenced from the Dec 2023 to Mar 2024. An area of 0.11 Acre will be reclaimed and will be development into recreational park for public use.Total cost of the project is [redacted] **/-.** The cost per $m^3$ for processing and disposal of the legacy waste is [redacted] **/-.**

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## 1. INTRODUCTION

Iritty is a Municipality and a Taluk of Kannur district in Kerala State. Even though he ULB has an excellent practice of waste management, the primary environmental issue currently faced by municipal authorities revolves around a longstanding existing legacy waste dumpsite. Despite discontinuing waste dumping activities, these legacy dumpsites remain as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. As a consequence, these sites pose significant environmental, social, and economic challenges for the communities and ecosystems in the vicinity.

As the SWM Rules 2016, all local bodies to identify the legacy dumpsites and to scientifically remediate it in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the project of remediation of legacy waste dumpsites in all the ULBs. As part of the project, in phase -1 the existing dumpsite of Athithattu, Iritty is proposed to remediated.

The legacy waste dumpsite remediation needs to be arrived from the feasibility study outlining the technical, economic, and social factors which will have implication of the process of remediation of legacy waste dumpsite. Based on the detailed field investigations & assessment and market sounding, the method proposed for remediation of legacy waste dumpsite will ensure long term sustainability and environmentally sound treatment which will be technically feasible, economically viable, and socially acceptable

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## 2. GENERAL DESCRIPTION ABOUT PROJECT

The Iritty municipality has an area of 46.65 sq.km with 33 wards. Solid waste generated from 11200 households and 1850 institutions including commercial establishments. The municipality intend to strengthen and enhance the existing treatment facilities of the bio degradable & non – degradable waste system at household, institutional and community level for effective management of the solid waste generated and also remediation of existing legacy waste dumpsite.

The Athithattu dumpsite was used for dumping of solid waste from the year 2000 to year 2020. The dumping of the solid waste was stopped due to protest from the local residents for addressing the issues of the problems created by odor and leachate from dumpsite and local residents are in demand to remediate the legacy dumpsite and to utilize the remediated land for social cause.

Since the cessation of dumping activities in 2020. The legacy waste is spread in an area of 0.11 Acre with average height of 4.5 m and a portion of the dumpsite is capped as part of the remediation. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes. The municipality intend to remediate the existing legacy waste dumpsite at Athithattu and recovery land 100% for development of recreational park for the public. The details of the legacy waste dumpsite are provided below:

*Table 1 Dumpsite Details*

| Name of ULB | Iritty |
|---|---|
| District | Iritty |
| Taluk | Iritty |
| Location | Ward 12 - Athithattu, Iritty |
| GPS Co-ordinate of the Site | Latitude: 11°50'04.41"and Longitude: 75°40'54.066" |
| Total dumpsite area (in acres) | 2 Acre 40.44 Cent |
| Legacy waste spread (in acres) | 0.11 Acre |


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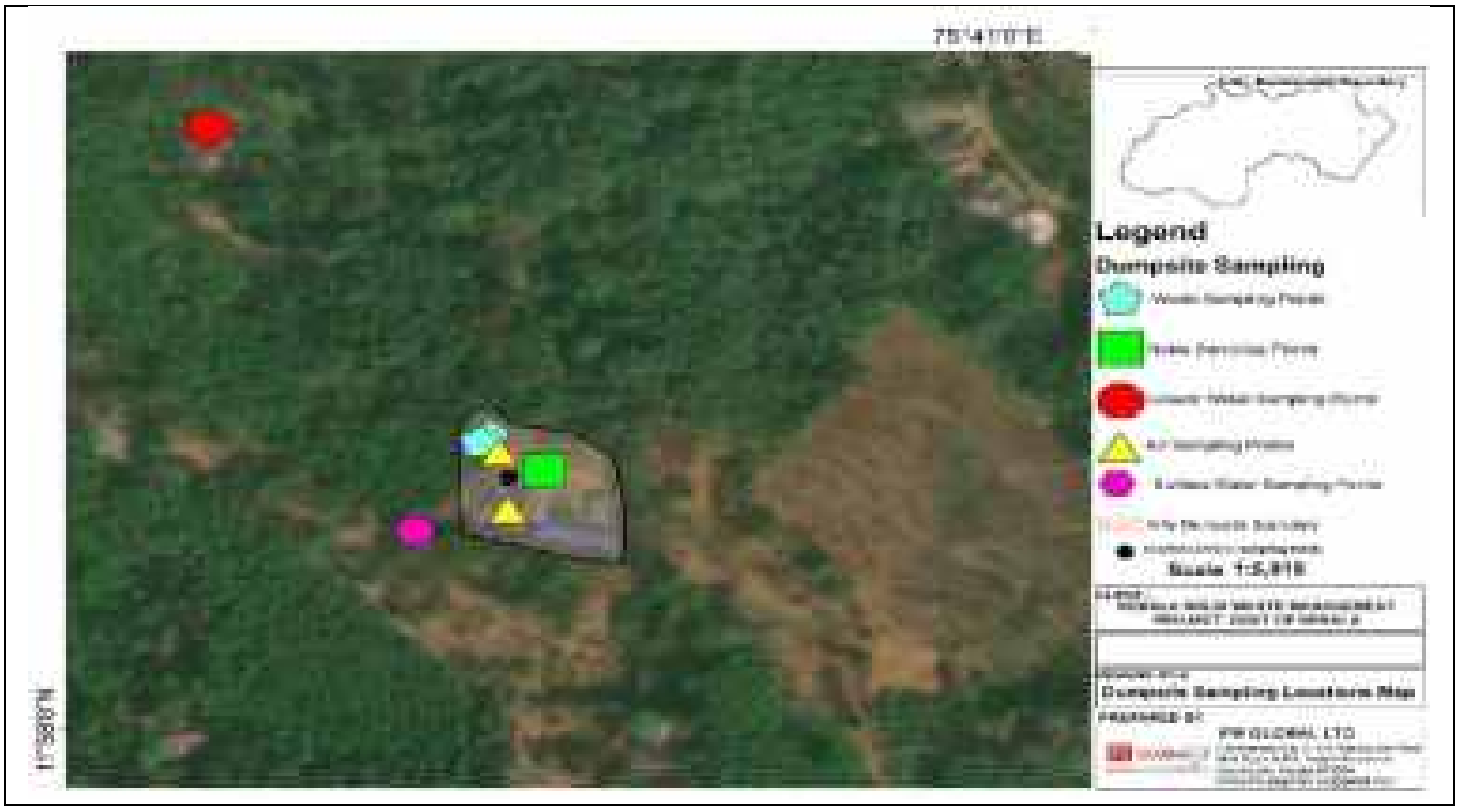



*Figure 1 Location of Dumpsite*


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## 3. OCATION, DEMOGRAPHY, ACCESS, LAND-USE, WATER TABLE AND CLIMATE OF THE ULB

### 3.1 LOCATION

Iritty is a Municipality in the state of Kerala, India and is located at Latitude: 11° 58'04.41"and Longitude: 75°40'54.066" with an area 46.65 square Kilometer. Iritty is known as The Coorg Valley in God's Own Country Iritty is one of the fastest upcoming towns in Kerala with the distance of 20 km (12 mi) from Kannur International Airport and one among five taluks in Kannur district.

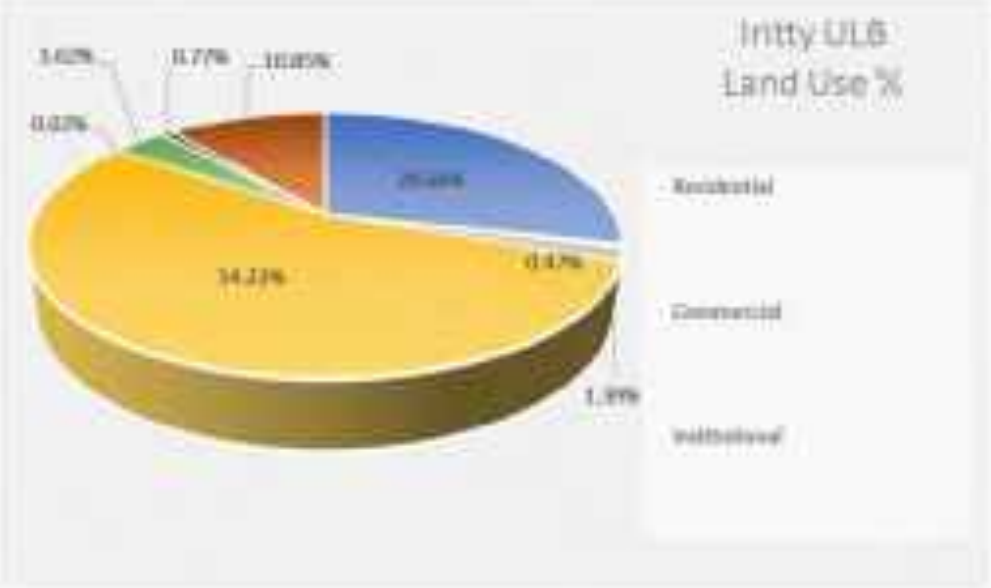
### 3.2 POPULATION, DENSITY AND LITERACY RATE

Iritty Municipality population is 43806, among them about 21,000 (48 %) are male and about 22,000 (52 %) are female. The Iritty Municipality was formed on 1st November, 2015, as per the survey present population is 43,806. The population density of Iritty municipality is 340 population per square kilometer

### 3.3 LAND USE

The Iritty municipality has a total area of 46.65 Sq. km. The land use indices of Iritty municipality are shown in below figure.

*Figure 2 Pie chart indicate the land use percentage wise*





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*Table 2 Land Use Details of Iritty*

| Description | Area in Sq.km | Land Use % |
|---|---|---|
| Residential | 13.37 | 28.66 |
| Commercial | 0.22 | 0.47 |
| Institutional | 0.65 | 1.39 |
| Agricultural | 25.29 | 54.22 |
| Recreational, open space | 0 | 0 |
| Transportation | 0.01 | 0.02 |
| Water bodies | 1.69 | 3.62 |
| Slums | 0 | 0 |
| Forest | 0 | 0 |
| Revenue Surplus land | 0 | 0 |
| Other Vacant land | 0 | 0 |
| Other (Hazardous Zone, Industrial, Quarry Laterite and Granite) | 0.36 | 0.77 |
| Others (Paddy Field (Cultivating), Paddy Field (Uncultivated), PWD- irrigation land, Roads) | 5.06 | 10.85 |

### 3.4 TRANSPORTATION CORRIDOR

*Table 3 Transportation corridor details*

| Mode | Details |
|---|---|
| Road | Iritty lies at an equal distance from the nearby cities of Kannur, Thalassery, Mahe, Taliparamba and Virajpet (Karnataka State). The proposed Kannur Mysore National Highway or SH 30 passes through Iritty connecting Thalassery, Mattanur Airport and Kodagu. This was initially called the TC Road by the British. This highway is used by interstate bus services plying to Madikeri, Mysore and Bangalore.SH 36 connects Iritty with Taliparamba that gives access to other towns like Irikkur and Sreekandapuram. Keezhur is the starting point of Iritty town. This place is well-connected by road from both Kannur and Thalassery. There are frequent buses from Iritty and to both these places and to several places across Kerala including Kottayam, Cochin (Ernakulam), Mangalore, Kasaragod, Panathur, Kanhangad, Cherupuzha, Wayanad and Kozhikode |


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| Mode | Details |
|---|---|
| Train | There is no railway line, with the nearest railway stations at Kannur and Thalaserry |
| Air | The nearest international airports are situated at Kannur (19.5 km away). |

### 3.5 TOPOGRAPHY

Iritty is surrounded by hills. A river flowing through Iritty is more commonly known as Iritty Puzha (Iritty River). There is a steel girder bridge, built in 1933, over the river. There is a dam in the place Pazhassi for irrigation purpose named 'Pazhassi Dam' which is almost 10 km from the town. Wayanad tourist destinations are near from this place. The nearby areas are depending on Iritty for most of their shopping. Payam, Aralam, Punnad, Vallithode, Kilyianthara, Kondambra, Kolikkadavu, Keezhur, Ulickal, Vattiyamthode, Mattara, Kalanki, Manikadave, Manippara Perumpally, Nuchiyad, Vayathoor, Edoor, Peratta, Karikottakari, Angadikadave, Puravayal, Kootupuzha, Charal, Alathupramba, Thermala, Urathoor, Vilakkode, Madathil etc. are the nearby small towns around.

### 3.6 CLIMATIC CONDITION

#### 3.6.1 TEMPERATURE & RAINFALL

The average monthly temperature and rainfall is shown in below. Iritty has a tropical monsoon climate with little to no rainfall from December to March and heavy to extremely heavy rainfall from April to November.

Iritty Municipality falls within the tropical to sub- tropical climatic region. The maximum temperature in the region varies almost between 28.60C to 33.90C and minimum temperature ranges from 21.40C to 25.70C. Iritty has a tropical monsoon climate with little to no rainfall from December to March and heavy to extremely heavy rainfall from April to November. Table 4 Temperature.

*Table 4 Temperature & Rainfall Data*

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average high °F | 31.6 | 32.5 | 33.6 | 33.9 | 33.2 | 29.9 | 28.6 | 29 | 29.7 | 30.5 | 31 | 31.2 |
| Average low °F | 21.4 | 22.6 | 24.3 | 25.7 | 25.6 | 23.9 | 23.4 | 23.5 | 23.5 | 23.6 | 22.9 | 21.5 |
| Average precipitation in | 3 | 4 | 12 | 45 | 283 | 867 | 1,332 | 711 | 329 | 279 | 166 | 58 |

*Source: Climate-Data.org*


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According to the Rainfall Data, the most favorable working period spans from December to March due to the lower precipitation levels.

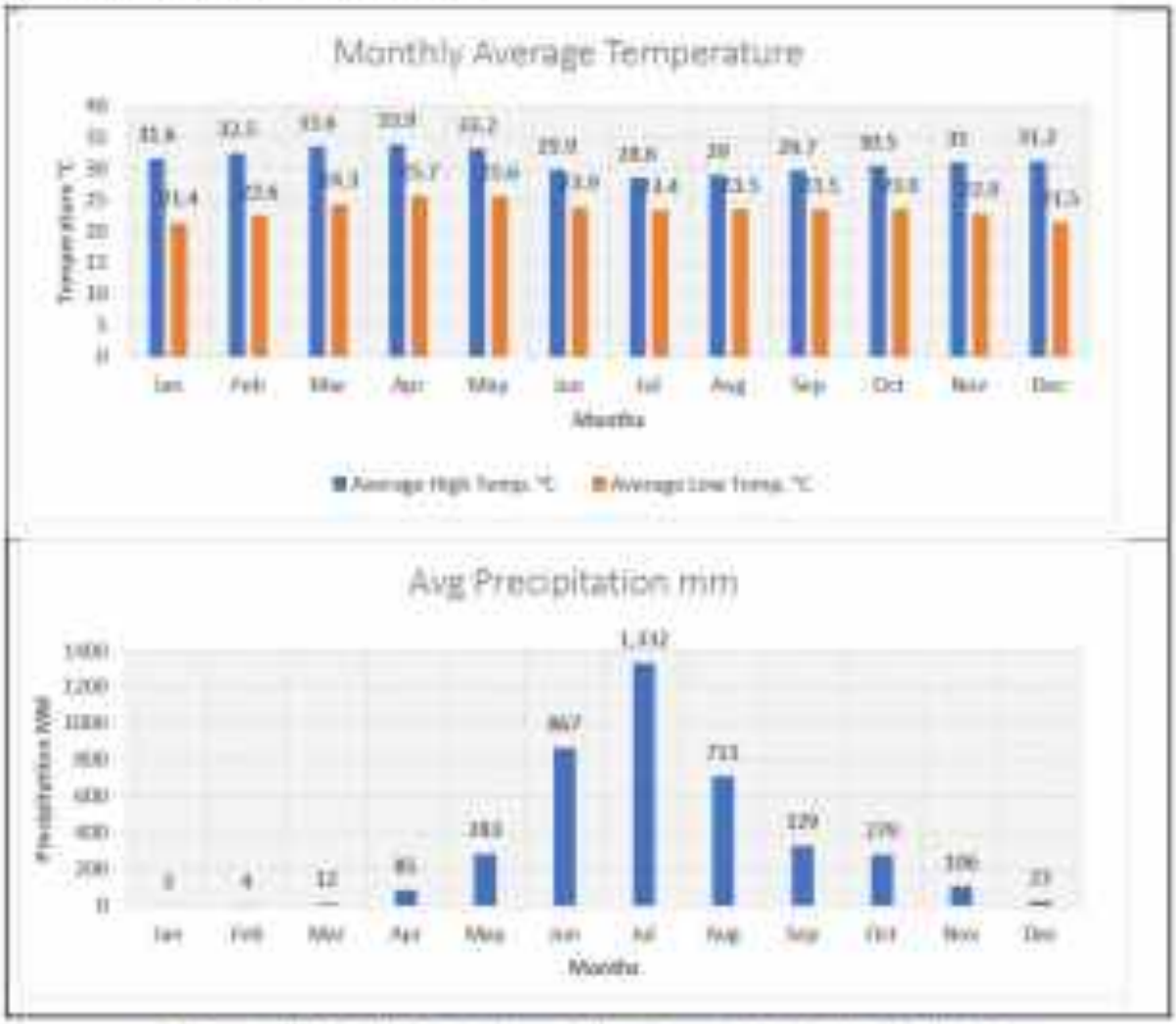



*Figure 3Monthly Variation of Climate and Rainfall for Iritty Town*

### 3.7 FLOOD ZONE

According to the 2022 Flood Probability Report published by the Kerala State Disaster Management Authority, the Iritty municipality has an average area of 10.45 square kilometers that is susceptible to flooding, with a peak elevation of 35.37m.

### 3.8 EARTHQUAKE ZONE

The Bureau of Indian Standards (BIS) has grouped the country into four seismic zones viz, zones II, III, IV and V as detailed in the Map below. The Kerala state falls under Seismic Zone 3.

### 3.9 COASTAL REGULATION ZONE


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As per the Coastal Regulation Zone (CRZ) notification 2011 and further amendment in CRZ notification 2019, the Iritty legacy dumpsite does not fall under the CRZ zone.

## 3.10 GROUND WATER LEVEL

The details of groundwater level during pre-monsoon and post-monsoon, and the average fluctuation is provided in the table below.

*Table 5 Details of Ground Water level*

| Pre-monsoon (m) | Post-monsoon (m) | Avg. Fluctuation (m) |
|---|---|---|
| 6.49 | 5.57 | 0.93 |


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## 4. DETAILED DESCRIPTION OF THE DUMPSITE

### 4.1 PHYSICAL FEATURE OF THE SITE

The total area of the dumpsite is approximately 2 Acre 40.44 Cent, out of which 0.11 Acre are covered by legacy waste, with an average height of 4.5 m from the adjacent road level. The legacy dumpsite is located Lat: 11° 58' 04.41" N, Long: 75° 40' 54.07" E at Aduthattu (ward-12), Iritty.

The dump site partially constructed of compound wall with buttress due to prevention of land slide and control the waste spillage in to the down side. Within the boundary of the site, MCF (area 67.74 m²), Thumboormuzhi (area 37.45 m²), Windrow compost unit (area 250 m²) and one open shed (area 72 m²) are available. The dumping activities were stopped from 2020 due to public protest.



*Figure 4 Iritty Dumpsite Photo*

### 4.2 INFORMATION ON SITE MANAGEMENT

The dumpsite of Iritty Municipality is located at Aduthattu (ward 12). The legacy waste has been dumped over last 20 years (from the year 2000 to year 2020).


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### 4.3 SITE HISTORY INCLUDING PUBLIC PROTEST

The dumping of the solid waste was stopped due to protest from the local residents for addressing the issues of the problems created by odor and leachate from dumpsite and local residents are in demand to remediate the legacy dumpsite and to utilize the remediated land for social cause.

### 4.4 DIRECTIONS FROM AUTHORITIES LIKE NGT, PCB, ETC.

#### 4.4.1 NGT DIRECTIONS & ORDERS

The National Green Tribunal (NGT) has set norms and guidelines (O.A. No. 606/2018) to address legacy waste accumulated at long-operating dumpsites, to mitigate environmental and health hazards. The norms focus on closure and remediation of dumpsites, waste segregation and treatment using appropriate technologies, conducting Environmental Impact Assessments (EIAs), implementing land use planning and zoning regulations, monitoring and compliance measures, and promoting public participation and awareness regarding legacy waste management. These guidelines aim to stabilize dumpsites, prevent further pollution, and involve communities in decision-making and risk education.

#### 4.4.2 LOCAL SELF GOVERNMENT DEPARTMENT - GUIDELINES

The remediation of dumpsites is further directed by Honorable NGT in its order OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. Remediation of Legacy Waste Dumpsites through Bioremediation - G.O.(Rt)No.2629/2022/LSGD Dated, Thiruvananthapuram, 29-10- 2022

#### 4.4.3 KSPCB - GUIDELINES FOR DUMPSITE REMEDIATION

The Kerala State Pollution Control Board (KSPCB) has established guidelines (PCB/HO/SEE2/Model City/Kozhikode corporation/2019 dated 09/09/2021) for dumpsite remediation to address the environmental and health impacts of waste disposal. The recommended steps include conducting a site assessment, developing a remediation plan based on risk assessment, selecting appropriate remediation technologies, implementing remediation activities under supervision, verifying the success of remediation, and ensuring long-term management and monitoring of the site. By following these guidelines, the KSPCB aims to mitigate the adverse effects of waste disposal, protect the environment, and safeguard public health.

#### 4.4.4 CPCB GUIDELINES

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Hon'ble NGT warned that due to incremental growth of Municipal Solid Waste (MSW), these MSW dumps are converting into virtual mountains. Hon'ble NGT further directed that every city/town should adhere to clause 'J' of Schedule–I (capping is not the first option for environmentally safe legacy waste management) of SWM Rules, 2016. Finally, Hon'ble NGT directed CPCB to propose Standard Operating Procedure (SOP) for implementation of Bio-mining and Bioremediation of legacy solid waste.

### 4.4.5 SWACHH BHARAT MISSION (SBM) ADVISORY

The advisory on dumpsite bioremediation addresses the challenges of legacy waste and promotes sustainable waste management practices and emphasizes the importance of dumpsite bioremediation as a sustainable solution for managing legacy waste. By adopting these guidelines, municipalities can address the environmental and health risks associated with dumpsites and promote a cleaner and healthier living environment for communities.

### 4.4.6 CENTRAL PUBLIC HEALTH AND ENVIRONMENTAL ENGINEERING ORGANIZATION (CPHEEO) GUIDELINES

The guidelines aim to provide a comprehensive approach to remediate dumpsites in a safe and environmentally sustainable manner. Key points from the guidelines include conducting site assessments, segregating waste, and implementing engineering and biological measures to control contamination, treating leachate to prevent groundwater contamination, and conducting post-remediation monitoring. These guidelines are crucial to ensure effective and environmentally sound dumpsite remediation that protects public health and the environment.

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# 5 SCOPE OF WORK

Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at Iritty includes the following steps.

- Conducting detailed field investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical, and Environmental Baseline Analysis by M/s Poluchem Laboratories.
- Assessment & Analysis of detailed investigation report submitted by the Laboratories.
- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.
- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the By-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation (land recovery – Biomining, Capping partially Biomining & Capping), Methods/Technologies (Stationary & Mobile- compact), Implementation mode, Forward linkages (Utilization/Management of By-products) and Environmental & Social categorization as per the Environmental Management Framework – Vol II Part A.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Baseline assessment, impact & risk assessment, mitigations measures and Environmental Management & monitoring plan and its budget.
- Social Safeguards - Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.
- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport, Environmental and social monitoring costs, Revenue from the project, Funding for project
- Project Implementation plan –contractual models and timelines.

## 5.1 OBJECTIVES:

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- To remediate legacy waste dumps with approximately 1254.02 Tons by 31st March 2024.
- To reclaim the area i.e., 0.11 Acreand to extent the waste management activities and to eliminate dump fires, leachate generation, foul odour from dumpsite.
- To reduce Green House Gas Emissions, soil pollution and Ground water contamination.
- To increase nearby social/Real estate value and benefit the citizens.

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# 6 COMPOSITION, CHARACTERISTICS OF LEGACY WASTE AND ITS IMPACTS

## 6.1 DETAILED INVESTIGATION STRATEGY

To understand the nature and composition of the legacy waste and the existing baseline environmental conditions, samples from waste, surface and groundwater, leachate, soil, air, and noise were collected as per the requirements given in the Project Implementation Manual, considering the state and national guidelines. Samples were collected as mentioned below:

- ✓ Bore hole upto a depth of 9 m and collection of 3 (nos) samples from the soil at interval of 1.5 m.
- ✓ Waste analysis viz., leachate sample from 3 (nos) locations and physical analysis from 2 (nos) location, and chemical analysis from 1 (nos) location.
- ✓ Environmental baseline analysis surface water 1 (nos) location and ground water samples from 3 (nos) location (Well Water Samples -1 up gradient, 2 down gradient) and Air sampling from 2 (nos) locations and noise sampling from 1 (nos) location

## 6.2 DETAILED INVESTIGATIONS

The detailed investigations carried out for the legacy waste dumpsite is given in the table below:

*Table 6 Investigation details*

| S.No | Parameters | Sampling Nos. |
|---|---|---|
| 1 | Geotechnical Investigation | |
| A | Boreholes up to 10m depth (as per CPHEEO Manual) | 1 |
| B | Permeability test- (as per CPHEEO Manual) standard penetration test SPT and collection of undisturbed samples - Soil Investigation - Classification, gradation, Atterberg's limit, Bulk density, dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, strength, compressibility (vertically- 3 samples per borehole) | 1 |
| 2 | Waste & Environmental Analysis | |
| A | Leachate Analysis (TCLP usepa 1311) (SCHEDULE II of SWM rules, 2016), Suspended solids, Dissolved solids (inorganic),pH, Ammonical nitrogen (as N), Total Kjeldahl nitrogen (as N), BOD, COD, Arsenic (as As), Mercury, Lead, Cadmium, Copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds | 3 |
| B | Physical Analysis of waste (As per CPHEEO manual) including Density, Bulk Density, Moisture Content, Size of waste Constituents, Calorific Value | 2 |


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| S.No | Parameters | Sampling Nos. |
|---|---|---|
| C | Chemical Analysis of waste/soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), total Carbon, C/N ratio, calorific value, Bio-chemical - biodegradable factor | 1 |
| D | Ground Water (Well Water Samples - 1 up gradient, 2 down gradient) - (shallow and deep wells): pH, Colour, EC, Turbidity, SS, TDS, TOC, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, TKN, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total Coliforms (IS 10500 – 2012) | 3 |
| E | Surface Water (pH, Colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, TKN, Total Alkalinity, Total hardness, Ecoli and Total Coliforms (IS 10500 – 2012) | 1 |
| F | Ambient Air Quality (Sulphur Dioxide (So2), Nitrogen Dioxide (No2), Particulate Matter 2.5, Particulate Matter 10, Ozone (O3), Lead (Pb), Carbon Monoxide (CO), Ammonia (NH3), Benzene (C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | 2 |
| G | Ambient Noise Level (Leq)(Rides) for 24 hours | 1 |
| **Note: Detailed Technical Investigations conducted as per PPR** | | |

### 6.3 METHODOLOGY OF SAMPLING

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed sampling methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat/Long) were considered. The following table shows the strategic location details of samples selected for the detailed investigation.

*Table 7 Details of sampling location*

| S.No | Description | Sampling location | Justification |
|---|---|---|---|
| 1 | Air sampling (2 Locations) | Within the dumpsite | As per the wind rose diagram, the direction and speed of the wind are determined and based on the existing wind-rose data the air sampling location fixed at two locations |
| | | Dumpsite entry point | |
| 2 | Noise (1 Location) | Within the dumpsite | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles |
| 3 | Surface water (1 Location) | Surface water near to the dumpsite (stream) | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope. This steep slope on |


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| S.No | Description | Sampling location | Justification |
|---|---|---|---|
| | | | southeast direction possesses a potential risk of leachate runoff, which could result in the contamination of surface water on that particular side of the site. So, the location of surface water is taken on the southeast direction. |
| 4 | Ground water (3 Locations) | 3 wells identified near the dumpsite area | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope (SE). The infiltration of leachate which could result in the contamination of ground water.<br>Based on the possible infiltration and slope direction, two ground water samples are collected in the east direction and one of the west direction. |
| 5 | Bore Hole (1 Location) | Within the dumpsite area | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. |
| 6 | Legacy Waste | Within the dumpsite area | Not Applicable |

*Table 8 Direction and Distance of the sampling location*

| S.No. | Description | Direction | From Dumpsite (m) | From Boundary (m) |
|---|---|---|---|---|
| 1 | Surface Water | South | 640 | 714 |
| 2 | Ground water-1 | East | 10 | 75 |
| 3 | Ground water-2 | North East | 118 | 175 |
| 4 | Ground water-3 | North West | 2820 | 2875 |
| **Note: Air and Noise Monitoring are monitored inside the dumpsite** | | | | |

*Table 9 Quantity of sampling & location*

| S.No | Items | Quantity of sample collected | Location |
|---|---|---|---|
| 1 | Solid Waste | 25 kg | Location -1: N- 11 °58'04.542" E -75°40'53.061"<br>Location -2: N- 11 °58'04.452" E -75°40'53.753" |
| 2 | Surface Water | 1.5 Litres | Location -1:N- 11 °57'49.198" E -75°41'11.609" |
| 3 | Ground Water | 1.5 litres | Location -1:N- 11 °58'02.844" E -75°40'53.189"<br>Location -2:N- 11 °58'09.276" E -75°40'50.453"<br>Location -3:N- 11 °57'50.389" E -75°39'29.761" |
| 4 | Leachate | 1.5 litres | Location -1: N- 11 °58'04.452" E -75°40'53.753" |


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| S.No | Items | Quantity of sample collected | Location |
|---|---|---|---|
| 5 | Ambient Air Quality | 2 Nos | Location -1:N- 11°58'04.41"E -75°40'54.066"<br>Location -2:N- 11°58'03.384"E -75°40'53.94" |
| 6 | Ambient Noise Quality | 1 Nos | Location -1: N- 11°58'04.116"E -75°40'54.509" |

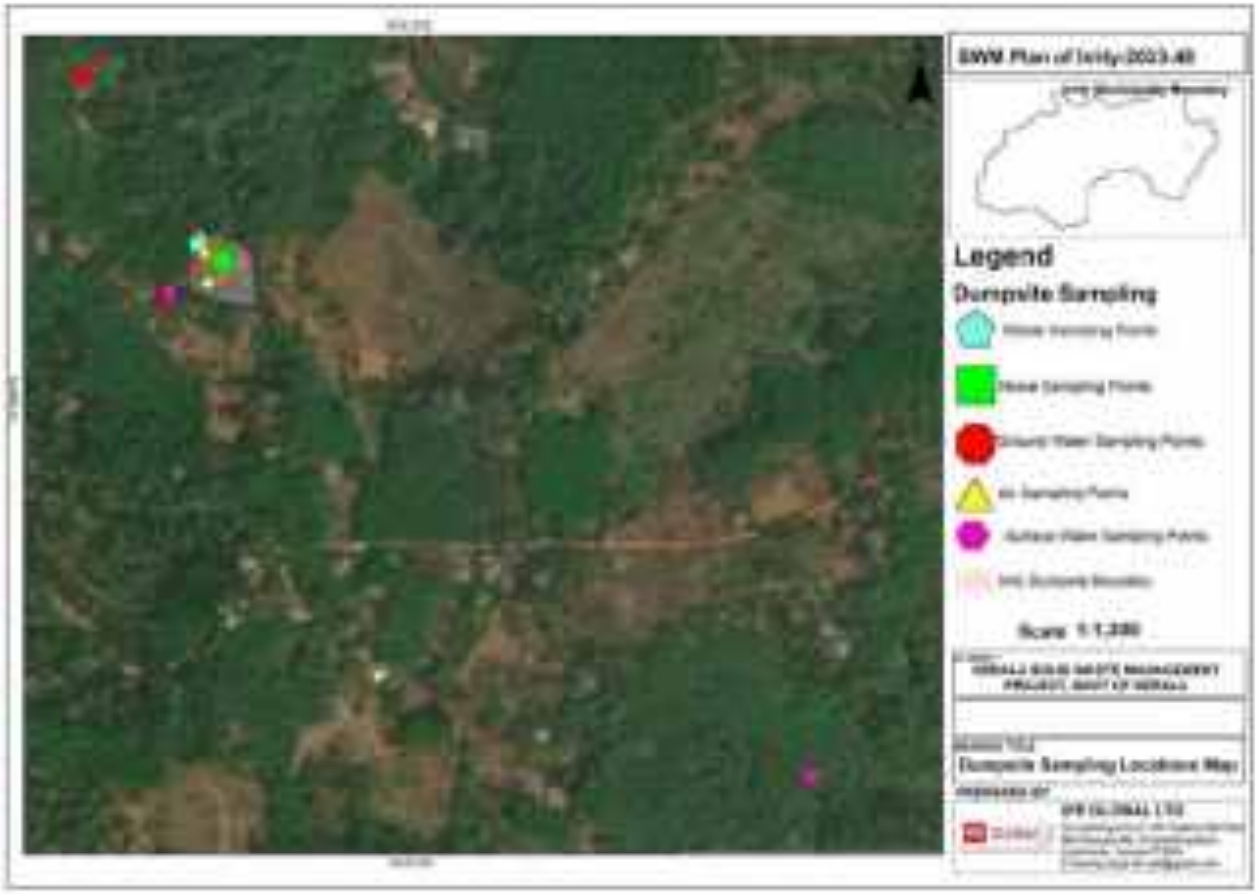



*Figure 5Sampling Locations – Borehole & legacy waste sample*

## 6.4 ANALYSIS AND INTERPRETATION OF EXPLORATORY DATA

As part of the feasibility study, Technical Support Consultants (IPE Global Ltd) has entrusted the geotechnical investigation & Environmental baseline assessment to M/s Matter Material Testing & Research Laboratory (P) Ltd and M/s Polluchem Laboratories (P) Ltd respectively.

The initial site visit was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd on 05-June- 2023 along with the experts of TSC and PIUs. Field Geotechnical investigation to collect the soil samples after drilling through the legacy waste was started on 27thJune 2023 and was completed on 28thJune 2023. Positioning of Air samplers & Noise monitoring equipment,


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sampling of surface/groundwater, leachate, and legacy waste were done on 09th June 2023 by M/s Polluchem Laboratories (P) Ltd. The lab analysis reports were submitted by the investigation agencies to TSC. The lab analysis reports are provided in Annexures – A & B

### 6.4.1 GEOTECHNICAL EXPLORATORY DETAILS

For assessing the depth of legacy waste and contamination of the soil below the legacy waste, bore hole samples were collected using rotary drill. The exploratory data of the bore hole revealed a maximum depth of 4.50m of waste followed by4.50m of soil. Lateritic rock was encountered below the soil stratum. The Geotechnical investigation was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. The details of the exploratory data of the bore hole is provided below.

*Table 10 Exploratory Data of Bore Log*

| S. No | Borehole location | Total Depth of the Borehole (m) | Depth of Soil (m) | Depth of Legacy Waste (m) | Remarks |
|---|---|---|---|---|---|
| 1 | N- 11°58'04.41"<br>E -75°40'54.066" | 9 | 4.5 | 4.5 | Lab Analysis Report provided at Annexure A |
| Note: Bore hole terminated at the depth of 4.50m below ground level due to Laterite rock. | | | | | |


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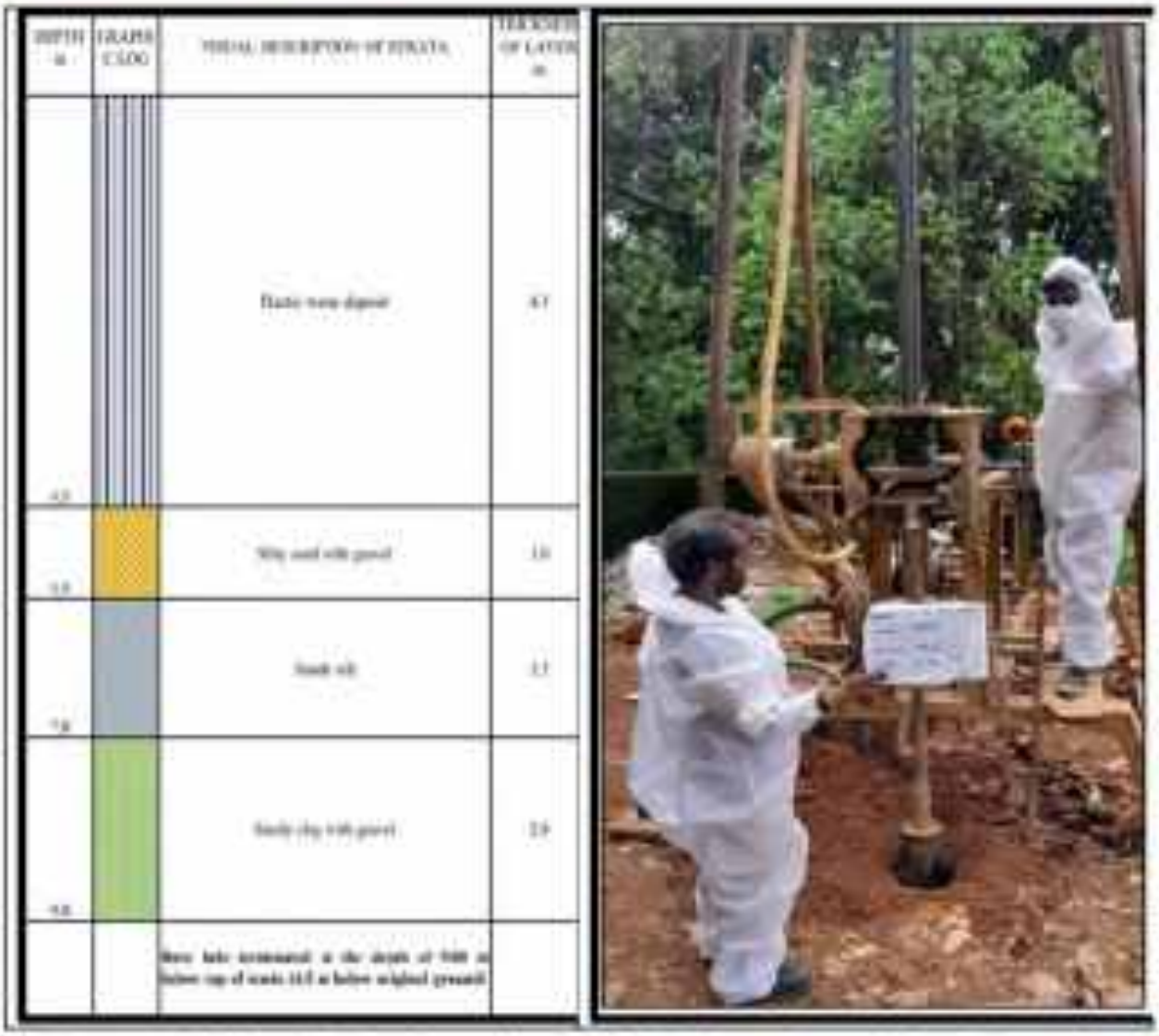


*Figure 6 Soil Profile Details and geotechnical Surveying at Iritty Dumpsite*

### 6.4.2 ESTIMATED TOTAL QUANTITY OF WASTE

The total quantity of waste is estimated based on the contour/topography survey profile of the waste over the ground level and exploratory data of the bore log (Geotechnical investigations). The details of the estimated total quantity of waste is provided below:

*Table 11 Quantity of waste below and above ground level*

| Waste | Area of Dumpsite | Depth of Waste (m) | Density of Waste (t/m³) | Total Quantity of Waste (m³) | Total Quantity of Waste (T) |
|---|---|---|---|---|---|
| Above and Below | 449.58 | 4.5 | 619.85 | 2023.11 | 1254.024 |


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| | | | | | |
|---|---|---|---|---|---|
| the Ground Level | | | | | |

*Table 12Estimated total quantity of waste*

| Estimated total quantity of waste | |
|---|---|
| Total Quantity of Legacy Waste ($m^3$) | 2023 |
| Total Quantity of Legacy Waste (T) | 1254.02 |
| Total Quantity of Legacy Waste (T) Approximately | 1254 |


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### 6.4.3 LEGACY WASTE CHARACTERIZATION

The characteristics of the legacy waste were assessed by collecting e samples of 25 kg from 2 (nos) locations within the dumpsite. The legacy waste samples were collected on 09th June 2023 by M/s Polluchem Laboratories (P) Ltd. The assessment of waste characteristics. was done based on the results of the analysis. The details of the characteristics viz., composition, physical & chemical characteristics, heavy metals, and estimated quantity of by-products are provided in the tables below:

| S. No | Items | Quantity of sample collected | Location |
|---|---|---|---|
| 1 | Solid Waste | 25 kg | Location -1:N- 11 °58'04.41"E -75°40'54.066"<br>Location -2:N- 11 °58'03.384"E -75°40'53.94" |

**Physical Composition:**

*Table 13 Physical Composition for Location- 1, 2 & Average*

| S. NO | Total Quantity of legacy waste (T) | Parameters | Location – I | | Location – II | | Average | |
|---|---|---|---|---|---|---|---|---|
| | | | Avg. Percentage(%) | Quantity (T) | Avg. Percentage (%) | Quantity (T) | Avg. Percentage (%) | Quantity (T) |
| 1 | 1254.02 | Bio Earth (-4.75mm) | 32 | 401.29 | 33 | 413.83 | 32.5 | 407.56 |
| | | Bio Earth (+4.75 to 8 mm) | 16 | 200.64 | 17 | 213.18 | 16.5 | 206.91 |
| 2 | | C&D (+8mm) | 23 | 288.43 | 22 | 275.89 | 22.5 | 282.16 |
| 3 | | Plastics | 18 | 225.72 | 17 | 213.18 | 17.5 | 219.45 |
| 4 | | MLP/SUP | 4 | 50.16 | 3.6 | 45.14 | 3.8 | 47.65 |
| 5 | | Cloths | 3 | 37.62 | 4.1 | 51.42 | 3.55 | 44.52 |
| 6 | | Glass | 2 | 25.08 | 1.5 | 18.81 | 1.75 | 21.95 |
| 7 | | Metals | 1.5 | 18.81 | 1.35 | 16.93 | 1.425 | 17.87 |

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| S. NO | Total Quantity of legacy waste (T) | Parameters | Location – I | | Location – II | | Average | |
|---|---|---|---|---|---|---|---|---|
| | | | Avg. Percentage(%) | Quantity (T) | Avg. Percentage (%) | Quantity (T) | Avg. Percentage (%) | Quantity (T) |
| 8 | | Rubber | 0.47 | 5.89 | 0.42 | 5.27 | 0.445 | 5.58 |
| 9 | | Other | 0.02 | 0.25 | 0.01 | 0.13 | 0.015 | 0.19 |
| 10 | | Leather | 0.01 | 0.13 | 0.02 | 0.25 | 0.015 | 0.19 |




*Figure 7 Percentage of Physical Composition are shown of Location 1 & 2 and Average.*

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**Physical Analysis:**

*Table 14 Physical Analysis*

| S. No | Parameters | | Test Method | Unit | Location 1 | Location 2 | Avg. | Limit as per FCO |
|---|---|---|---|---|---|---|---|---|
| 1 | Moisture@105°C | | ASTM D 2216 | % | 32.2 | 28.6 | 30.4 | 15.0-25.0 |
| 2 | Bulk Density | | USEPA | kg/m³ | 640 | 687 | 663.5 | |
| 3 | Density | | USEPA | g/cm³ | 0.6156 | 0.6241 | 0.61985 | <1 |
| 4 | Calorific Value | | ASTM D 5865 | K.cal/kg | 2145 | 1841 | 1993 | -- |
| 5 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | Retained | Retained | Retained | |
| | | 75 | -- | | | 0 | 3.8 | 1.9 | |
| | | 40 | -- | | | 11.4 | 20.6 | 16 | |
| | | 20 | -- | | | 11.2 | 34.5 | 22.85 | |
| | | 8 | -- | | | 31.8 | 12.6 | 22.2 | |
| | | 4.75 | 4 + | | | 27.6 | 8.6 | 18.1 | |
| | | 2.36 | 8 | | | 12.1 | 6.3 | 9.2 | |
| | | 1.18 | 16 | | | 5.3 | 9.2 | 7.25 | |
| | | 0.6 | 30 | | | 0.6 | 4.4 | 2.5 | |
| | | 0.3 | 50 | | | 0 | 0 | 0 | |
| | | 0.15 | 100 | | | 0 | 0 | 0 | |
| | | 0.09 | 170 | | | 0 | 0 | 0 | |
| | | 0.075 | 200 | | | 0 | 0 | 0 | |
| | | 0.045 | 325 | | | 0 | 0 | 0 | |
| Lat/Long: Location -1: N- 11°58'0.542", E -75°40'53.861" and Location -2: N- 11°58'04.452", E -75°40'53.753" | | | | | | | | |

**Chemical Analysis:**

*Table 15 Chemical Analysis*

| S. No | Parameters | Test Method | Unit | Location -1 |
|---|---|---|---|---|
| 1 | pH@25°C | USEPA | -- | 7.44 |
| 2 | Biodegradable Factor | USEPA | % | 5.6 |
| 3 | Total carbon | USEPA 9060A | % | 3.7 |


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| S. No | Parameters | Test Method | Unit | Location -1 |
|---|---|---|---|---|
| 4 | Phosphorus(P) | USEPA | % | 0.047 |
| 5 | Nitrogen(N) | USEPA | % | 0.26 |
| 7 | Potassium(K) | USEPA | % | 0.017 |
| 8 | C/N Ratio | USEPA | .. | 14.2:1 |
| 9 | Calorific Value | ASTM D 5865 | Kcal/kg | 2232 |

**Heavy Metal Analysis:**

*Table 16 Heavy Metal Analysis*

| S. No | Parameters | Test Method | Unit | Location -1 | Limit as per Organic Compost (FCO 2009) |
|---|---|---|---|---|---|
| 1 | Iron (Fe) | USEPA 3050 | % | 2.87 | -- |
| 2 | Arsenic (As) | USEPA 3050 | mg/kg | <0.1 | 10 |
| 3 | Selenium (Se) | USEPA 3050 | mg/kg | <0.1 | -- |
| 4 | Nickel (Ni) | USEPA 3050 | mg/kg | 50.7 | 50 |
| 5 | Zinc (Zn) | USEPA 3050 | mg/kg | 114.4 | 1000 |
| 6 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 | 5 |
| 7 | Copper (Cu) | USEPA 3050 | mg/kg | 50.7 | 300 |
| 8 | Chromium (Cr) | USEPA 3050 | mg/kg | 6.9 | 50 |
| 9 | Lead (Pb) | USEPA 3050 | mg/kg | 46.6 | 100 |
| 10 | Mercury (Hg) | USEPA 3050 | mg/kg | <0.1 | .15 |
| 11 | Manganese (Mn) | USEPA 3050 | mg/kg | 140.5 | -- |

**By-Products:**

*Table 17 By-Products*

| By-Products | Bio Earth | C&D Waste | RDF | Recyclable |
|---|---|---|---|---|
| Percentage (%) | 49% | 22.50% | 25.33% | 3.18% |
| Quantity (cu.m) | 614.47 | 282.15 | 317.58 | 39.81 |

### 6.4.4 ENVIRONMENTAL BASELINE

The environmental baseline was assessed from the analytical results of air, surface &groundwater, noise and leachate from the location as mentioned in the section 6.3. The samples were collected on 09th June 2023 by M/s Polluchem Laboratories (P) Ltd. The Environmental baseline was


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analyzed with reference to the lab analysis reports. The details of analysis & inferences are provided in the tables below:

**Surface Water Analysis:**

*Table 18 Surface water Analysis*

| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 – 1983RA2017 | 6.20 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 10 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 6.4 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 36 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 23.4 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 12 mg/l | --- | -- |
| Total Hardness as CaCO3 | IS 3025 (P) 21 – 1983RA2014 | 8 mg/l | 200 mg/l | -- |
| Total Alkalinity as CaCO3 | IS 3025 (P) 23 – 1986RA2014 | 6 mg/l | -- | -- |
| Chloride as Cl- | IS 3025 (P) 32 – 1988RA2014 | 10.45 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as SO4 | IS 3025 (P) 24 – 1986RA2014 | 2.94 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 – 1989RA2014 | 1.3 mg/l | 6 mg/l | 4 mg/l |
| B.O.D ( 3 days at 27° C ) | IS 3025 (P) 44 - 1993RA2014 | 2.4 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 - 2006RA2017 | 8 mg/l | --- | -- |


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| Parameters | Test method | Result | Limit as per IS:2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| TOC | APHA5310 | BDL(MDL-0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 3 mg/l | -- | -- |
| Nitrate as NO3 | IS 3025 (P)34 – 1988RA2014 | 1.15 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 - 2008RA2014 | 0.11 mg/l | 1.5 mg/l | 1.5 mg/l |
| Nichel as Ni | IS 3025(P) 54- 2003RA2014 | BDL(MDL-0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41- 1992RA2014 | BDL(MDL-0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47- 1994RA2014 | BDL(MDL-0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42- 1992RA2014 | BDL(MDL-0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59- 2006RA2017 | BDL(MDL-0.01mg/l) | 0.5 mg/l | -- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL-0.001mg/l) | 0.001 mg/l | -- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL-0.01mg/l) | 15 mg/l | 15 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.44 mg/l | 0.3 mg/l | 0.5 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL-0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37- 1988RA2014 | BDL(MDL-0.01mg/l) | 0.05 mg/l | 0.2 mg/l |
| Location | Inference | | | |
| 1 | The analysis reveals that surface water is slightly acidic, BODs is slightly greater than the allowable limit (A-class), and the iron content is also slightly higher than permissible limit of A-class. | | | |

Note: The sampling location and its respective distance from the dumpsite have been incorporated into Table 10.The stream is not use for any public use.


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**Ground Water Analysis:**

*Table 19 Groundwater Analysis*

| Parameter | Test Method | Location -1 | Location -2 | Location -3 | Acceptable Limit As per IS-10500-2012 |
|---|---|---|---|---|---|
| pH | IS 3025 (P) 11 – 1983RA2017 | 6.58 | 5.72 | 6.34 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 6 Hazen Unit | 9 Hazen Unit | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 1.3 NTU | 2.9 NTU | 0.1 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 300 µS/cm | 80 µS/cm | 80 µS/cm | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 174 mg/l | 48 mg/l | 52 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 4 mg/l | 12 mg/l | BDL(MDL-1mg/l) | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 100 mg/l | 22 mg/l | 20 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 68 mg/l | 10 mg/l | 20 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 15.2 mg/l | 13.3 mg/l | 12.35 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 58.31 mg/l | 2.94 mg/l | 2.67 mg/l | 200 mg/l |
| COD | IS 3025 (P) 58 – 2006RA2017 | 6 mg/l | 12 mg/l | 8 mg/l | — |
| TOC | APHA5310 | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | — |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | — |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1mg/l) | 1.08 mg/l | 1.63 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 – 2008RA2014 | 0.35 mg/l | 0.2 mg/l | 0.2 mg/l | 1.0 mg/l |
| Nickel as Ni | IS 3025(P) 54-2003RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.02 mg/l |


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| Parameter | Test Method | Location -1 | Location -2 | Location -3 | Acceptable Limit As per IS-10500-2012 |
|---|---|---|---|---|---|
| Cadmium as Cd | IS 3025(P) 41-1992RA2014 | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47-1994RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42-1992RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59-2006RA2017 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 5.0 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.46 mg/l | 0.26 mg/l | BDL(MDL-0.05mg/l) | 1.0 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37-1988RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.01 mg/l |
| Lat/Long: Location -1: [N- 11 °58'02.844", E -75°40'53.189"], Location -2 [N- 11 °58'09.276", E -75°40'50.453"], Location -3 [N- 11 °57'50.389", E -75°39'20.761"] | | | | | |

| Location | Inference |
|---|---|
| 1 | The location-1 ground water found to be is slightly acidic. Color range of ground water is also slightly higher than permissible limit, and the turbidity is also slightly high observed. |
| 2 | The location-2 ground water found to be is slightly acidic. Color range of ground water is also slightly higher than permissible limit, and the turbidity is also slightly high observed. |
| 3 | The location-3 ground water found to be is slightly acidic. |

**Note :** The sampling location and its respective distance from the dumpsite have beenincorporated into Table 10.


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**Ambient Air Quality:**

*Table 20 Ambient Air Quality*

| Parameters | Test Method | Location -1 | Location -2 | Limits as per NAAQS |
|---|---|---|---|---|
| Particulate Matter ($PM_{10}$) | IS 5182 Part 23 2006RA2012 | 102 µg/m³ | 76.3 µg/m³ | 100 µg/m³ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 48.7 µg/m³ | 29.6 µg/m³ | 60 µg/m³ |
| Sulphur Dioxide ( $SO_2$) | IS 5182 Part 2 2001 RA 2017 | 5.4 µg/m³ | 6.3 µg/m³ | 80 µg/m³ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 9.8 µg/m³ | 9.7 µg/m³ | 80 µg/m³ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | <1 mg/m³ | <1 mg/m³ | 4 mg/m³ |
| Ammonia ( $NH_3$) | CPCB | < 1 µg/m³ | < 1 µg/m³ | 400 µg/m³ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m³ | < 0.1 µg/m³ | 1 µg/m³ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m³ | <0.1 ng/m³ | 6 ng/m³ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m³ | <0.1 ng/m³ | 20 ng/m³ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m³ | < 1 µg/m³ | 180 µg/m³ |
| Benzene ($C_6H_6$) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m³ | < 0.1 µg/m³ | 5 µg/m³ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m³ | < 0.1 ng/m³ | 1 ng/m³ |
| Lat/Long: Location -1 [N- 11°50'04.41", E-75°40'54.066"], Location -2 [N-11°50'03.388", E-75°40'53.94"] | | | | |

| Location | Inference |
|---|---|
| 1 | The analysis report on ambient air reveals that except $PM_{10}$ all other parameters are within the acceptable limits as per NAAQS. $PM_{10}$ is very slightly higher than the acceptable limit. |
| 2 | The analysis on ambient air reveals that all parameters are within the acceptable limits as per NAAQS. |
| NOTE: The contractor is required to implement all necessary protective measures during the construction process to ensure that air quality levels are maintained within permissible limits. | |


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**Note :** The sampling location and its respective distance from the dumpsite have been incorporated into Table 10.

**Ambient Noise Level:**

*Table 21 Ambient Noise level*

| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|
| **09.06.2023** | 15.00 Hrs | dB (A) | 62.3 | Residential Area: |
| | 16.00 Hrs | dB (A) | 58.6 | Day time -55 dB(A) Leq |
| | 17.00 Hrs | dB (A) | 63.4 | Night time 45 dB(A) Leq |
| | 18.00 Hrs | dB (A) | 62.4 | |
| | 19.00 Hrs | dB (A) | 59.7 | |
| | 20.00 Hrs | dB (A) | 54.2 | |
| | 21.00 Hrs | dB (A) | 53.1 | |
| | 22.00 Hrs | dB (A) | 50.1 | |
| | 23.00 Hrs | dB (A) | 48.6 | |
| **10.06.2023** | 00.00 Hrs | dB (A) | 50.1 | |
| | 01.00 Hrs | dB (A) | 52.3 | |
| | 02.00 Hrs | dB (A) | 53.2 | |
| | 03.00 Hrs | dB (A) | 51.2 | |
| | 04.00 Hrs | dB (A) | 50.1 | |
| | 05.00 Hrs | dB (A) | 53.6 | |
| | 06.00 Hrs | dB (A) | 59.5 | |
| | 07.00 Hrs | dB (A) | 60.9 | |
| | 08.00 Hrs | dB (A) | 64.3 | |
| | 09.00 Hrs | dB (A) | 65.4 | |
| | 10.00 Hrs | dB (A) | 67.8 | |
| | 11.00 Hrs | dB (A) | 69.5 | |
| | 12.00 Hrs | dB (A) | 64.3 | |
| | 13.00 Hrs | dB (A) | 61.3 | |
| | 14.00 Hrs | dB (A) | 59.8 | |
| Avg. Leq Day – 60.2 dB (A) | | | | |
| Avg. Leq Night – 51.3 dB (A) | | | | |
| **Location** | **Inference** | | | |
| 1 | The analysis reveals that noise levels are within the acceptable limits | | | |


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**Leachate Analysis:**

*Table 22 Leachate Analysis*

| Parameters | Test Method | L1 | Limits as per SWM Rules 2016 |
|---|---|---|---|
| pH | IS 3025 (P) 11-1983 RA2017 | 6.35 | 5.5 to 9.0 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16-1984 RA2017 | 654 mg/l | 2100 mg/l |
| Total Suspended Solids | IS 3025 (P) 15-1984 RA2017 | 48 mg/l | 100 mg/l |
| Chloride as Cl | IS 3025 (P) 32-1988 RA2014 | 189.3 mg/l | 1000 mg/l |
| COD | IS 3025 (P) 58-2006 RA2017 | 240 mg/l | 250 mg/l |
| BOD(3 days at 27 deg.cel) | IS 3025 (P) 44-1988 RA2014 | 65.3 mg/l | 30 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34-1988 RA2014 | 20.3 mg/l | 100 mg/l |
| Ammonical Nitrogen as N | IS 3025 (P) 34-1988 RA2014 | 16.3 mg/l | 50 mg/l |
| Phenolic Compound as C6H5OH | IS 3025 (P) 43-1992RA2014 | 0.3 mg/l | 1 mg/l |
| Fluoride asF | IS 3025 (P) 60-2008RA2014 | BDL(MDL-0.01 mg/l) | 2 mg/l |
| Cynadie as Cn | IS 3025 (P) 27-1986 RA2014 | BDL(MDL-0.01 mg/l) | 0.2 mg/l |
| Nickel as Ni | IS 3025 (P) 54-2003 RA2014 | BDL(MDL-0.01 mg/l) | 3 mg/l |
| Cadmium as Cd | IS 3025 (P) 41-1992 RA2014 | BDL(MDL-0.001 mg/l) | 2 mg/l |
| Lead as Pb | IS 3025 (P) 47-1994 RA2014 | BDL(MDL-0.01 mg/l) | 0.1 mg/l |
| Copper as Cu | IS 3025 (P) 42-1992 RA2014 | 1.1 mg/l | 3 mg/l |
| Mercury as Hg | IS 3025 (P) 48-1994 RA2014 | BDL(MDL-0.001 mg/l) | 0.01 mg/l |
| Zinc as ZN | IS 3025 (P) 49-1994 RA2014 | 1.3 mg/l | 5 mg/l |


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| Parameters | Test Method | L1 | Limits as per SWM Rules 2016 |
|---|---|---|---|
| Total Arsenic as As | IS 3025 (P) 37-1988 RA2014 | BDL(MDL-0.01 mg/l) | 0.2 mg/l |

| Location | Inference |
|---|---|
| 1 | The analysis reveals that all the parameter within the acceptable limit except the BoD is greater than the allowable limit. Indicating that the leachate is containing biological contents. |

### 6.5 RISK ASSESSMENT

**Surface Water:** Dumpsites can release pollutants into nearby surface water bodies through leachate, which is generated when rainwater or other liquids come into contact with the waste. Leachate can contain various contaminants such as heavy metals, organic compounds, and pathogens. Proper containment and management of leachate are essential to prevent water pollution.

In Iritty dumpsite, the analysis of surface water reveals that all the parameter are within the acceptable limit, except BoD value slightly surpasses the permissible limit and does not have any effect.

*Table 23 Risk Assessment- surface water*

| Risk Assessment | |
|---|---|
| **Source** | **Legacy Waste Dumpsite** |
| **Pollutant** | **Leachate from Dumpsite – BoD higher than the acceptable limits** |
| **Pathway** | **Water / Run off** |
| **Receptor** | **Humans, Animals, Aquatic life and flora & fauna** |
| **Risk** | **No effect on receptor** |

**Groundwater:** Pollutants from dumpsites can infiltrate into the underlying groundwater, particularly if the dumpsite is not adequately lined or if waste disposal practices have caused contamination of the soil. Once pollutants enter the groundwater, they can spread over a wide area, affecting drinking water sources and ecosystems. Remediation techniques often focus on preventing or minimizing further groundwater contamination.

In Iritty dumpsite, the analysis of ground water samples at three different locations reveals that except pH, color and turbidity all other parameters are within the limit as per IS 10500:2012. The


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pH of the sample analysis in all three location which is in slightly acidic range, which cause for corrosionsand make the water not fit for any industrial purpose. The color and turbidity is also very slightly higher for location 1 & 2 and two stations means either chances of having organic matter in the dissolved form or suspended particles or both respectively. But due to high range of turbidity founded at two locations in ground water, there may be chances of more suspended impurities found in ground water. Turbidity is a critical parameter in drinking water because bacteria, viruses and parasites (such as giardia and cryptosporidium) can attach themselves to the suspended particles.

*Table 24 Risk Assessment - Ground water*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite – pH is acidic in nature |
| **Pathway** | Water, Soil |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | **No major effect on receptor** |

**Air:** Dumpsites may emit pollutants into the air through processes such as open burning of waste or the release of gases from decomposing organic materials. Airborne pollutants can include particulate matter, volatile organic compounds (VOCs), dioxins, and other hazardous substances. These pollutants can have adverse effects on air quality and human health.

In Iritty dumpsite, the analysis of Air samples at two different locations reveals that the $PM_{10}$ value is high in one location.

*Table 25 Risk Assessment - air*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Within the limits |
| **Pathway** | Air |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | **Negligible impact on the receptor is anticipated, and following the remediation of the site, the $PM_{10}$ associated value is expected to decrease.** |

**Soil:** Dumpsites can contaminate the surrounding soil with a wide range of pollutants. Hazardous chemicals, heavy metals, and organic compounds can leach from the waste and accumulate in the soil, potentially posing risks to plants, animals, and humans.


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*Table 26 Risk Assessment - soil*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Heavy metals etc. |
| **Pathway** | Soil |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | **Possible risks to Human health**<br>Soils if contain substances such as heavy metals, which may be toxic to humans, can pass those substances on to humans through crop uptake, leading to unsafe foods.<br>**Possible risks to Animals**<br>When farm animals consume the plants grown from contaminated soil it affects the health of animals in later stage.<br>**Possible risks to flora**<br>Soil pollution may alter plant metabolism and reduce crop yields and cause trees and plants that may absorb soil contaminants to pass them up the food chain. |

**Bioaccumulation in Biota**: Pollutants from dumpsites can enter the food chain and bioaccumulate in plants and animals. Contaminated soil or water can be taken up by plants, and these plants may then be consumed by animals. As pollutants move up the food chain, their concentrations can increase, leading to potential health risks for humans and wildlife.

In Iritty dumpsite, the environmental baseline parameters are almost within the permissible limits and do not have any major effect on receptors.

*Table 27 Risk Assessment - Bioaccumulation in Biota*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Leachate and gas emission from Dumpsite |
| **Pathway** | Air, water and soil |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | Negligible impact on the receptor is anticipated, and following the remediation of the site, the associated value is expected to decrease. |


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# 7 EVALUATION OF REMEDIATION TECHNIQUES

Although the term "legacy waste" has not been defined in any official government document in India, it typically refers to aged municipal solid waste in landfills or dumpsites. There is no information on how old waste must be in order to qualify tobe called legacy waste. These legacy dumpsites are creating various irreversible environmental/health/livelihood hazards. The major sources of pollution are:

- ✓ Puddles of leachate flowing through the adjacent area and reaching the water table long-term issues of greenhouse gas emissions
- ✓ Surface water and groundwater pollution due to erosion and seepage
- ✓ Dumpsite fires
- ✓ Due to the faster urban development and increased waste generation per capita and mismanagement of generated waste.

The dumpsites have emerged as pollution hubs, especially those situated in human settlements, as cities have grown over the decades. It has, therefore, become a necessity for the city authorities to remediate the existing dumpsites in an environmentally sound and economically viable manner.

**Remediation of legacy waste dumpsite**

Remediation is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

1. Uplift of the environment- reduction in greenhouse gas emissions, soil pollution, ground water contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.
2. Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in nearby real state value and rental values.
3. Land - Dumpsite land becomes available for public use or for setting up SWM facility on the reclaimed land.
4. Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled, or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels.

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For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- ✓ A total station survey for assessment of volumetric quantity of legacy waste above the ground level.
- ✓ Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- ✓ History of the site, Physical features of site, as –is/current situation and compositional analysis of waste.
- ✓ Baseline study of heavy metals in surface;
- ✓ water, rainfall, soil type, surface hydrology, topography, wind directionetc. shall be studied before and after bioremediation.
- ✓ Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area.

The details of the remediation techniques for the remediation of the legacy waste dumpsite remediation are as follows

### 7.1 BIO-MINING – RECLAMATION/RECOVERY OF LAND

Bio- mining is the scientific technique to extract materials of economic interest from legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) and followed by sustainable management through recycling, co-processing, road construction etc.

*Table 28 Phases of Bio-mining*

| Phases of Bio-mining | |
|---|---|
| Phase 1: Stabilization | The legacy waste is formed into equal-sized windrows, and which are turned frequently, bio-culture is added and de-odourizer (an odour-controlling agent) sprayed. This phase removes stench, reduces moisture and eliminates pathogens. |
| Phase 2 Sorting & Segregation | In this phase, stabilized legacy waste is sorted/segregated into bio earth, recyclables, refused derived fuel (RDF) and C&D through series of various sizes of Trommels/circular rotatory sieves and manpower. |


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| | |
|---|---|
| **Phase 3: Disposal & Utilization** | In this phase, the non-combustible fractions such as soil and stones are disposed of for further processing into finer aggregates or for earth filling. The combustible fractions are called refuse-derived fuel (RDF) are sent for co-processing in cement industries. |

| | |
|---|---|
| **Salient Aspects** | land recovery, increase in value of land and available for public use/habitation with immediate effect.<br>Ensures long-term sustainability and environmentally sound treatment of legacy waste and present lucrative revenue-generating opportunities.<br>Bio products/aggregates generated from the process can be used as alternative construction material, fuel and recyclables.<br>Compliance to SWM Rules and NGT orders.<br>Improvement in aesthetics and quality of life & health. |
| **Applicability** | The ownership is well defined.<br>Working space is available in the dumpsite.<br>Linkage for utilization by-products is available |

### 7.2 CAPPING WITHOUT LAND RECOVERY

Capping is a scientific process of profiling legacy waste and covering with barrier layers consisting of soil, high density polyethylene (HDPE) liner, gas collection system surface drainage system, and a vegetative cover to minimize the percolation of rainwater into the legacy waste.

| | |
|---|---|
| **Salient Aspects** | The capped area becomes a green space and can be developed into parks/recreational areas.<br>Capped area will be equipped with environmental monitoring systems for post-closure maintenance to monitor pollution levels in groundwater and surface-water sources and air (especially methane emissions) at least 15 years.<br>Capped area needs to be inspected periodically for settlement due to physical, chemical and biological transformation, leachate generation, erosion and naturally occurring invasion by deep-rooted vegetation. Recurring expenditure will be incurred for regular maintenance. |


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| | |
|---|---|
| | On July 17, 2019, the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested bio-mining as environmentally safe and the most preferable approaches to dumpsite remediation.<br>SWM rules do not permit habitation over it for at least 15 years because of the danger posed by toxic gases release by the waste. |
| **Applicability** | Capping could be a solution for legacy waste where bio-mining is not possible because of steep terrain, inaccessible ravines and narrow valleys.<br>Lack of linkage for utilization/ disposal of segregated components<br>Lack of working space & resources |

### 7.3 CAPPING WITH PARTIAL LAND RECOVERY

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can linked to relevant buyers and the inert material will be capped to prevent further degradation of the environment.

| | |
|---|---|
| **Salient Aspects** | The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.<br>Ensures short -term sustainability and environmentally sound treatment of legacy waste.<br>Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area |
| **Applicability** | Legacy waste dumpsite area partial of steep terrain, inaccessible ravines and narrow valleys.<br>Lack of linkage for disposal of inert<br>Recovery land for public use is not a priority |


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## 7.4 SELECTION OF REMEDIATION OPTION

Selection of the applicable method/type or technique is based on the factors like., salient aspects & applicability of remediation types viz., Capping without land recovery, Bio-mining – reclamation/recovery of land & capping with partial land recovery and also available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for land recovery and forward linkages/utilization of processed aggregates/by-products.

Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. It may be noted that the bio-earth and C&D material which will be recovered by remediation is proposed to be used for development of the reclaimed legacy waste dumpsite as recreational park/facility (for site development work/ profiling). The bio-earth and C&D material recovered will be subjected to bi-weekly sampling and conform to the parameters mentioned in Schedule II of SWM Rules 2016 before using the material. Considering the same, there won't be any leachate generation using this material. There won't be any capping done and hence the question of erosion etc. doesn't arise.

**Salient parameters for opting the Bio-mining – reclamation/recovery of land.**

1. Based on the assessment from the chemical analysis report from the M/s. Polluchem, all the heavy metals are within the permissible limits as prescribed by the regulatory authorities Soil is free of contamination viz., heavy metals, chemical and other toxic substances.
2. Land recovery, increase in value of land and available for public use/setting of SWM facility with immediate effect. An area of 1.25 acres will be reclaimed through bio-mining
3. Adequate downstream linkages for the management/disposal waste viz., Bio-earth and C&D waste will be utilized for development of the reclaimed legacy dumpsite as recreational park/facility, recyclables will be sold to the authorized recyclers & will be collected from the project site and RDF will be sent to Cement industries for co-processing viz., as supplement to the conventional fuel.
4. By products/aggregates generated from the process can be used as alternative construction material (after processing), fuel and recyclables.

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5. The Solid Waste Management Rules, 2016 and several National Green Tribunal (NGT) directives have mandated that urban local bodies opt for bio-mining over capping.

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# 8 TECHNICAL DESCRIPTION OF THE SELECTED OPTION

## 8.1 METHODOLOGY

The legacy waste dumpsite reclamation through bio-mining with recovery of land involves Phase 1: stabilization, Phase 2: sorting & segregation and Phase 3: disposal & utilization

The type of machinery, capacity and type of screens to stabilize of the legacy waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) will depend on the physical site conditions including quantity & characteristics of legacy waste and utilization of the aggregates/by-products/recovered material.

The type machinery available for the bio mining are as follows:

1. Stationary screening machinery and
2. Mobile/compact machinery.




### 8.1.1 STATIONARY SCREENING MACHINERY

A Stationary trommel is a specialized piece of equipment used in legacy waste bioremediation processes to separate and classify solid waste materials. It is designed to efficiently screen and sort different components of the waste based on size and other characteristics. Technical description of a Stationary Trommel used in legacy waste bioremediation are as follows:

- ✓ Structure: The Stationary trommel consists of a frame made of steel or other durable materials. It is designed to withstand the harsh conditions of waste treatment facilities. The frame supports a cylindrical drum that is inclined at an angle for optimal material flow.
- ✓ Drum: The drum is the main component of the Stationary Trommel and is typically made of perforated metal or mesh. It is cylindrical in shape and rotates on its axis using a motorized drive system. The drum's 3- 5 mtr diameter and 10 mtr length can vary depending on the specific requirements of the waste treatment process.
- ✓ Motor and Drive System: The Stationary Trommel is equipped with a motor and drive system that powers the rotation of the drum. The motor is typically electrically powered


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and is connected to the drum through a gearbox or direct drive mechanism. The rotational speed of the drum can be adjusted to optimize the screening process.

- ✓ Inlet and Outlet: The Stationary Trommel has an inlet where the legacy waste is fed into the drum for processing. The waste material enters the drum at one end, typically assisted by a conveyor or loader. The screened waste material is discharged from the opposite end of the drum through an outlet.
- ✓ Screening Mechanism: As the drum rotates, the legacy waste inside it is subjected to a combination of tumbling and rolling actions. The perforated drum allows smaller-sized particles and materials to pass through, while larger items such as bulky waste, debris, and contaminants are retained inside the drum. The drum's perforation size can be customized to achieve the desired separation efficiency.
- ✓ Waste Sorting: The Stationary Trommel facilitates the separation of different components within the legacy waste. It effectively segregates organic waste, inert materials, recyclables, and other categories based on their size and physical properties. This sorting process



prepares the waste for further treatment or disposal.

Source: DCC Infra., Gurugram Site

Salient Features of Stationary Screening Machinery:

- Land requirement high for setting of machinery and processing area.
- Erection, Installation and Commissioning is time consuming
- Cost Intensive – CAPEX & OPEX high

***Figure 8Stationary Trommel Machine***

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- Electrical Power Intensive and Consumption is high
- Breakdown of the Machinery is high, onsite technicians should be available.
- Manpower – skilled & unskilled Intensive
- Suitable for quantity more than 2,00,000 ton of legacy waste.
- Less suitability for reuse of the machinery/screenings for more than one site/location.

### 8.1.2 MOBILE/COMPACT SCREENING MACHINERY

The Mobile Trommel is a technical apparatus utilized in legacy waste bioremediation processes. Its primary function is to separate and sort various types of waste materials, such as solid waste and organic matter, for effective bioremediation.

**Structure:** The trommel consists of a cylindrical drum, typically made of heavy-duty metal, which is inclined at a slight angle. The drum is supported by a framework and set in motion by a motor or engine, causing it to rotate slowly. The rotation of the drum allows the waste materials to be fed into the trommel at one end, while simultaneously moving the materials along its length. Large screening area (9.5 sq m). Helps in good quality segregation & high productivity.

**Screening Mechanism:**The Mobile Trommel incorporates various mechanical features to facilitate waste separation. As the waste enters the drum, it encounters a series of screens or perforations arranged along the length of the drum. These screens have different mesh sizes, which allow for the separation of different-sized particles. The smaller particles, such as sand or fine soil, pass through the screens and fall through openings at the bottom of the trommel, while larger materials, such as plastics or larger debris, are retained and carried along by the rotation of the drum.

**Separation System:** Additionally, the Mobile Trommel may be equipped with paddles or lifters mounted inside the drum. These paddles help to agitate and tumble the waste materials, assisting in the separation process by ensuring proper contact between the waste and the screens. They also help to break up clumps or aggregates, aiding in the release of trapped organic matter. Four different screen inclination angles for operations between 20°-35° are available for selection provides flexibility.

**Treatment Process:**In the context of legacy waste bioremediation, the Mobile Trommel plays a crucial role in preparing the waste for subsequent treatment steps. By separating the waste into different fractions based on particle size, it allows for targeted bioremediation processes. For

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example, the fine fraction may be subjected to aerobic or anaerobic composting, while the larger fraction can undergo mechanical or physical treatments.

**Transport:** Quick and easy folding of conveyor helps in quick setup time.

**Discharge height:** Wider conveyor and higher discharge heights help in making bigger stockpile and eliminates the frequent loader usages.



*Source: Kleemann Mobile Screens (Piranna, Ahamadabad Site)*

*Figure 9 Compact Screening Machinery*

**Salient Features of Mobile/Compact Screening Machinery:**

- Full Mobility: Plants are fully mobile like excavator. Plants can be moved across the most difficult of surfaces and terrain and can accommodate the most inaccessible locations.
- Quick Set up time: Track-Mobile plants can normally be set-up within 1 hour, as it normally does not require additional conveyors, feed hopper to link separate machines, thus increasing machine utilization.
- Versatility: Track-Mobile plants can be operated independently or in combination of two or three stage screening depending upon user requirements.
- No Civil works required: Plants do not require any civil works, can be erected & shifted quickly. Thus, offer quicker return on investment.
- Manpower requirement is less.

## 8.2 SELECTION OF MACHINERIES

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining –

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reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by- products as per the requirements of the utilization/forward linkage.

Based on the detailed assessment of the selection parameters listed above, the site conditions, legacy waste characteristics, statutory requirements etc, mobile / compact screening shall be the optimum screening machinery for the Iritty Dumpsite. The 1254.02 tons legacy waste can be remediated within the stipulated time by NGT i.e. 31st March 2024

**Salient parameters for opting the Mobile/Compact screeners.**

1. Sorting/segregation of the stabilized legacy waste of 2023 m³/ 1254.02 Tons within the stipulated timeline of 31st March 2024.
2. The remediation process will be guided by National, State Regulations & EIA/EMP in line with KSWMP ESMF.
3. Salient Features of Mobile/Compact Screening Machinery – details are in the section 8.1.2

## 8.3 SYSTEM REQUIREMENTS

### 8.3.1 CAPACITY SIZING OF MOBILE COMPACT SCREENER

The capacity of the Mobile compact screener is assessed as **100 TPH** considering the physical site conditions including quantity & characteristics of legacy waste and stipulated timeline for 100 % land reclamation by **31st March 2024.** The calculation shown is only indicative and the contractor is required to propose own design and capacity to complete the works in the stipulated time and standards. The details of plant capacity sizing are provided in the table below:

*Table 29 Capacity sizing of Mobile Compact Screener*

| Description | Quantity |
|---|---|
| Quantity of waste (Tons) | 1254.02 |
| Mobilization and site preparation (days) | 45 |
| Weekends & Holidays | 12 |
| Rainy Days | 20 |
| Break downs (Days) | 15 |
| No of days (Dec 2023 - Mar 2024) | 120 |
| Effective processing days | 35 |


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| | |
|---|---|
| Processing per day (Tons) | 400 |
| Capacity of the Plant - Considering working 8 hrs/day | 94 |
| Proposed Capacity of plant TPH | 100 |

### 8.3.2 MACHINERIES & VEHICLES

Detailed assessment of quantity (nos.) of machinery, vehicles, auxiliary items required for effective processing of the legacy waste are provided in the Annexure – E. The summary of machineries and vehicles requirements are provided in the table below:

*Table 30 Machineries & Vehicles*

| S. No. | Description | Quantity(Nos) | Remarks |
|---|---|---|---|
| 1 | Mobile Trommel @ 100TPH | 1 | Detailed Specifications are provided at Annexure –F |
| 2 | Baling Machine @ 50TPD | 1 | |
| 3 | Ballistic Separator @ 30TPH | 1 | |
| 4 | Magnetic Separator | 1 | |
| 5 | Front End Loader @ Bucket Capacity 1Cum | 2 | |
| 6 | Chain Mounted Excavator @ Bucket Capacity 1.1 Cum | 2 | |
| 7 | Weighing bridge - 40 Ton | 1 | |
| 8 | Tipper @ 8Cums | 5 | |
| 9 | Tractor - Trolley shift of Materials | 1 | |
| 10 | Tractor -Trolley Water Tanker | 1 | |
| 12 | Mechanical Sprayer | 2 | |
| 13 | Office - Portable cabin (1 Nos) | 1 | |
| 14 | GPS (5 Nos) & Tracking System (1 Nos) | 5 | |
| 15 | CCTV System (Cameras 5 Nos) | 5 | |
| 16 | Fire Safety System - Fire Extinguisher ABC type 4 Kg/cm2 | 10 | |

***Note: Considering the size of the site, it is required that the contractor liaisons with the Fire Department and deploys a fire tender team at the site during the period of the contract works to manage any fire incident as part of Fire Safety Plan. Alternatively, general SOPs for fire safety detailed herewith are to be followed:***

- ***a) Fire Fighting System including fire hydrant, pressure pumps, 5000 Ltr (min) water storage, adequate hose reel and fire extinguishers to be provided at site.***
- ***b) Alternate source of power (DG)***
- ***c) Manual Fire Alarm System with evacuation plan***
- ***d) Regular check, maintenance of equipment's for firefighting (before initiating work and then at interval of 1 months thereof)***
- ***e) Training to all men. (Before initiating work and then at interval of 3 months thereof).***


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*f) Maintaining fire line while storage of material (RDF). RDF to not exceed 10% of total estimated waste at site at any given time.*

*g) Any other requirement in consultation with local Fire & Rescue Services office.*

## 8.4 OPERATIONS AND MAINTENANCE

### 8.4.1 MANPOWER:

Detailed assessment manpower required for effective processing of the legacy waste are provided in the Annexure – I. The summary of manpower required are provided in the table below:

*Table 31 Manpower details*

| S. No | Manpower | Nos |
|---|---|---|
| 1 | Site In-charge/Head | 1 |
| 2 | Environmental, Socialand Health & Safety (ESHS) Officer | 1 |
| 3 | Security (3 X 8 Hrs) | 3 |
| 4 | Operations Supervisor & Accountant | 2 |
| 5 | Machine Operator, Mechanic & Electrician | 2 |
| 6 | Labors for stone removal | 2 |
| 7 | Labors for spraying Bio culture | 2 |
| 8 | Labors near Screening machinery | 4 |
| 9 | Labors at Baling facility | 2 |
| 10 | Drivers for tipper trucks, excavators, backhoe loaders and tractors | 11 |

### 8.4.2 ELECTRICAL POWER:

*Table 32 Electrical Power details*

| Machineries | Required Electrical Load (KW) | Working Hr. | Total Units (KW-Hr) |
|---|---|---|---|
| Balling Machine | 5 | 4 | 20 |
| Ballistic Separator | 15 | 6 | 90 |
| Magnetic Separator | 5 | 6 | 30 |
| Weigh bridge | 5 | 6 | 30 |
| **Total** | **30** | | **170** |


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### 8.4.3 FUEL/DIESEL FOR VEHICLES:

*Table 33 Fuel/Diesel for Vehicles*

| Description | Liters per Day |
|---|---|
| Fuel - Diesel Mobile Trommel (12 liters/hour) | 96 |

### 8.4.4 WATER REQUIREMENTS:

*Table 34 Water Requirements*

| Description | Liters per Day |
|---|---|
| Water required for workers and other uses. | 5000 Liters Per Day |
| (Source – Municipality water Supply) | |

***Note;** The responsibility of availing necessary power and water connection shall be with the contractor as condition precedent before starting the work.*


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# 9 SCOPE OF DISPOSAL INCLUDING LOCATION OF DISPOSAL FOR RDF, BIO SOILS, C & D WASTE, AND OTHERS AS PER LOCAL DEMANDS

## 9.1 UTILIZATION OF BY PRODUCTS

The details of the utilization of aggregates/by-products screened out by processing of the stabilized legacy waste are provided in the table below.

*Table 35 Utilization RDF, bio soils, C & D waste*

| S.No | Component | Quantity (Cu.m) | Utilization/Linkage/Usage |
|---|---|---|---|
| 1 | Bio earth and C&D Waste | 896.62 | The bio earth and C&D and quantity 896.62 cu.m waste will be utilized for development of the reclaimed legacy waste dumpsite as recreational park/facility |
| 2 | RDF | 317.58 | RDF will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel supplementing the conventional fuel. Currently the indicative nearest location for the RDF disposal is at Dalmia Cements, Trichy which has the necessary infrastructure for co-processing of RDF. |
| 3 | Recyclables & others | 39.81 | Recyclables will be sold to CKCL/recyclers authorized by KSPCB/CPCB. |
| Note: The contractors engaged in biomining will be responsible for ensuring this disposal of Bio Earth, RDF, recyclables, and others. | | | |


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## 10 ESTIMATED PROJECT COST

The details of the estimated cost for bio-mining - recovery of land by remediating legacy waste dumpsite is provided in the table below:

*Table 36 Details of Estimated Project Cost*

| Estimate for Dumpsite remediaion considering Forward Linkage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Activity** | **Details** | **Rate/ m3** | **Cost Index @ 1.35 * A** | **COP @ 1.15 * C** | **Round off (INR)** | **Quantity (m3)** | **Amount (Rs)** |
| | | | **A** | **B** | **D** | | | |
| 1 | Remediation/ Biomining | Rate adopted from Calculation from Suchitwa Mission (DSR 2018 including baling) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 2 | Transportation of RDF | The average distance to cement factories works out to be 400 km. The rate of transportation of of RDF can be considered as [redacted]. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 3 | Disposal of recyclable | Considering that the recyclable will be sold at rate of [redacted] per m3 of recyclable, disposal cost can be around [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 4 | Disposal of Inert | Considering the disposal cost of [redacted] per m3 (market rate) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 5 | Disposal of Compost / Soil enricher | Considering the disposal cost of [redacted] per m3 (market rate) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| | | | | | | | | [redacted] |
| | **Environmental & Social Safeguard estimated amount for the implementation and monitoring** | | | | | | | [redacted] |
| | **Grand Total** | | | | | | | [redacted] |

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| | |
|---|---|
| | The above rates are for each line item identified to be quoted by the bidders for various activities. [redacted] |
| NOTE | |
| 1 | [redacted] |
| 2 | [redacted] |
| 3 | [redacted] |
| 4 | The estimate is based on the information available. The actual cost may vary from site to site based on results of dumpsite investigations report and contractors forward linkages |

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## 10.1 REVENUE FROM THE PROJECT

The anticipated sources of revenue from the processing of the legacy waste dumpsite viz., by sale Bio earth & C&D waste, organic compost, RDF and recyclables. But due to the following reasons mentioned below no revenue from the project is considered

- Bio earth & C&D waste will be utilized within the remediated dumpsite as filler material for development of recreational park.
- RDF is utilized as fuel (co – processing) in the cement industries, presently most cement industries are only accepting the RDF at no cost whereas transportation cost is required to be borne by the contractor sending the RDF to the cement factory/ WtE facility.
- The uncertainty of quantity and quality of the recyclables from legacy dumpsite due to burnt or crushed or disintegrated, rusted and additional money is required for cleaning of the recyclables for saleable.

## 10.2 FUNDING FOR PROJECT

The estimated cost of Rs. [redacted] /- for the project Dumpsite Remediation which works to Rs. [redacted] /- per $m^3$. The sources and funding pattern is given below:

*Table 37 Funding for the project*

| Item | External (70%) Rs. | State Govt.(30%) Rs. | Total cost Rs |
|---|---|---|---|
| Remediation of Legacy waste dumpsite | [redacted] | [redacted] | [redacted] |


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# 11 PROJECT IMPLEMENTATION PLAN

## 11.1 PROPOSED OPERATIONAL PLAN

The bioremediation of Irrity dumpsite will be done with the land recovery and will be executed through an outsourcing model. The proposed operational plan is provided at the Annexure - I

## 11.2 TIMELINE

In compliance with the National Green Tribunal (NGT) orders, it is mandatory to remediate all dumpsites in Kerala by March 2024. To ensure timely completion and compliance with the deadline, timeline for the implementation of project is provided below.

| S No | Description | Indicative Time frame |
|---|---|---|
| 1 | Start date | 01/12/2023 |
| 2 | End date | 31/03/2024 |



## 11.3 CONTRACT MODEL

**Execution Method:**

- Item Rate Contract and disposal/Management of by-products/aggregates with land recovery and redevelopment of the site with inert/ soil enricher. The work shall be carried out in compliance with SWM Rules 2016 and CPCB Guidelines for the disposal of legacy waste 2019.

**Working Model:**

- 100% work to outsourced to selected private contractor
- TSC will assess the quantity of waste and the ULB will hand over the land for setting up the plant to the Contractor.
- Cost of Electricity connection to be provided by ULB for the plant.
- Electricity charges for the usage of the plant to be paid by contractor
- Contractor is responsible for disposal of RDF, recyclables, and aggregates


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## 12 BENEFITS OF THE PROJECT

Remediation of legacy waste dumpsite in the Iritty leads to the following anticipated benefits:

- **Reclamation of Land**: An area of 0.11 acres will be reclaimed and will be developed into a recreational park for public use. A contamination assessment is to be carried out before any public use project is taken up at the location.
- **Environmental Protection**: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By cleaning up contaminated sites, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity. The project shall arrest GHG emissions from the legacy dumpsite.
- **Health Improvement**: Remediation projects reduce these risks, leading to improved public health outcomes and a reduction in waterborne and airborne diseases.
- **Enhanced Water Quality**: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to the safe drinking water.
- **Aesthetic and Social Benefits**: Remediation of legacy waste dumpsite can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents. Uncontrolled waste dumping will be stopped.
- **Operational & Life cycle Aspects**

  Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through bio-mining process.
- **Employment**

  During remediation& post- remediation period, requirement of un-skilled labor will be fulfilled by s local sourcing.

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## 13 CONCLUSION

- The activities of the bio-mining will be commenced from Dec 2023 to Mar 2024. An area of 0.11 acres will be reclaimed and will be developed into a recreational park for public use but it is not finalized so it can be used as SWM processing facilities after contamination assessment.
- Through the process of bio mining the dumpsite, complete land reclamation and recovery, while prioritizing environmental safeguards. This means that the land will be reclaimed and put to use.
- Considering site conditions and quantum, screening of the 2023 $m^3$ of legacy waste, mobile / compact screening machinery will be preferred.
- Favorable site conditions for bio-mining:
    1. Optimum width of the road is available for movement of the vehicles.
    2. Electrical power infrastructure viz., power lines & electrical transformer is available adjacent to the boundary of the dumpsite.
    3. The borewell water source is available in the dumpsite.
    4. At the dumpsite plot, a vacant land parcel of approx. 0.20 acres is available for the installation of auxiliary infrastructures, supporting conditions movement of processing machinery and vehicles.
- The project activity requires to obtained "Site Authorization, Consent to Establish and Consent to Operate" from KSPCB
- By-products utilization/forward linkages/Usage
    1. The bio earth & C&D quantity of 991.32 $m^3$&455.20 $m^3$respectively is proposed to be utilized after testing for the contamination for development of the reclaimed land as recreational park/facility. The contraction shall level the site in consultation with the PIU/TSC/DPMU.
    2. Refused derived fuel (RDF) of 512.35 $m^3$ will be to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the processes. The indicative location of cement plant is Dalmia Cements, Trichy.
    3. Recyclables of 64.23 $m^3$ will be sold to CKCL /Private recyclers authorized by KSPCB/CPCB

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- The implementation/execution of the project activities shall be conforming to SWM Rules 2016, NGT orders, KSPCB norms, CPCB guidelines and KSWMP ESMF and other regulatory rules & norms.
- Environmental & Social safeguards:
    1. The project attracts E2 Environmental category based on the Environmental Screening and Exclusions mentioned in the Environmental and Social Framework Guidelines.
    2. Site specific Environmental Assessment and Environmental Management Plan has been developed.
    3. The project attracts moderate risk social category based on the social mapping & transect walk to understand the settlements/habitations/establishments etc., and consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.
- Total cost of the project is Rs. [redacted] /- (INR [redacted]). The cost per $m^3$ for processing and disposal of the legacy waste is Rs [redacted] /- per $m^3$.

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## ANNEXURES

*Table 38 List of Annexures*

| Annexures | Description |
|---|---|
| Annexure A | GEOTECHNICAL TEST REPORT |
| Annexure B | ENVIRONMENTAL TEST REPORT |
| Annexure C | PHOTOGRAPHS –SAMPLING |
| Annexure D | VOLUMETRIC ANALYSIS |
| Annexure E | SITE PLAN |
| Annexure F | SURVEY CONTOUR PLAN |
| Annexure G | REQUIREMENT OF VEHICLE & MACHINERY |
| Annexure H | SPECIFICATION OF MACHINERIES & VEHICLES |
| Annexure I | PROPOSED OPERATIONAL PLAN |
| Annexure J | LSGD GUIDELINES FOR REMEDIATION OFLEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION |


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## Annexure-A

# GEOTECHNICAL TEST REPORT

MatterLab

Where Quality Matters

Report Number: **ML/GT/2229/245/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE D OF KSWMP AT ATHITHATTU, IRITTY, KANNUR DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | Project Manager, IPE Global Ltd. |
| Address | : | 2nd Floor, 16/3878-3879, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact Person | : | - |
| Project No | : | GT-337 |
| Project Name | : | Geotechnical examination of dumpsite under package D of KSWMP at Athirathattu, Iritty, Kannur District. |
| Owner | : | KSWMP |
| Project Location | : | Athirathattu, Iritty, Kannur District |
| Tel / Fax No | : | - |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 20-07-2023 | 1st Submission | Dr. Gautham Adapa | |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Dr. Jimmy Thomas | Geotechnical Expert, Consultant, MatterLab | |
| Approved by: | Freddy Soman | General Manager, MatterLab | |

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2 SCOPE OF WORK ..... 3

3 OBSERVATIONS FROM SITE VISIT ..... 3

4 GEOTECHNICAL INVESTIGATIONS ..... 4

5 LABORATORY ANALYSIS ..... 6

6 SUMMARY ..... 7

## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results

# 1 INTRODUCTION

Matter Material Testing and Research Laboratory Pvt. Ltd has been set-up as a result of increased demand locally from various industries for a multidisciplinary testing, materials consultancy & investigation facility in alignment with global standards and technology advancements. MatterLab is an independent professional and technical services provider to all who are concerned with quality and performance of materials & products.

IPE Global Ltd. which provides technical support consultancy services to the Urban local bodies in different municipalities for the Kerala State Waste Management Project (KSWMP) has entrusted the geotechnical investigative works as part of their DPR study for the remediation of dumpsite in Athithattu, Iritty, Kannur district to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was bored using a rotary drill. The initial site visit was done on 05th June 2023. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 27th June 2023 and was completed on 28th June 2023. Standard Penetration test (SPT) was conducted within the borehole as required. Representative and undisturbed soil samples were collected to conduct relevant laboratory tests to acquire the necessary parameters. This report presents results of the geotechnical investigation of the ground encountered after drilling through the waste at the dumpsite.

# 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil samples and performing necessary laboratory tests on the collected samples to obtain the desired parameters of the ground profile.
- Preparation of report with laboratory test results.

# 3 OBSERVATIONS FROM SITE VISIT

Matterlab has deputed a team from our geotechnical department along with Mr. Kamal Kishore Jha and Mr. Mahesh an environmental expert of IPE Global during the first week of

June 2023, in order to collect the information regarding the site prior to mobilising the equipment for drilling.

The dumpsite is situated well away from any human habitation. The site at this location is a sloping terrain.



**Figure 1** : Location of the borehole drilled at the dumpsite.

## 4 GEOTECHNICAL INVESTIGATIONS

### 4.1 Rotary drilling

Rotary drilling technique was adopted for advancing and clearing out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste at the dumpsite.

### 4.2 Drilling equipment

Mechanical rigs of rotary drilling machine were used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The borehole of 150mm diameter was formed using a drag bit (Soil Cutter) in soil. The drag

bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by drilling mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

### 4.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as representative samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log the commencement and completion date,

location of borehole, elevation of top and bottom of boring, ground water table, boundaries of each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelog is attached as **Appendix-I.**

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant Standard Codes. A summary of laboratory tests carried out is shown below in **Table 1** and the complete results of laboratory testing are presented in **Appendix II**.

**Table 1: Details of various laboratory tests and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 1 | Soil | Grain-Size Analysis | IS: 2720(Part-4)-1985 |
| 2 | | Atterberg's Limit | IS: 2720(Part-5)-1976 |
| 3 | | MDD\OMC(Light Compaction) | IS:2720(Part-7)-1980 |
| 4 | | Moisture Content | IS 2720(Part 2)-1973 |
| 5 | | Bulk Density | BS:1377-(Part-2)-1990 |
| 6 | | Permeability | IS :2720 (Part-17)-1986 |



(a)



(b)



(c)



(d)

**Figure 2 :** Laboratory tests performed at MatterLab.

## 6 SUMMARY

The geotechnical examination on the soil samples collected after boring through the waste at the dumpsite at Athirathattu, Iritty, Kannur was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a single borehole was bored using a rotary drilling method. The maximum depth of investigation was 9.0 m (4.5 m in waste and 4.5 m in the ground). SPT and collection of undisturbed samples were carried out at regular intervals. Various laboratory tests were carried out on the SPT and undisturbed soil samples.

Based on the investigations carried out, it was observed that the original ground below the waste comprises of a silty sand with gravel layer until 5.5 m followed by a sandy silt layer having an average SPT N-value of 26 underlain by a sandy clay with gravel layer with an average N-value of refusal until the depth of termination at 9.0 m below the top of waste. The tests mentioned in the above table were performed on the samples in the laboratory following the respective codes to obtain the necessary parameters. The laboratory results on samples obtained from the site are appended in **Appendix II**.

# APPENDIX-I

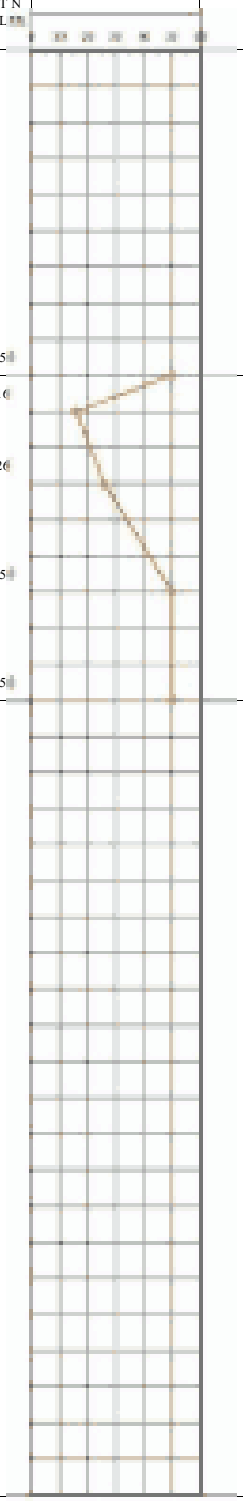
# BORELOGS

Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT** | **: Geotechnical Investigation at Dumpsite in Athithattu, Iritty** | **SHEET NO.** | **: 1 of 1`** | **START DATE** | **: 27/06/2023** |
| **CLIENT** | **: Project Manager, IPE Global.** | **BORE DIAMETER (mm)** | **: 150** | **END DATE** | **: 28/06/2023** |
| **Proposed Structure** | **: Dumpsite remediation** | **BORING TYPE** | **: Rotary** | **REDUCED LEVEL (m)** | **: -** |
| **LOCATION** | **: Athithattu, Iritty, Kannur District.** | **TERMINATION DEPTH (m)** | **: 9.0** | **EASTING (m)** | **: -** |
| **BOREHOLE NO.** | **: BH-01** | **WATER LEVEL** | **:** | **NORTHING (m)** | **: -** |

| DEPTH m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM N1 | BLOW COUNT/15CM N2 | BLOW COUNT/15CM N3 | SPT N VAL | DEPTH V/S N VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.5 | | Plastic waste deposit | 4.5 | 4.5 | SPT-1 | 50 | > | > | >5 | | Balance-28cm |
| 5.5 | | Silty sand with gravel | 1.0 | 5.0 | SPT-2 | 7 | 8 | 8 | 16 | | |
| | | | | 5.5 | UDS-1 | | | | | | |
| 7.0 | | Sandy silt | 1.5 | 6.0 | SPT-3 | 8 | 12 | 14 | 26 | | |
| | | | | 6.5 | UDS-2 | | | | | | |
| | | | | 7.0 | UDS-3 | | | | | | |
| 9.0 | | Sandy clay with gravel | 2.0 | 7.5 | SPT-4 | 50 | > | > | >5 | | Balance-29cm |
| | | | | 8.0 | UDS-4 | | | | | | |
| | | | | 8.5 | UDS-5 | | | | | | |
| | | | | 9.0 | SPT-5 | 50 | > | > | >5 | | Balance-30cm |
| | | **Bore hole terminated at the depth of 9.00 m below top of waste (4.5 m below original ground)** | | | | | | | | | |



Abbreviations
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
CR- Core Recovery, RQD- Rock Quality Designation

Sd/-
Site Supervisor

# APPENDIX-II

# LABORATORY TEST RESULTS

# SUMMARY OF LABORATORY TEST RESULTS

**Report Number : ML23/R-02363 Report Date:14/07/2023**

**Project : Geotechnical Investigation at Dumpsite in Athithattu, Iritty**

**Borehole ID : BH-01**

| N value | MatterLab ref | Depth (m) | Type of sample (SPT/UDS/RC) | Soil description | IS Classification | Atterberg Limit | | | Grain size distribution | | | | | | | Water content (w), % | Bulk Density, gm/cc | Permeability, cm/s | Maximum dry density, gm/cc | Optimum moisture content, % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit,% | Plastic Limit,% | Plasticity Index | Coarse Gravel,% | Fine Gravel,% | Coarse Sand,% | Medium Sand,% | Fine Sand,% | Silt,% | Clay,% | | | | | |
| 16 | ML23/W-02363/S1 | 5 0 | SPT | Sandy silt of high plasticity with gravel | MH | 61 | 31 | 30 | | 21 | 15 | 4 | 3 | 29 | 28 | | | | | |
| | ML23/W-02363/S2 | 5 5 | UDS | | | | | | | | | | | | | 38 | 1 82 | | | |
| 26 | ML23/W-02363/S3 | 6 0 | SPT | Silt of high plasticity with sand | MH | 72 | 35 | 37 | | 8 | 4 | 4 | 4 | 48 | 32 | | | | | |
| | ML23/W-02363/S4 | 6 5 | UDS | | | | | | | | | | | | | 23 | 6 50 | | | |
| | ML23/W-02363/S5 | 7 0 | UDS | | | | | | | | | | | | | | | 9 20 E-05 | 1 61 | 22 |
| >50 | ML23/W-02363/S6 | 7 5 | SPT | Gravelly clay of high plasticity with sand | CH | 70 | 32 | 38 | | 21 | 7 | 6 | 4 | 33 | 29 | | | | | |
| | ML23/W-02363/S7 | 8 0 | UDS | | | | | | | | | | | | | 33 | 2 14 | | | |
| | ML23/W-02363/S8 | 8 5 | UDS | | | | | | | | | | | | | | | | | |

MatterLab
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Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur Nada (PO) Thiruvannur,
Kozhikode, Kerala, 673029.

## Water Content of Soil Test Report

Report No: ML23/N-02363/01
Issue No: 1.0
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 16/2878 - 3879, Kavarati Building, Karayannor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Athithattu, Iritty |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Athithattu, Iritty, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS), BH 01, Depth 5.50m |
| Work Order ID: | ML23/N-02363 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/N-02363/03 | Source*: | BH 01, Depth 5.50m |
| Date Sampled: | 28/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Athithattu, Iritty, Kannur District | Date Tested: | 06/07/2023 - 07/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS), BH 01, Depth 5.50m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS), BH 01, Depth 5.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 38 | - |

For and on behalf of Matter Lab

**Comments**

*Information provided by client

All work and services carried out by Matter Lab are subject to, and conducted in accordance with, standard terms and conditions of MatterLab. This document may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. These results relate only to the samples tested.



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MatterLab
Where Quality Matters

Matter Material Testing & Research Laboratory (P) Ltd.
Main Bypass Road, Thiruvannur Kada (PO) Thiruvannur,
Kozhikode, Kerala, 673622

## Water Content of Soil Test Report

Report No: ML23/N-02363/2
Issue No.: 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 16/2878 - 2879, Kaveraat Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Alinthattu, Ithy |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Alinthattu, Ithy, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS), BH 01, Depth 6.50m |
| Work Order ID: | ML23/N-02363 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/N-02363/54 | Source*: | BH 01, Depth 6.50m |
| Date Sampled: | 28/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Alinthattu, Ithy, Kannur District | Date Tested : | 06/07/2023 - 07/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS), BH 01, Depth 6.50m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS), BH 01, Depth 6.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 23 | - |

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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Kozhikode, Kerala, 673625

TC-16745

## Water Content of Soil Test Report

Report No: ML23/IR-023823
Issue No.: 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 1603/8 - 3879, Kavarati Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Alithattu, Iritty |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Alithattu, Iritty, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS), BH 01, Depth 8.00m |
| Work Order ID: | ML23/W-02363 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02363/ST | Source*: | BH 01, Depth 8.00m |
| Date Sampled: | 29/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Alithattu, Iritty, Kannur District | Date Tested : | 06/07/2023 - 07/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS), BH 01, Depth 8.00m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS), BH 01, Depth 8.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 33 | - |

For and on behalf of Matter Lab

**Comments**

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Kozhikode, Kerala, 673029.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23R-023603A
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 18/3878 - 3879, Kavenatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Athithattu, Iritty |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Athithattu, Iritty, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 5.00m |
| Work Order ID: | ML23W-02363 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02363/01 | Source*: | BH 01, Depth 5.00m |
| Date Sampled: | 26/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Athithattu, Iritty, Kannur District | Date Tested : | 06/07/2023 - 09/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 5.00m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 5.00m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.5 Mechanical Method | Liquid Limit,% | 61 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 31 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 30 | - |

For and on behalf of MatterLab

**Comments**

* Information provided by client

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Kozhikode, Kerala, 673029.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23R-022863/0
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IFE Global |
| Address: | 2nd Floor, 16/3878 - 3878, Kavenatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Athithattu, Irrity |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Athithattu, Irrity, Kannur District |
| Tel / Email: | - |

ULR-TC787A23800004915F

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 09/07/2023 | Client Sample Ref.*:- | Soil, BH 01, Depth 6.00m |
| Work Order ID: | ML23W-022863 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-022863/03 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 28/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Athithattu, Irrity, Kannur District. | Date Tested : | 09/07/2023 - 09/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 6.00m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 6.00m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.5 Mechanical Method | Liquid Limit,% | 72 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 35 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 37 | - |

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## Comments

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# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23R-02363/W
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| **Client:** | Project Manger, IPE Global |
| **Address:** | 2nd Floor, 15/3879 - 3879, Kavenatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| **Contact:** | - |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Athithattu, Iritty |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Athithattu, Iritty, Kannur District |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 06/07/2023 | **Client Sample Ref.*:** | Soil, BH 01, Depth 7.50m |
| **Work Order ID:** | ML23WW-02363 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23WW-02363/SS | **Source*:** | BH 01, Depth 7.50m |
| **Date Sampled:** | 28/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2131 - 1981 | **Sample Size(kg):** | 5 Approx |
| **Sample Location*:** | Athithattu, Iritty, Kannur District | **Date Tested :** | 06/07/2023 - 09/07/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil, BH 01, Depth 7.50m |
| **Tested By:** | MV | **Client Sample Desc*:** | Soil, BH 01, Depth 7.50m |
| **Condition of Soil:** | Natural | **Period of Soaking:** | 24 Hrs |
| **Test Location:** | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3 Mechanical Method | Liquid Limit,% | 70 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 32 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 38 | - |

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Kozhikode, Kerala, 673029.

TC-19199

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/R-0236/07
Issue No: 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 16/3678 - 3679, Kavarratt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Athithattu, Iritty |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Athithattu, Iritty, Kannur District |
| Tel / Email: | - |

## Sample Details

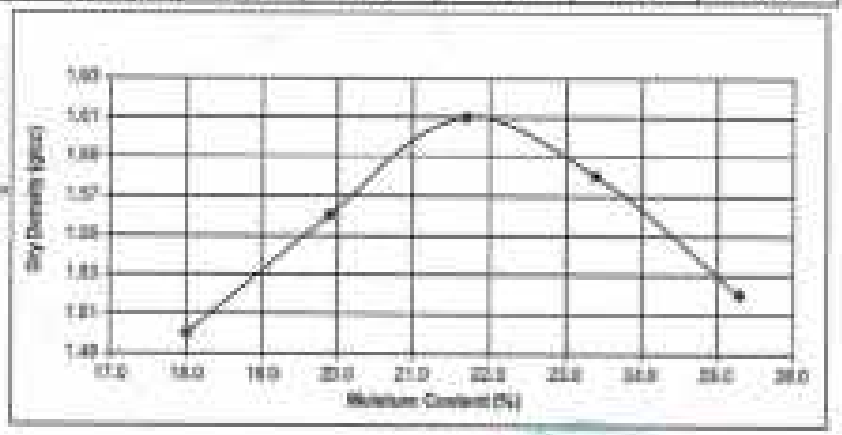
| | | | |
|---|---|---|---|
| Received Date: | 09/07/2023 | Client Sample Ref.*): | Soil (UDS), BH 01, Depth 5.50m-6.50m |
| Work Order ID: | ML23/W-02363 | Sample Submitted By.*): | Geotechnical Division |
| Sample ID: | ML23/W-02363/02,535&536 | Source*): | BH 01, Depth 5.50m - 6.50m |
| Date Sampled: | 28/06/2023 | Sampled By*): | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 6 Approx |
| Sample Location*): | Athithattu, Iritty, Kannur District | Date Tested : | 07/07/2023 - 09/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS), BH 01, Depth 5.50m-6.50m |
| Tested By: | DK/MV | Client Sample Desc.: | Soil (UDS), BH 01, Depth 5.50m-6.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ (cm$^3$) | 998 | | | | |
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4063 | | | | |
| Mass of mould + compacted sample | | W (g) | 5829 | 5929 | 6023 | 6009 | 5955 |
| Mass of sample | | | 1766 | 1866 | 1960 | 1946 | 1892 |
| Wet density | $(W-W_m)/V_m$ | $\rho_b$ (Mg/m$^3$) | 1.77 | 1.87 | 1.96 | 1.95 | 1.90 |
| Mass of wet sample | | $W_w$ (g) | 508.2 | 604.2 | 687.8 | 682.4 | 671.6 |
| Mass of dry sample | | $W_d$ (g) | 430.7 | 420.5 | 400.8 | 382.3 | 376.4 |
| Moisture content | $((W_w-W_d)/W_d)\times100$ | m (%) | 18.0 | 19.9 | 21.7 | 23.4 | 25.3 |
| Dry density | $\rho_b/(1+m/100)$ | $\rho_d$ (Mg/m$^3$) | 1.50 | 1.56 | 1.61 | 1.58 | 1.52 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc: | 1.61 |
| Optimum moisture content, % | 22 |
| Material retained on 20mm % | 1 |
| Sample used | Single |
| Size of mould | 1000cm$^3$ |
| Weight of rammer | 2.6 kg |




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Comments

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Thiruvannur, Kozhikode, Kerala, 673029

# Permeability of Soil Test Report

Report No: ML23R-028939
Issue No: 1
Report Date: 09/07/2023

| | |
|---|---|
| Client: | Project Manger, IRE Global |
| Address: | 2nd Floor, 16/3678 - 3679, Ravenatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Athithattu, Iritty |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Athithattu, Iritty, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS), BH 01, Depth 5.50m - 6.00m |
| Work Order ID: | ML23W-03383 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-03383/02.05858 | Source*: | BH 01, Depth 5.50m - 6.30m |
| Date Sampled: | 28/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Athithattu, Iritty, Kannur District | Date Tested : | 07/07/2023 - 08/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS), BH 01, Depth 5.50m - 6.00m |
| Tested By: | DK/GK | Client Sample Desc.*: | Soil (UDS), BH 01, Depth 5.50m - 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 6.20 E-05 | - |

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**Comments**

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Thiruvennur, Kozhikode, Kerala, 673039

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-023830
Issue No : 1
Report Date: 19/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 19/3678 - 3679, Kavarati Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical investigation at Ourspalla in Alhithattu, Iritty |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Alhithattu, Iritty, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS), BH 01, Depth 5.50m |
| Work Order ID: | ML23/W-02383 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02383/02 | Source*: | BH 01, Depth 5.50m |
| Date Sampled: | 29/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Alhithattu, Iritty, Kannur District | Date Tested : | 06/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS), BH 01, Depth 5.50m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS), BH 01, Depth 5.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 1.82 | - |

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**Comments**

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Thiruvannur, Kozhikode, Kerala, 673028

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/6336/16
Issue No: 1
Report Date:18/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 19/3878 - 3879, Kesavadi Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala 628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Athithattu, Irrity |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Athithattu, Irrity, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS), BH 01, Depth 6.00m |
| Work Order ID: | ML23/W-02393 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02393/04 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 29/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx. |
| Sample Location: | Athithattu, Irrity, Kannur District | Date Tested : | 06/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS), BH 01, Depth 6.00m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS), BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 2.35 | - |

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Thiruvannur, Kozhikode, Kerala, 673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/W-02363/1/1
Issue No: 1
Report Date: 19/07/2023

| | |
|---|---|
| Client: | Project Manger, PE Global |
| Address: | 2nd Floor, 1603/9 - 3979, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Gunpalla in Alhithadu, Iritty |
| Consultant: | - |
| Owner: | KSWIMP |
| Contractor: | - |
| Project Location: | Alhithadu, Iritty, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*): | Soil (UDS), BH 01, Depth 8.00m |
| Work Order ID: | ML23/W-02363 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02363/07 | Source*): | BH 01, Depth 8.00m |
| Date Sampled: | 05/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Alhithadu, Iritty, Kannur District | Date Tested : | 06/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS), BH 01, Depth 8.00m |
| Tested By: | GK/DK | Client Sample Desc.*): | Soil (UDS), BH 01, Depth 8.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2) 1990 | Bulk Density of Soil, g/ml | 2.14 | - |

SREELESH TV

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Thiruvannur, Kozhikode, Kerala, 673029

# UNCONFINED COMPRESSIVE STRENGTH(UCS) OF SOIL TEST REPORT

Report No: ML23/R-023832
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IRE Global |
| Address: | 2nd Floor, 19/3878 - 3879, Kavarati Building, Ramapuram Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Olumpalle in Alinthattu, Irity |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Alinthattu, Irity, Kannur District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS), BH 01, Depth 5.50m |
| Work Order ID: | ML23/W-03383 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-023832[2] | Source: | BH 01, Depth 5.50m |
| Date Sampled: | 29/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Alinthattu, Irity, Kannur District. | Date Tested : | 06/07/2023 - 07/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Lab Sample Desc.: | Soil (UDS), BH 01, Depth 5.50m |
| Tested By: | GK/DK | Client Sample Desc.: | Soil (UDS), BH 01, Depth 5.50m |

## Test Results

Method: IS: 2720 (Part 10)-1991 (RA2015)




| | |
|---|---|
| Unconfined Compressive Strength (kPa) | 206 |
| Specimen Height (mm) | 140 |
| Specimen Diameter | 70 |
| Specimen Density(g/cc) | 1.82 |
| Moisture Content(%) | 38 |
| Type of specimen | Undisturbed |
| Specimen Condition | - |

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673029

## UNCONFINED COMPRESSIVE STRENGTH(UCS) OF SOIL TEST REPORT

Report No: ML23/R-02363/12
Issue No: 1
Report Date: 09/07/2023

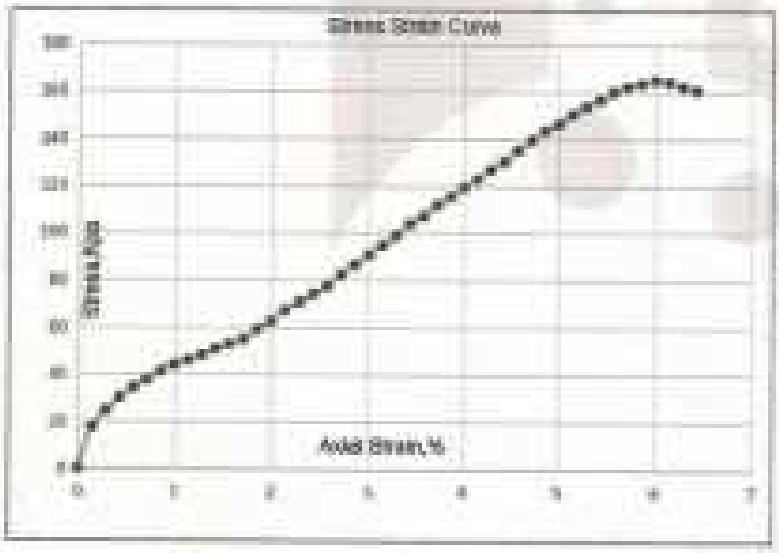
| | |
|---|---|
| Client: | Project Manger, SPE Global |
| Address: | 2nd Floor, 16/3878 - 3879, Kavanatt Building, Kanapparoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Athithattu, Ithly |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Athithattu, Ithly, Kannur District |
| Tel / Email: | - |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*): | Soil (UDS), BH 01, Depth 8.00m |
| Work Order ID: | ML23/W-02363 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02363/07 | Source: | BH 01, Depth 8.00m |
| Date Sampled: | 28/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Athithattu, Ithly, Kannur District | Date Tested : | 06/07/2023 - 07/07/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Lab Sample Desc.: | Soil (UDS), BH 01, Depth 8.00m |
| Tested By: | GK/DK | Client Sample Desc.: | Soil (UDS), BH 01, Depth 8.00m |

### Test Results

Method: IS: 2720 (Part 10)-1991 (RA2013)




| | |
|---|---|
| Unconfined Compressive Strength(kPa) | 165 |
| Specimen Height (mm) | 140 |
| Specimen Dia(mm) | 70 |
| Specimen Density(g/cc) | 2.14 |
| Moisture Content(%) | 33 |
| Type of specimen | Undisturbed |
| Specimen Condition | - |

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673029

## Hydrometer Analysis Test Report

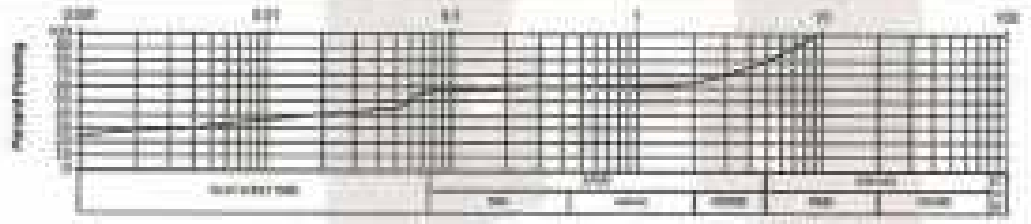
| | | | |
|---|---|---|---|
| Client: | Project Manger, AHL Global | Consultant: | - |
| Address: | 2nd Floor, 1/0/879 - 3/79, Kaveyodi Building, Kanapparam Village, Kakkanad, Ernakulam, Kerala-682030 | Owner: | KSWMP |
| Contact: | - | Contractor: | - |
| Project No: | - | Project Location: | Adhikattu, Vithy, Kannur District |
| Project Name: | Geotechnical Investigation at Durrpalla in Adhikattu, Vithy | Tell / Email: | |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 30/07/2023 | Client Sample Ref.*: | Bdd, BH 01, Depth: 6.00m |
| Work Order ID: | ML23/W-02903 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02903/01 | Source*: | BH 01, Depth: 6.00m |
| Date Sampled: | 26/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(Kg): | 5 Approx |
| Sample Location*: | Adhikattu, Vithy, Kannur District | Date Tested: | 27/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Bdd, BH 01, Depth: 6.00m |
| Tested By: | ??? | Client Sample Desc.*: | Bdd, BH 01, Depth: 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

### Particle Size Distribution

Method: IS: 2720 (Part 4)-1985, CI 6.3



Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 0.600 | 100 |
| 4.750 | 74 |
| 2.000 | 64 |
| 0.840 | 61 |
| 0.600 | 57 |
| 0.420 | 52 |
| 0.300 | 48 |
| 0.150 | 38 |
| 0.075 | 27 |
| 0.062 | 25 |
| 0.057 | 23 |
| 0.036 | 21 |
| 0.019 | 20 |
| 0.014 | 18 |
| 0.011 | 16 |
| 0.007 | 14 |
| 0.005 | 12 |
| 0.004 | 10 |
| 0.002 | 8 |
| 0.001 | 3 |

| | |
|---|---|
| Gravel % | 31 |
| Sand % | 22 |
| Silt % | 32 |
| Clay % | 25 |

Engineer T.V
Geo-Civil Laboratory

For and on behalf of MatterLab

Comments:
Information provided by client

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These results relate only to the item(s) tested



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Thiruvannur, Kozhikode, Kerala, 673029

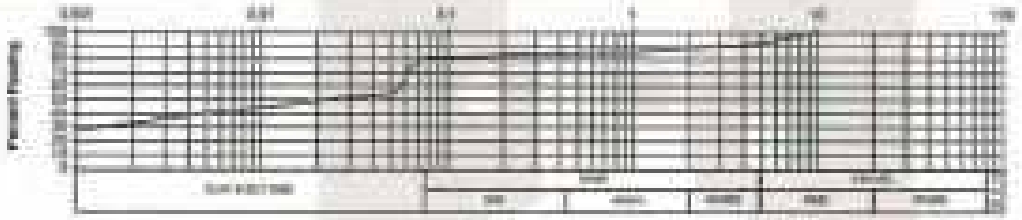
## Hydrometer Analysis Test Report

| | | | |
|---|---|---|---|
| Client: | Project Manager, IPE Global | Consultant: | - |
| Address: | 2nd Floor, 15/3679 - 3679, Kanavath Building, Kanakkanoor Village, Pallikkandi, Ernakulam, Kerala-682030 | Owner: | KSWAP |
| Contact: | - | Contractor: | - |
| Project No: | - | Project Location: | Adhithattu, Ithily, Kannur District |
| Project Name: | Geotechnical Investigation at Dumpsite in Adhithattu, Ithily | Test Details: | |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 6.00m |
| Work Order ID: | ML23W-03263 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-03263/03 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 28/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Shipping: | 5 Approx |
| Sample Location*: | Adhithattu, Ithily, Kannur District | Date Tested: | 07/07/2023 - 09/07/2023 |
| Sample Cert. No: | - | Test Method Variations: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 6.00m |
| Tested By: | BH | Client Sample Desc.*: | Soil, BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4) 1985, Cl.9.5




Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 97 |
| 2.000 | 89 |
| 0.850 | 86 |
| 0.600 | 83 |
| 0.425 | 80 |
| 0.300 | 66 |
| 0.150 | 57 |
| 0.075 | 50 |
| 0.053 | 50 |
| 0.037 | 50 |
| 0.027 | 47 |
| 0.019 | 46 |
| 0.014 | 45 |
| 0.010 | 44 |
| 0.007 | 42 |
| 0.005 | 40 |
| 0.004 | 38 |
| 0.003 | 36 |
| 0.001 | 27 |

| | |
|---|---|
| Gravel % | 8 |
| Sand % | 12 |
| Silt % | 46 |
| Clay % | 34 |

SHEELEEH T.V
Civil Engineer

For and on behalf of MatterLab

**Comments**

Information provided by client.

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*Please refer note 3 on the second page.



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Thiruvannur, Kozhikode, Kerala, 673029

## Hydrometer Analysis Test Report

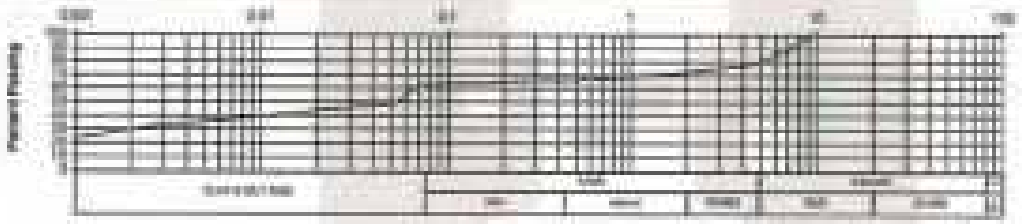
| | | | |
|---|---|---|---|
| Client: | Project Manager, IPR District | Consultant: | - |
| Address: | 2nd Floor, 1503/B - 3870, Kaveriyah Building, Kanayannur Village, Pathanamt, Ernakulam, Kerala-682030 | Owner: | KSWAP |
| Contact: | - | Contractor: | - |
| Project No: | - | Project Location: | Athithattu, Hilly, Kannur District |
| Project Name: | Geotechnical Investigation at Champlode in Athithattu, Hilly | Tel / Email: | |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 06/01/2023 | Client Sample Ref.*: | Bore, BH-01, Depth 7.50m |
| Work Order ID: | ML23/W-02368 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02368/S8 | Source*: | BH-01, Depth 7.50m |
| Date Sampled: | 28/09/2022 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Quantity: | 5 Approx. |
| Sample Location*: | Athithattu, Hilly, Kannur District | Date Tested: | 21/01/2023 - 06/01/2023 |
| Sample Cert. No: | - | Test Method Variations: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH-01, Depth 7.50m |
| Tested By: | Rini | Client Sample Desc.*: | Soil, BH-01, Depth 7.50m |
| Test Location: | MatterLab - Kozhikode | | |

### Particle Size Distribution

Method ID: 2720 (Part 4): 1985, Cl.8.2



Particle size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 78 |
| 2.000 | 72 |
| 0.850 | 68 |
| 0.600 | 67 |
| 0.425 | 66 |
| 0.300 | 65 |
| 0.150 | 64 |
| 0.075 | 62 |
| 0.052 | 49 |
| 0.037 | 47 |
| 0.028 | 45 |
| 0.019 | 43 |
| 0.014 | 41 |
| 0.010 | 39 |
| 0.007 | 37 |
| 0.005 | 35 |
| 0.003 | 33 |
| 0.002 | 30 |
| 0.001 | 23 |

| | |
|---|---|
| Gravel % | 31 |
| Sand % | 17 |
| Silt % | 33 |
| Clay % | 29 |

For and on behalf of MatterLab

### Comments

*Information provided by client

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## Annexure-B

# ENVIRONMENTAL TEST REPORT

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Phone: 0484-2544030, 8281982322, 9747400085, 9747400089, www.poluchem.com, poluchem@gmail.com

TC-6589

ACCREDITED BY NABL, DEPT OF IND.& ANR ISO/IEC 17025 TESTING LABORATORY


## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/142/2023 (ULR NO:TC658923000000000142F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 20/06/2023 |
| | Date of monitoring | 09/06/2023 |
| | Date of sample received | 11/06/2023 |
| | Date of analysis Started | 11/06/2023 |
| | Sample Code | G/F/143/2023 |
| | Sample description | Ambient air –Iritty-Athithattu |
| | Sample Location | Gps Reading : N- 11 °58'04.41"<br>E -75°40'54.066" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 102 µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 48.7 µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 5.4 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 9.8 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | <1 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

The results are related only to the sample submitted for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory

For and on behalf of
POLUCHEM LABORATORIES (P) LTD

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

# POLUCHEM LABORATORIES PVT LTD

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5231/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 20/06/2023 |
| | Date of monitoring | 09/06/2023 |
| | Date of sample received | 11/06/2023 |
| | Date of analysis Started | 11/06/2023 |
| | Sample Code | G/F/5231/2023 |
| | Sample description | Ambient air –Iritty- Athithattu |
| | Sample Location | Gps Reading : N- 11 °58'04.41"<br>E -75°40'54.066" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 µg/m$^3$ | 400 µg/m$^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m$^3$ | 1 µg/m$^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 6 ng/m$^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 20 ng/m$^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m$^3$ | 180 µg/m$^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m$^3$ | 5 µg/m$^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m$^3$ | 1 ng/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

The results are related only to the sample submitted for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory

For and on behalf of
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AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

# POLUCHEM LABORATORIES (P) LTD.

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

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TC-4589

ACCREDITED BY NABL – BEHT, CHINDIA AND NABET AS A GRADE LABORATORY


## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/141/2023 (ULR NO-TC658913000000101411F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 20/06/2023 |
| | Date of monitoring | 09/06/2023 |
| | Date of sample received | 11/06/2023 |
| | Date of analysis Started | 11/06/2023 |
| | Sample Code | G/F/141/2023 |
| | Sample description | Ambient air –Iritty-Athithattu |
| | Sample Location | Gps Reading : N- 11 °58'03.384"<br>E -75°40'53.94" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 76.3 µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 29.6µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 6.3 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 9.7 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | <1 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
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SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

# POLUCHEM LABORATORIES PVT LTD

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Phone : 0484-2544030, 8281982322, 9747400085,www.poluchem.com, poluchem@gmail.com

ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5230/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 20/06/2023 |
| | Date of monitoring | 09/06/2023 |
| | Date of sample received | 11/06/2023 |
| | Date of analysis Started | 11/06/2023 |
| | Sample Code | G/F/5230/2023 |
| | Sample description | Ambient air –Iritty- Athithattu |
| | Sample Location | Gps Reading : N- 11°58'03.384"<br>E -75°40'53.94" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 $\mu g/m^3$ | 400 $\mu g/m^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 $\mu g/m^3$ | 1 $\mu g/m^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 6 $ng/m^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 20 $ng/m^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 $\mu g/m^3$ | 180 $\mu g/m^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 $\mu g/m^3$ | 5 $\mu g/m^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 $ng/m^3$ | 1 $ng/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
| The results are related only to the sample submitted for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory | For and on behalf of<br>POLUCHEM LABORATORIES (P) LTD<br><br>AUTHORIZED SIGNATORY<br>SREEJA RAMESH<br>QUALITY MANAGER<br>POLUCHEM LABORATORIES PVT. LTD. |

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Phone: 0484-2544030, 8281982322, 9747400085, 9747400089, www.poluchem.com, poluchem@gmail.com

TC-6589 — ACCREDITED BY NABL – GOVT. OF INDIA AND ISO/IEC 17025 : 2017 GRADE LABORATORY


**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/SD/5232/2023(ULR NO:TC658923000000005232F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 20/06/2023 |
| | Date of monitoring | 09/06/2023 |
| | Monitoring Location | Iritty- Athithattu<br>GPS Reading : N- 11 °58'04.116"<br>E -75°40'54.509" |
| | Sample Description | Ambient Sound Level |

| HOURLY INTERVAL | | RESULT | HOURLY INTERVAL | RESULT |
|---|---|---|---|---|
| 09.06.2023 | 15.00 Hrs | 62.3 dB (A) | 08.00 Hrs | 64.3 dB (A) |
| 16.00 Hrs | | 58.6 dB (A) | 09.00 Hrs | 65.4dB (A) |
| 17.00 Hrs | | 63.4 dB (A) | 10.00 Hrs | 67.8 dB (A) |
| 18.00 Hrs | | 62.4 dB (A) | 11.00 Hrs | 69.5 dB (A) |
| 19.00 Hrs | | 59.7 dB (A) | 12.00 Hrs | 64.3 dB (A) |
| 20.00 Hrs | | 54.2 dB (A) | 13.00 Hrs | 61.3 dB (A) |
| 21.00 Hrs | | 53.1dB (A) | 14.00 Hrs | 59.8 dB (A) |
| 22.00 Hrs | | 50.1dB (A) | | |
| 23.00 Hrs | | 48.6 dB (A) | | |
| 10.06.2023 | 00.00 Hrs | 50.1 dB (A) | | |
| 01.00 Hrs | | 52.3 dB (A) | | |
| 02.00 Hrs | | 53.2 dB (A) | | |
| 03.00 Hrs | | 51.2 dB (A) | | |
| 04.00 Hrs | | 50.1 dB (A) | | |
| 05.00 Hrs | | 53.6 dB (A) | | |
| 06.00 Hrs | | 59.5 dB (A) | LeqDay | 60.2 dB (A) |
| 07.00 Hrs | | 60.9 dB (A) | LeqNight | 51.3 dB (A) |

Limits: Industrial Area Day Time-75dB(A),Night Time- 70dB(A),Commercial area Day Time -65 dB(A),Night Time55dB(A),
Residential area Day Time -55 dB(A),Night Time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am

*End of the Report *

For Poluchem Laboratories (P) Ltd.

Authorized Signatory

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

# POLUCHEM LABORATORIES PVT LTD

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

Phone : 0484-2544030, 8281982322, 9747400685,www.poluchem.com, poluchem@gmail.com

ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5239/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 20/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received: | 09/06/2023 |
| | Date of analysis | 09/06/2023 |
| | Sample Description | Waste Analysis –Iritty- Athithattu |
| | Sample Location | Gps Reading : N- 11 °58'04.542"<br>E -75°40'53.861" |

**CHEMICAL PARAMETERS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 7.44 |
| 02 | Biodegradable Factor | USEPA | % | 5.6 |
| 03 | Total carbon | USEPA 9060A | % | 3.7 |
| 04 | Phosphorus(P) | USEPA | % | 0.047 |
| 05 | Nitrogen(N) | USEPA | % | 0.26 |
| 07 | Potassium(K) | USEPA | % | 0.017 |
| 08 | C/N Ratio | USEPA | .. | 14.2:1 |
| 09 | Calorific Value | ASTM D 5865 | K.cal/kg | 2232 |

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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5239/2023 |
|---|---|---|
| M/s. IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 20/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received: | 09/06/2023 |
| | Date of analysis | 09/06/2023 |
| | Sample Description | Waste Analysis –Iritty- Athithattu |
| | Sample Location | Gps Reading : N- 11 °58'04.542"<br>E -75°40'53.861" |

**TOXICITY ANALYSIS- HEAVY METALS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 10 | Iron (Fe) | USEPA 3050 | % | 2.87 |
| 11 | Arsenic(As) | USEPA 3050 | mg/kg | <0.1 |
| 12 | Selenium(Se) | USEPA 3050 | mg/kg | <0.1 |
| 13 | Nickel(Ni) | USEPA 3050 | mg/kg | 50.7 |
| 14 | Zinc (Zn) | USEPA 3050 | mg/kg | 114.4 |
| 15 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 |
| 16 | Copper (Cu) | USEPA 3050 | mg/kg | 50.7 |
| 17 | Chromium(Cr) | USEPA 3050 | mg/kg | 6.9 |
| 18 | Lead(Pb) | USEPA 3050 | mg/kg | 46.6 |
| 19 | Mercury(Hg) | USEPA 3050 | mg/kg | <0.1 |
| 20 | Manganese(Mn) | USEPA 3050 | mg/kg | 140.5 |

* End of the Report*

| | |
|---|---|
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QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

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## TEST REPORT



**Ref.No: PL/RT/GW/1440/2023**
(ULR NO:TC658023000000014407)

**Date of Issue: 20/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Iritty- Athithattu
Gps Reading : N- 11 °58'02.844"
E -75°40'53.189"

Sample code : F/1440/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 20/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.38 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 6 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 1.3 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 300 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 174 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 4 mg/l | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 100 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 68 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 15.2 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 58.31 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.46 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.35 mg/l | 1.0 mg/l |

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Continuation of Test Certificate No: 1440/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | Absent | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/5233/2023** **Date of Issue: 20/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Iritty- Athithattu
Gps Reading : N- 11 °58'02.844"
E -75°40'53.189"

Sample code : F/5233/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 20/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 6 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | ---- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 5233/2023

## RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/1441/2023**
(ULR NO:TC658923000000001441F)

**Date of Issue: 20/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-2
Sample Location : Iritty- Athithattu
Gps Reading : N- 11 °58'09.276"
E -75°40'50.453"

Sample code : F/1441/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 20/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.72 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 9 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 2.9 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 80 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 48 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 12 mg/l | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 22 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 18 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 13.3 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 2.94 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.26 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 1.08 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.2 mg/l | 1.0 mg/l |

Contd...

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

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CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

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Continuation of Test Certificate No: 1441/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | Absent | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Polychem Laboratories (P) Ltd

Authorized Signatory.

Microbiologist
Polychem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/5234/2023** **Date of Issue: 20/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-2
Sample Location : Iritty - Athithattu
Gps Reading : N- 11 °58'09.276"
E -75°40'50.453"

Sample code : F/5234/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 20/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 12 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | --- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level, MDL- Minimum Detection Level

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 524/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

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## TEST REPORT



**Ref. No: PL/RT/GW/1442/2023**
(ULR NO:TC658923000000001442F)

**Date of Issue: 20/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : Iritty -Athithattu
Gps Reading : N- 11 °57'50.389"
E -75°39'20.761"

Sample code : F/1442/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 20/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.34 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 0.1 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 80 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 52 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1 mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 20 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 20 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 12.35 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 2.67 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL-0.05 mg/l) | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 1.63 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.2 mg/l | 1.0 mg/l |

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

Conti...

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Continuation of Test Certificate No: 1442/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | Absent | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/5235/2023** **Date of Issue: 20/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : Iritty- Athithattu
Gps Reading : N- 11 °57'50.389"
E -75°39'20.761"

Sample code : F/5235/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 20/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 8 mg/l | ---- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | ---- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5237/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 20/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received: | 09/06/2023 |
| | Date of analysis | 09/06/2023 |
| | Sample Description | Waste Analysis –Iritty- Athithattu |
| | Sample Location | Gps Reading : N- 11 °58'04.542"<br>E -75°40'53.861" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 32.2 |
| 02 | Bulk Density | | | USEPA | $kg/m^3$ | 640 |
| 03 | Density | | | USEPA | $g/cm^3$ | 0.6156 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 2145 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 75 | -- | | | 0 |
| | | 40 | -- | | | 11.4 |
| | | 20 | -- | | | 11.2 |
| | | 8 | -- | | | 31.8 |
| | | 4.75 | 4 | | | 27.6 |
| | | 2.36 | 8 | | | 12.1 |
| | | 1.18 | 16 | | | 5.3 |
| | | 0.6 | 30 | | | 0.6 |
| | | 0.3 | 50 | | | 0 |

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**TEST REPORT** 

| **Client Name & Address** | **Certificate No:** | **PL/RT/5238/2023** |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 20/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received: | 09/06/2023 |
| | Date of analysis | 09/06/2023 |
| | Sample Description | Waste Analysis –Iritty- Athithattu |
| | Sample Location | Gps Reading : N- 11 °58'04.452"<br>E -75°40'53.753" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 28.6 |
| 02 | Bulk Density | | | USEPA | $kg/m^3$ | 687 |
| 03 | Density | | | USEPA | $g/cm^3$ | 0.6241 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 1841 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 75 | -- | | | 3.8 |
| | | 40 | -- | | | 20.6 |
| | | 20 | -- | | | 34.5 |
| | | 8 | -- | | | 12.6 |
| | | 4.75 | 4 | | | 8.6 |
| | | 2.36 | 8 | | | 6.3 |
| | | 1.18 | 16 | | | 9.2 |
| | | 0.6 | 30 | | | 4.4 |

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## TEST REPORT



**Ref.No: PL/RT/SW/1443/2023**
(ULR NO:TC658923000000014437)

**Date of Issue: 20/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad'
Ernakulam
(TSC Package D, KSWMP)

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water
Sample Location : Iritty - Athithattu
Gps Reading : N- 11 °57'49.198"
E -75°41'11.609"

Sample code : F/1443/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 20/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 –1983RA2017 | 6.20 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 –1983RA2017 | 10 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 6.4 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 36 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 23.4 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 12 mg/l | --- | -- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 8 mg/l | 200 mg/l | -- |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 6 mg/l | -- | -- |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 10.45 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 2.94 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 –1989RA2014 | 1.3 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.44 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 1.15 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.11 mg/l | 1.5 mg/l | 1.5 mg/l |

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

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Continuation of Test Certificate No: 1443/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 280 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | --- | --- |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd.

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/SW/5236/2023** **Date of Issue: 20/06/2023**

Name & address of customer :M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water
Sample Location : Iritty- Athithattu
Gps Reading : N- 11 °57'49.198"
E -75°41'11.609"

Sample code : F/5236/2023
Date of Sample Collected :08/06/2023
Date of receipt of sample :09/06/2023
Date of analysis started :09/06/2023
Date of completion of analysis :20/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | --- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | --- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27$^{0}$ C ) | IS 3025 (P) 44 -1993RA2014 | 2.4 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 8 mg/l | --- | -- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 3.0 mg/l | --- | -- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

*End of the report*

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## TEST REPORT



| Client Name & Address | | |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Certificate No: | PL/RT/5630/2023 |
| | Date of issue: | 20/06/2023 |
| | Date of sample collection | 09/06/2023 |
| | Date of sample received: | 11/06/2023 |
| | Date of analysis | 11/06/2023 |
| | Sample Received From | Iritty- Athithattu |
| | Sample description | Waste Segregation |
| | Sample Location | Gps Reading : N- 11 °58'04.542"<br>E -75°40'53.861" |

PHYSICAL COMPOSITION

| SL NO | Parameters | | Result | |
|---|---|---|---|---|
| | | | Weight | Percentage |
| 01 | BioEarth | (-4.75mm) | 8.25 | 33 |
| | | (+4.75 to 8 mm) | 4.25 | 17 |
| 02 | C&D | C&D (+8mm) | 5.5 | 22 |
| 03 | Plastics | Plastics | 4.25 | 17 |
| 04 | MLP/SUP | MLP/SUP | 0.9 | 3.6 |
| 05 | Cloths | Cloths/ Rags | 1.1 | 4.1 |
| 06 | Glass | Glass | 0.38 | 1.5 |
| 07 | Metals | Metals | 0.35 | 1.35 |
| 08 | Rubber | Rubber | 0.1 | 0.42 |
| 09 | E-Waste | E-waste | 0.0025 | 0.01 |
| 10 | Leather | Leather | 0.0025 | 0.02 |
| Total Weight Of sample -25 g | | | | |

* End of the Report*

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AUTHORISED SIGNATORY
QUALITY MANAGER

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5625/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 20/06/2023 |
| | Date of sample collection | 09/06/2023 |
| | Date of sample received: | 11/06/2023 |
| | Date of analysis | 11/06/2023 |
| | Sample Received From | Iritty- Athithattu |
| | Sample description | Waste Segregation |
| | Sample Location | Gps Reading : N- 11 °58'04.452"<br>E -75°40'53.753" |

### PHYSICAL COMPOSITION

| SL NO | Parameters | | Result | |
|---|---|---|---|---|
| | | | Weight | Percentage |
| 01 | BioEarth | (-4.75mm) | 8.00 | 32 |
| | | (+4.75 to 8 mm) | 4.00 | 16 |
| 02 | C&D | C&D (+8mm) | 5.75 | 23 |
| 03 | Plastics | Plastics | 4.50 | 18 |
| 04 | MLP/SUP | MLP/SUP | 1.00 | 4 |
| 05 | Cloths | Cloths/ Rags | 0.75 | 3 |
| 06 | Glass | Glass | 0.50 | 2 |
| 07 | Metals | Metals | 0.38 | 1.5 |
| 08 | Rubber | Rubber | 0.12 | 0.47 |
| 09 | E-Waste | E-waste | 0.005 | 0.02 |
| 10 | Leather | Leather | 0.0025 | 0.01 |
| Total Weight Of sample -25 g | | | | |

* End of the Report*

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AUTHORIZED SIGNATORY

BREEJA RAMESH
QUALITY MANAGER

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## TEST REPORT



**Ref.No: PL/RT/5265/2023** **Date of Issue: 20/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Leachate
Sample Location : Iritty- Athithattu
Gps Reading : N- 11 °58'04.452" E -75°40'53.753"

Sample code : F/5265/2023
Date of sample collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 20/06/2023

| Parameters tested | Test method | Results | Limit for disposal to inland surface water |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.35 | 5.5-9.0 |
| Total Dissolved Solids(Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 654mg/l | 2100 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 48 mg/l | 100 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 189.3 mg/l | 1000 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 240 mg/l | 250 mg/l |
| B O D (3 days at 27° C) | IS 3025 (P) 44 – 1993RA 2014 | 65.3 mg/l | 30 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 20.3 mg/l | 100 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 16.3 mg/l | 50 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 0.3 mg/l | 1 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 2 mg/l |
| Cyanide as CN | IS 3025 (P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) | 0.2 mg/l |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) | 3 mg/l |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) | 2 mg/l |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL(MDL- 0.01 mg/l) | 0.1 mg/l |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 1.1 mg/l | 3 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 1.3 mg/l | 5.0 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) | 0.2 mg/l |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

*End of the report*

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## Annexure-C

# PHOTOGRAPHS –SAMPLING



*Figure 10 Geotechnical Survey*



*Figure 11 Ground Water Sampling*



*Figure 12 Air Ambient Sampling*



*Figure 13 Surface Water Sampling*



*Figure 14 Ambient Noise Sampling*

## Annexure-D

# VOLUMETRIC ANALYSIS

**Dumpsite volume:**

## IRITTY DUMPSITE QUANTITY

| Sl.no | Name: | Area (sq mtr) | Height above Ground level (m) | Average Height below Ground level (m) | Total Height (m) | Volume(Height x Area) (cum) |
|---|---|---|---|---|---|---|
| 1 | Plot 1 | 449.58 | - | 3.5 | 3.5 | 1573.53 |
| | | | | Grand Total | | 1573.53 |

Note:
*The volume herein above mentioned is not accurate. We haven't measured the height wherein we have calculated the total quantity according to the information given to us by the concerned authorities.*

NOTE: After the Geotechnical Analysis, It was found that the Waste depth is 4.5 m. So the Volume of the waste is revised. i.e 449.58 * 4.5 = **2023.11 cu.m**

## Annexure-E

# SITE PLAN




*Figure 15 Site Management Plan*

Annexure-F

# SURVEY CONTOUR PLAN




*Figure 16 Contour Survey Map*

Annexure-G

# REQUIREMENT OF VEHICLE & MACHINERY

*Table 39 Details Analysis*

| S.No | Machinery & Vehicles | Qty | Units |
|---|---|---|---|
| 1 | Excavation Process | | |
| | Design capacity | 800 | TPD |
| | Required Material to be Excavated per hour | 100 | TPH |
| | Capacity of front-end loader with backhoe per hour | 40 | TPH |
| | No of front-end loader with backhoe required | 3 | Nos |
| 2 | Vehicles Needed for Site movement | | |
| | Tipper capacity per Trip | 5 | Tons |
| | No of trips Per hour | 3 | |
| | No of tippers required | 5 | |
| 3 | No of Tipper required for transporting Byproducts of Biomining ( Earth,RDF, Inerts & Recyclables) | 6 | |
| 3 | Windrow formation and turning | | |
| | Front end loader required for formation of Windrow from the material dropped by the tipper trucks and for turning of waste | 2 | Nos |
| 4 | Feeding to sieving and baling operations | | |
| | Quantity of waste to be fed to sieving machines | 800 | TPD |
| | Quantity of RDF material to be fed to baling machine | 96 | TPD |
| | Capacity of front-end loader to feed in a day to feeders (20 TPH X 10 hours) | 200 | TPD |
| | No of front-end loaders required for feeding sieving and baling machines | 1 | Nos |
| 5 | Water Tanker | 1 | Nos |
| 6 | Tractor | 1 | Nos |
| 7 | Backhoe Loader | 2 | Nos |

Annexure-H

# SPECIFICATION OF MACHINERIES & VEHICLES

*Table 40 Machineries Details*

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| 1 | Mobile Trommel | 1 | Model – Ekomann Scalper MSS 802 |
| | | | Crawler Chassis – Chassis 833D |
| | | | Drive – KYB MAG 85 NP, Speed 0.98 km/h |
| | | | Fuel Tank holding Capacity – 330 litres |
| | | | Feed Capacity (up to approx.) – 500 t/h |
| | | | Screen Size (W*L) – 1,550 *4,880 mm |
| | | | Machine Weight – 30,000 - 36,000 Kg |
| | | | Drive Output – 99 kW at 1800 rpm |
| | | | Screen Slope – 15.4 - 20 Degree |
| | | | Screen Slpoe Conveyor – 12.5 Degree |
| | | | Fine-grain Conveyor Belt Width – 1200 mm |
| | | | Hopper Discharge Capacity – 9.1 cum |
| | | | Screen Pure Size – Less than 900 * 7760 mm |
| | | | Between 900*7760 mm and 1550*4880 mm |
| | | | Greater Than 1550*4880 mm |
| | | | Warranty – 12 months, however max. 2,000 operation hours from setting into operation, however 15 months after the reported date of readiness for shipment resp. |
| 2 | Baling Machine | 1 | Model – FLT-BMPO 25MT |
| | | | Capacity – 25 Tonnes |
| | | | Cylinder – Single Cylinder (140mm*80mm@3000psi) |
| | | | Oil Tank Capacity – 250 Litreres Lifetime Oil |

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| | | | Bale Size = 600*600*600 - 900mm |
| | | | Bale Weight = 50-75 Kg |
| | | | Cycle Time = 15-20mm per Bale |
| | | | Power = 7.5 HP |
| | | | Production Capacity = 1000-1500 Kg/8hr Shift |
| | | | Feed Type = PET, HDPE, MLP, PAPER, CLOTHS, BAGS, CHAPPAL |
| 3 | Weighing bridge | 1 | Model = Modular U Shape Weighbridge, Load Capacity: 10t To 150 |
| | | | Capacity = 30 Tonne (10-150 Tonnes) |
| | | | Size = 5 to 10 m |
| | | | Power Supply 90V to 270V |
| | | | Shape = S Shape |
| | | | Accuracy = 5 Kg |
| 4 | Ballistic Separator | 1 | Drive Power (15 HP) - 1 No.<br>Blower- 1 No.<br>Screen Size - 70*70 MM<br>Material of Construction - IS:2062 ( MS )<br>Throughput Capacity - 30 TPH<br>Output Material - 3 Fraction ( RDF , Inert, Compost)<br>Automatic Feeding Conveyor<br>Drive Power (7.5HP)<br>Feeding Conveyor Inclined<br>Drive Power (7.5HP)<br>Inert Conveyor<br>Drive Power (3.0HP)<br>RDF Conveyor |

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| | | | Drive Power (3.0HP)<br>Compost Conveyor<br>Drive Power (3.0HP)<br>Material of Construction – IS:2062 ( MS )<br>Electrical Control Panel Complete With Wiring |

*Table 41 Vehicle Details*

| B | Vehicle | Nos | Technical Specification |
|---|---|---|---|
| 1 | Back Hoe Loader | 2 | Type = BS 6<br>Bucket min. Capacity = 0.6 cum<br>Gross Power = 94 HP<br>Fully power shift transmission source from the internationally renowned ZF, with heavy duty cluth packs for smooth and easy click of the knob gear shift as per approved design standard |
| 2 | Tipper | 5 | Type = BS 6<br>Hydraulic Lifting Capacity = 10 cum single stock front end hydraulic system<br>Wheel consist of heavy duty steel radials with spare wheel along with 6 cylinder engine, inter cooled as per approved design standard with current pollution |
| 3 | Tractor (separately) | 2 | Mahindra 275 Eco Tractor (BS-6)<br>Fuel Tank Capacity = 45L<br>Brake Type = Oil Brakes<br>Engine Rated RPM = 1900 r/min<br>Main Cluth Type = Single Clutch Heavy Duty Diaphragm type<br>Tyre = 13.6 * 28 / 12.4 *28 (Front / Rear) |
| 4 | Trolley for tractor (separately) | 1 | Janta Enterprise Trolley Making<br>Material = MS |

| Sl | Vehicle | Nos | Technical Specification |
|---|---|---|---|
| | | | Size of Trolley = 1700*825*1200 |
| | | | Capacity = 7 Tonne |
| | | | Weight = 900 Kg |
| 5 | Water Tanker for tractor (separately) | 1 | Brand = QEE |
| | | | Capacity = 500-10000 Litres |
| | | | Materials = MS |
| 6 | Front End Loader | 1 | Types = BS 6 |
| | | | Minimum Capacity = 1 cum |
| | | | Gross Power = 125 HP |
| | | | Fully power shift transmission source from the internationally renowned ZF, with heavy duty clutch packs for smooth and easy click of the knob gear shift. |

*Table 42 Equipment Details*

| C | Equipment | No.S | Technical Specification |
|---|---|---|---|
| 1 | CCTV | 5 | 4 MP IP Bullet Colour Camera with Mic EA4IL2C-GP (Nos. -4) |
| | | | 4CH NVR 104-FI |
| | | | 1 TB HDD |
| | | | 4+2POE Switvh CP-DNW- GPU4G2-4II |
| | | | 6U Rack 600Depth |
| | | | 2.2 KV UPS |
| | | | RJ45 Connector |
| | | | CODOX |
| | | | CAT6 Cable |
| | | | Monitor Cell 22"inch |
| 2 | GPS System For Vehicle | 5 | Vehicle Type = truck, Bus, Ship, Generator |
| | | | Model Name = RT wireless Fuel sensor |
| | | | Available Accessories = Wires |

Annexure-I

# PROPOSED OPERATIONAL PLAN

## Proposed Operational Plan

The project of the Bio-mining with land recovery will be implemented through 100% outsourcing model. The detailed operations of land recovery is provided below:

### 1. Project Kick-off

The existing legacy waste dumpsite should be visited jointly by representative of implementation agency, officials ULB and experts of PMU/PMC & TSC for the following

- ✓ For assessment of ***As –Is Situation*** of local settings viz., human settlement & environmental settings etc.,
- ✓ For validation of profile, quantity & physical characterization of legacy waste.
- ✓ Available services viz., electrical power, source of water and access road etc.,
- ✓ For ground truthing the sampling locations of baseline environmental parameter, locations where monitoring will conduct during operation phase and post reclamation phase
- ✓ For sensitizing/awareness of the upcoming the project activity to the stakeholders within the vicinity of the dumpsite.
- ✓ For understanding the sensitive of environmental & social aspects/social considerations viz., educational institutions, religious places and settlements settings.
- ✓ For ensuring that the implementation agency understands and to complies with all local and national regulations related to project activities.

### 2. Site Management Plan

The position of the machineries and other auxiliary machineries/equipment's in-line with the defined process of bio-mining with land recovery play imperative role in effective implementation of the project activities.

A detailed site management plan is prepared including the details of excavation & pre stabilization area in phases (1 to 4), machineries, weigh bridge, area allocation for by-products storage, vehicle parking area and position of CCTV cameras. The detailed site Management plan is provided in below photo.

### 3. Site Preparation

The portion of the legacy waste dumpsite will be clear vegetation and levelling the area to create a stable & level platform for positioning of bio-mining machineries/equipment's and for processing of legacy waste.

4. **Procurement of Machinery & Vehicles and Equipment's**

An indicative list of Machineries &Vehicles and equipment's are proposed to for effective processing the quantity of existing legacy waste in-tune to the timeline of NGT orders. The indicative list of the Machinery & Vehicles and equipment's are provided in the Section 8.3.2

5. **Mobilization of Manpower**

For effective management of the project activities, an indicative list Manpower provided in the Section 8.4.1 shall be mobilize required.

6. **Statutory Approvals**

The implementation agency is responsible for obtaining all required permission/consent/approvals from the competent authorities. The ULB/DPMU/DPMC will only facilities implementation agency in obtaining the approvals etc. The indicative list of statutory approvals required for the project is provided below.

a. Site Authorization from KSPCB in conforming to SWM Rules 2016 and Consent to Establish/Operate KSPCB.
b. Dept. of mining and geology
c. Necessary permission for storage of process materials and chemicals
d. NOC from Dept. of Fire and Rescue
e. Segregated Hazardous waste disposal arrangement (eg: KEIL Ambalmedu, Kochi)
f. NOC from Heritage/Archeology if the site is in regulated zone of heritage/protected building
g. Any other statutory approvals/ permissions

7. **Establishment of forward linkages**

The By-products from the bio-mining process/operations viz., Bio earth/ C&D waste (Inert), RDF and Recyclables will be stored in the designated place (as indicated in the site management plan) within the dumpsite. The contractor is responsible for management/establishment of forward linkages. Utilization of Bio earth/C&D (inert) may be finalized in consultation with ULB. An indicative forward linkage is provided in the Section 9.1. The compost should conform to Schedule

II of SWM Rules 2016, and RDF should conform to the Guidelines on Usage of RDF in various Industries issued by MoHUA. Bi-weekly sampling will be carried out to confirm the same.

**Bio-mining operations**

- Step-1 – Waste Stabilization

The initial step involves the use of a front-end loader to excavate the legacy waste, allowing for the leachate to dry out through exposure to solar radiation and for the removal of trapped methane from the heap. To ensure the decomposition of biodegradable waste such as discarded food, fruits, flowers, and garden waste, proper aeration is necessary to prevent the generation of leachate and odors. The top layer of the legacy waste, approximately 150 mm in depth, is repeatedly loosened using the front-end loader. Additionally, the waste is lightly mist-sprayed with bio-cultures to manage odors and disperse decomposing microbes throughout the waste. The loosened legacy waste forms windrows.

- Step-2 – Windrow Formation

The second step involves creating windrows of the legacy waste using backhoe. Composting bio-cultures are added to accelerate decomposition and generate biological heat within the waste, aiding in drying it out and reducing its volume. These windrows are turned every 3 days to ensure proper biological treatment and moisture loss. After 1-2weeks, when the heaps have reached a suitable consistency for screening, the material is weighed and transferred to a Mobile Trommel, which consists of rotating cylinders with different-sized perforations.

- Step-3 – Sorting and Segregation by Mobile Trommel

The third step is to move stabilized waste to mobile trommel to get 3 different sizes of fractions

- ✓ Fraction 1 – (minus 30 mm) – Bio Soil/earth -Used for side development/ filling.
- ✓ Fraction 2 – (30-80) mm – Mixed fraction – Plastics with C&D (send to Ballistic Separator)
- ✓ Fraction 3 – (80 +) mm – Mixed fraction – (send to Ballistic Separator)

The Fraction-2 & Fraction-3 (30-80) mm & (80 +) mm is required to move for further separation process through ballistic separator.

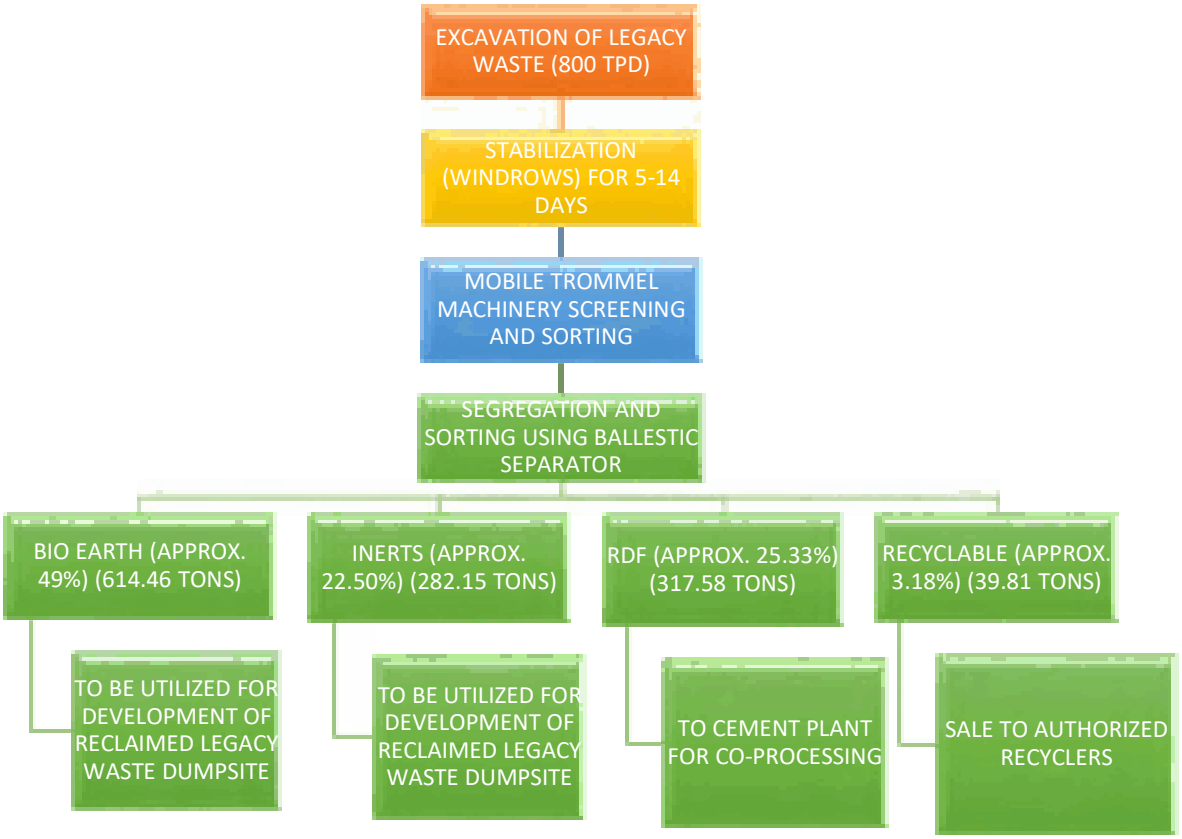


- Step-4 – By - products – C&D materials

In the fourth step, the fraction-2 and fraction-3 are sorted into three types based on their shape and weight: heavy and rolling fraction (referred to as 3D) - C&D Material, light fraction (referred to as 2D) - RDF, and the sieved fraction (or under-screen fine fraction) - Plastic.

- Step-5 - Byproducts – RDF

In the fifth step, the RDF sorted by the ballistic separator (30TPH) is moved to the baling machine (50TPD) for packaging the RDF fractions. The baled RDF is then transported to Cement plants via a weigh bridge (30Ton), where a co-processing facility is available.




## 8. Monitoring & Supervising Mechanism

Supervision and monitoring during dumpsite remediation by TSC/PIU/DPMU

## 9. Record keeping and Reporting

i. The Implementation agency shall maintain a record of the daily processed legacy waste and also keep proper record of all the recovered and disposed of materials.

ii. The Implementation agency shall maintain authorized weigh bridge records at the point of receipt by end designated agency. A consolidated weigh bridge records certified by the

Plant Manager/competent authority of the authorized Cement plant/ WtE or such units certifying the total RDF received from the Project is a valid proof of compliance.

iii. The Implementation agency shall maintain all the statutory records, as per SWM Rules, 2016, and also conditions stipulated in Site Authorization/Consent to Establish/Operate by KSPCB if any, KSWMP/WB requirements and other project relevance statutory requirements.

iv. The site shall be operated in CCTV surveillance with data storage of entire contract period. For CCTV surveillance High-Definition IP based cameras in adequate numbers. As per the requirement of the ULB/KSWMP link with mobile compatibility may be provided for online monitoring of the project activities.

v. The vehicles engaged for the project activities shall be equipped with Vehicles Tracking System (VTS) by equipping with GPS and online monitoring system.

vi. The agency is required to maintain loading and unloading weighbridge slips, e-way bill, LR copy, RDF receipt acknowledgement letter from the cement factory/ WtE facility for complete traceability of the recovered fractions.

## 10. Land recovery/project closure

Land shall be reclaimed i.e. all the legacy waste will be removed till it reaches the surface of the earth/ soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the bidder to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to bi-weekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site.

Annexure-J

# LSGD GUIDELINES FOR REMEDIATION OF LEGACY WASTE DUMPSITES THROUGH BIOREMEDIATION

# GOVERNMENT OF KERALA

## Abstract

Local Self Government Department - Guidelines for Remediation of Legacy Waste Dumpsites through Bio Remediation - orders issued.

## DEPARTMENT

G.O.(Rt)No.2629/2022/LSGD Dated,Thiruvananthapuram, 29-10-2022

Read 1 Letter No. 2683/C2/2022/SM dated 16.09.2022 from Executive Director Suchitwa Mission.

## ORDER

As per the letter read above, Executive Director, Suchitwa Mission had submitted draft guidelines for implementation of project for remediation of Legacy Waste Dumpsites through Bio Remediation.

2) Government have examined the matter in detail and are pleased to approve the guidelines enclosed herewith for implementation of project for reclamation of legacy waste dumpsites through bio remediation.

(By order of the Governor)
SHIBI ABRAHAM
DEPUTY SECRETARY

To:

Principal Director Local Self Government Department

Director Local Self Government(Urban) Department

Director, Local Self Government (Rural) Department

Executive Director, Suchitwa Mission

Principal Accountant General (A&E/Audit-I/Audit-II)Kerala, Thiruvananthapuram.

Executive Director, Information Kerala Mission.

The Information Officer (Web & New Media ) I&PRD

Stock File / Office Copy

G.O.(Rt)No.2629/2022/LSGD

Forwarded /By order

Signed by Prasanth C
Date: 29-10-2022 14:53:04

Section Officer

**Copy to:- PS to Minister LSGD**

**PA to ACS LSGD**

**CA to SS LSGD**

I/5470223/2022

**ബയോ**റെമഡിയേഷൻ വഴി തദ്ദേ**ശ** സ്വ**യംഭരണ** സ്ഥാപന**ങ്ങ**ളിലെ ലെഗ**സി മാ**ലിന്യ **നിക്ഷേപ** സൈ**റ്റുകൾ/ഭൂമികൾ** വീ**ണ്ടെടു**ക്കുന്നതി**ലേ**ക്കുള്ള പദ്ധതികൾ **ന**ടപ്പിലാ**ക്കുന്ന**തിന**ുള്ള** മാർഗ്ഗനിർദ്ദേശങ്ങൾ

ഖരമാലിന്യ സംസ്കരണ ചട്ടങ്ങൾ 2016-ലെ വ്യവസ്ഥകൾ അനുസരിച്ച കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ പുറപ്പെടുവിച്ച മാർഗ്ഗനിർദ്ദേശങ്ങളുടെ അടിസ്ഥാനത്തിൽ ലെഗസി മാലിന്യങ്ങൾ നിർമ്മാർജ്ജനം ചെയ്യുന്നതിനും അത്തരം ഭൂമി വീണ്ടെടുക്കുന്നതിനും തദ്ദേശ സ്ഥാപനങ്ങളെ ചുമതലപ്പെടുത്തിയിട്ടുണ്ട. ടി മാനദണ്ഡങ്ങൾ പ്രകാരം നിർമ്മാർജ്ജനം ചെയ്യേണ്ട മാലിന്യത്തിന്റെ സ്വഭാവവും അളവും വിലയിരുത്തൽ, ലെഗസി മാലിന്യ നിക്ഷേപങ്ങൾ ഉറക്കുന്നതിനുള്ള ഉത്ഖനന പ്രവർത്തനങ്ങൾ, മാലിന്യം തരംതിരിക്കുന്നതിനായി സ്ക്രീനിംഗ് സോർട്ടിംഗ്, വീണ്ടെടുക്കപ്പെട്ട വസ്തുക്കളുടെ പുനരുപയോഗം, വിൽപ്പന/വിപണനം, തിരസ്കൃത വസ്തുക്കളുടെ ശാസ്ത്രീയ നിർമ്മാർജനം എന്നിങ്ങനെ വിവിധ പ്രവർത്തനങ്ങൾ ആയതിൽ ഉൾപ്പെടുന്നു. കൂടാതെ ഇത്തരം സൈറ്റുകൾ/ഭൂമികൾ വീണ്ടെടുക്കേണ്ടതിന്റെ ആവശ്യകത 17.07.2019 ലെ OA 519/2019-ലെ ഉത്തരവിൽ ബഹു: ദേശീയ ഹരിത ട്രൈബ്യൂണൽ നിർദ്ദേശിച്ചിട്ടുണ്ട. ഇതിനെത്തുടർന്ന, പ്രവർത്തനങ്ങൾ വേഗത്തിലാക്കുന്നതിനായി 22.03.2020 ലെ സ.ഉ (സാധാ) നം 702/2020/തസ്വഭവ പ്രകാരം ബയോമൈനിംഗ വഴി ലെഗസി മാലിന്യ നിക്ഷേപ ഭൂമികൾ വീണ്ടെടുക്കുന്നതിന വിവിധ സ്റ്റേക്ക ഹോൾഡർമാരുടെ ഉത്തരവാദിത്തം ഉൾപ്പെടെയുള്ള നിർവ്വഹണ സ്ട്രാറ്റജി അംഗീകരിച്ച ഉത്തരവായിരുന്നു. എന്നാൽ, നാളിതുവരെ ഇത്തരം പദ്ധതികളുടെ നിർവ്വഹണത്തിൽ ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ പുരോഗതി കൈവരിച്ചിട്ടില്ലാത്തതാണ. ലെഗസി മാലിന്യ നിർമ്മാർജ്ജന പദ്ധതികൾക്ക പ്രോജക്ടിന്റെ അംഗീകാരം മുതൽ നടപ്പിലാക്കുന്ന രീതി (വീണ്ടെടുത്ത വസ്തുക്കളുടെ വിൽപ്പനയും സംസ്കരണവും ഉൾപ്പെടെ) വരെയുള്ള നടപടിക്രമങ്ങളിൽ വ്യക്തതയില്ലാത്തതാണ ഒരു പ്രധാന കാരണമായി കണക്കാക്കുന്നത. ഇത്തരം പദ്ധതികൾ പൊതു നിർമ്മാണ/സിവിൽ പ്രവൃത്തികൾക്ക സമാനമല്ലാത്തതിനാലും, നിലവിലുള്ള ഒരു ലെഗസി ഡംപസൈറ്റിൽ നിന്ന വീണ്ടെടുക്കാൻ കഴിയുന്ന വസ്തുക്കളുടെ സ്വഭാവം, ഗുണമേന്മ, അളവ എന്നിവ അത്തരം ഡംപസൈറ്റുകൾ ഉറക്കാതെ കൃത്യമായി മുൻകൂട്ടി നിർണ്ണയിക്കാൻ കഴിയാത്തതിനാലും, മറ്റ പൊതുമരാമത്ത പ്രവർത്തികൾ പോലെ ഇത്തരം പ്രവൃത്തികൾക്ക എസ്റ്റിമേറ്റ തയ്യാറാക്കുന്നത പ്രായോഗികമല്ല. ഈ പ്രശനങ്ങൾ പരിഹരിക്കുന്നതിനായി, സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-നും സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന "അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ (Adv sory on Landf Rec amat on)" പുറപ്പെടുവിച്ചിട്ടുള്ളതാണ. ആയതിലെ അനുയോജ്യമായ വ്യവസ്ഥകൾ കേരളത്തിൽ ഇത്തരം പദ്ധതികൾ നടപ്പിലാക്കുന്നതിന സ്വീകരിക്കാവുന്നതാണ. മേൽ സാഹചര്യത്തിൽ, സർക്കാർ ഇക്കാര്യം വിശദമായി പരിശോധിക്കുകയും തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ മുഖേന ലെഗസി മാലിന്യ നിർമ്മാർജ്ജന പദ്ധതികൾ നടപ്പിലാക്കുന്നതിന ഇനിപ്പറയുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങൾ പുറപ്പെടുവിക്കുന്നു.

പാ**ലി**ക്കേണ്ട **മാന**ദ**ണ്ഡ**ങ്ങളും **മാർ**ഗ്ഗനി**ർദ്ദേശ**ങ്ങ**ളും**

- കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ 2019-ൽ പുറത്തിറക്കിയ "ഗൈഡലൈൻസ ഫോർ ഡിസ്പോസൽ ഓഫ ലെഗസി വേസ്റ്റ (ഓൾഡ മുനിസിപ്പൽ സോളിഡ വേസ്റ്റ)"

- കേന്ദ്ര പാർപ്പിട-നഗരകാര്യ മന്ത്രാലയവും (MoHUA) സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന 2020 ൽ പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ (SBM U - Adv sory on Landf Rec amat on)"

- പ്രസ്തുത വിഷയവുമായി ബന്ധപ്പെട്ട കാലാകാലങ്ങളിൽ കേരള സർക്കാർ പുറപ്പെടുവിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങൾ

**തദ്ദേശ** സ്വയം**ഭരണ** സ്ഥാപനങ്ങ**ൾ** മു**ഖേ**ന **ലെഗ**സി **മാ**ലിന്യ **നി**ർമ്മാർജന പദ്ധതികൾ നടപ്പി**ലാ**ക്കുന്നതിനുള്ള **മാതൃകക**ൾ

- 100% ഔട്ടസോഴസ ചെയത മോഡൽ (MoHUA-യും CPHEEO-യും പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഫിൽ റിക്ലമേഷൻ" പ്രകാരം)

**ലെഗസി മാ**ലിന്യ **നിർമ്മാർ**ജന പദ്ധതികളു**ടെ നിർവ്വഹ**ണ ഉദ്യോഗ**സ്ഥ**ൻ

- ലെഗസി മാലിന്യ നിർമാർജന പദ്ധതികളുടെ നിർവ്വഹണ ഉദ്യോഗസ്ഥൻ തദ്ദേശ സ്വയംഭരണ സ്ഥാപനത്തിന്റെ എഞ്ചിനീയർ ആയിരിക്കും

നിർമ്മാർജനം ചെയ്യേണ്ട ലെഗസി മാലിന്യ നിക്ഷേപങ്ങളുടെ അളവ തിട്ടപ്പെടുത്തൽ

- പൊതുവായി, നിർമ്മാർജ്ജനം ചെയ്യേണ്ട ലെഗസി മാലിന്യത്തിന്റെ അളവ (ക്യൂബിക മീറ്ററിൽ) ടോട്ടൽ സ്റ്റേഷൻ സർവേയിലൂടെ കണ്ടെത്താവുന്നതാണ. എന്നാൽ ടോട്ടൽ സ്റ്റേഷൻ സർവേ സാധ്യമല്ലാത്ത സാഹചര്യത്തിൽ, ഒരു ലക്ഷം ക്യൂബിക മീറ്റർ വ്യാപ്തിയിൽ കൂടുതലുള്ള വലിയ ഡംപസൈറ്റുകളുടെ കാര്യത്തിൽ ഡ്രോൺ സർവ്വേ രീതി സ്വീകരിക്കാവുന്നതാണ.

- ആവശ്യമുള്ള പക്ഷം, പുറമെയുള്ള സർവേ ഏജൻസികളെ നിശ്ചിത നടപടിക്രമങ്ങൾ പാലിച്ച ഇതിനായി ഏർപ്പെടുത്താവുന്നതും, അതിനുള്ള ചെലവ ലഭ്യമായ ഫണ്ടിൽ നിന്ന തദ്ദേശ സ്വയംഭരണ സ്ഥാപനം വഹിക്കേണ്ടതുമാണ.

- സൈറ്റിന്റെ കോണ്ടൂർ മാപ്പ തയ്യാറാക്കേണ്ടതും ആയത തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ പരിശോധിച്ച അംഗീകരിക്കേണ്ടതുമാണ.

എസ്റ്റിമേറ്റ തയ്യാറാക്കലും പദ്ധതി രൂപീകരണവും

- സൈറ്റിന്റെ നിലവിലെ അവസ്ഥ, മാലിന്യത്തിന്റെ സ്വഭാവം/തരം, മാലിന്യ നിക്ഷേപത്തിന്റെ കാലയളവ, മറ്റ അടിസ്ഥാന വിശദാംശങ്ങൾ എന്നിവയെക്കുറിച്ചുള്ള വിശദമായ റിപ്പോർട്ട അനുബന്ധം- I ൽ നൽകിയിരിക്കുന്ന പ്രൊഫോർമയിൽ തയ്യാറാക്കേണ്ടതാണ

- അനുബന്ധം-II ൽ നൽകിയിരിക്കുന്ന സ്പെസിഫിക്കേഷനും ഡാറ്റയും അനുസരിച്ച ബയോമൈനിംഗ മുഖേന പ്രവൃത്തി നടപ്പിലാക്കുന്നതിന എസ്റ്റിമേറ്റ തയ്യാറാക്കേണ്ടതാണ.

- പ്രൊപ്പോസൽ തയ്യാറാക്കുന്നതിന്റെ ഭാഗമായി പ്രസ്തുത പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള എല്ലാത്തരം ചെലവുകളും പരിഗണിക്കേണ്ടതാണ.

- വാർഷിക പദ്ധതിയുടെ ഭാഗമായി പ്രോജക്ട ഏറ്റെടുക്കേണ്ടതും ലഭ്യമായ സ്രോതസ്സുകളിൽ നിന്നും ഫണ്ട വകയിരുത്തേണ്ടതുമാണ.

സാങ്കേതിക അനുമതി

നിലവിലുള്ള സാമ്പത്തിക അധികാരങ്ങൾ അനുസരിച്ച തദ്ദേശ സ്വയംഭരണ വകുപ്പ(ലോക്കൽ ഇൻഫ്രാസ്ട്രക്ച്ചർ & എഞ്ചിനീയറിംഗ വിങ) ലെ ബന്ധപ്പെട്ട എഞ്ചിനീയർ പ്രോജക്ടിന സാങ്കേതിക അനുമതി നൽകുകയും മാനദണ്ഡങ്ങൾ പാലിക്കുന്നതിനായി ചീഫ ടെക്നിക്കൽ എക്സാമിനർക്ക (ഫിനാൻസ വിംഗ) ആവശ്യമായ റിപ്പോർട്ടിംഗ ഉറപ്പാക്കുകയും ചെയ്യേണ്ടതാണ.

തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ ലെഗസി മാലിന്യ നിക്ഷേപ സൈറ്റുകൾ/ഭൂമികൾ വീണ്ടെക്കുന്നതിനുള്ള പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള നടപടി ക്രമങ്ങൾ

ടെൻഡറിംഗ

- ലെഗസി മാലിന്യ നിക്ഷേപ സൈറ്റുകൾ വീണ്ടെടുക്കുന്നതിനുള്ള പ്രവൃത്തിയുടെ വിശദമായ സ്കോപ്പ ഓഫ വർക്ക, നിബന്ധനകളും വ്യവസ്ഥകളും മുതലായവ വ്യക്തമായി പരാമർശിക്കുന്ന 'ടു കവർ ബിഡ്സ താല്പര്യപത്രം'(Request for Proposa - wo Cover Bd) തയ്യാറാക്കേണ്ടതും ആയത നടപടിക്രമങ്ങൾ പാലിച്ച പ്രസിദ്ധീകരിക്കുകയും ചെയ്യേണ്ടതാണ.

- കേന്ദ്ര പാർപ്പിട-നഗരകാര്യ മന്ത്രാലയവും (MoHUA) സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ" ൽ നൽകിയിരിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങളെ

അടിസ്ഥാനമാക്കി RFP-യിലെ വ്യവസ്ഥകൾ/യോഗ്യതാ മാനദണ്ഡങ്ങൾ നിശ്ചയിക്കാവുന്നതാണ.

- കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ പുറപ്പെടുവിച്ച "ഗൈഡലൈൻസ ഫോർ ഡിസ്പോസൽ ഓഫ ലെഗസി വേസ്റ്റ (ഓൾഡ മുനിസിപ്പൽ സോളിഡ വേസ്റ്റ) " പ്രകാരം ലെഗസി മാലിന്യ നിക്ഷേപങ്ങൾ നിർമ്മാർജ്ജനം ചെയ്യേണ്ടതാണെന്ന നിബന്ധന പ്രവൃത്തിയുടെ 'സ്കോപ്പ ഓഫ വർക്കിൽ' ഉൾപ്പെടുത്തുന്നുണ്ടെന്ന ഉറപ്പ വരുത്തേണ്ടതാണ.

- ലഭ്യമാകുന്ന ടെക്നിക്കൽ ബിഡ്സുകൾ പരിശോധിച്ച വിലയിരുത്തേണ്ടതും സാങ്കേതിക യോഗ്യത നേടുന്ന ബിഡ്ഡർമാരെ ബിഡ/ടെൻഡർ അംഗീകാരത്തിന്റെ തുടർ ഘട്ടത്തിനായി ഷോർട്ടലിസ്റ്റ ചെയ്യേണ്ടതുമാണ. ടെക്നിക്കൽ ബിഡ്സുകളുടെ മൂല്യനിർണ്ണയം നടത്തുന്നതിനായി താഴെപ്പറയുന്ന അംഗങ്ങളെ ഉൾപ്പെടുത്തി തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ സാങ്കേതിക സമിതി രൂപീകരിക്കേണ്ടതാണ;

    - സെക്രട്ടറി
    - LSGD (LID & EW) എഞ്ചിനീയർ
    - ഹെൽത്ത വിഭാഗം ഉദ്യോഗസ്ഥൻ (നഗര തദ്ദേശ സ്ഥാപനങ്ങളുടെ കാര്യത്തിൽ)
    - ജില്ലാ ശുചിത്വ മിഷനിൽ നിന്നുള്ള സാങ്കേതിക വിദഗ്ധൻ
    - ജില്ലാ മലിനീകരണ നിയന്ത്രണ ബോർഡിന്റെ പ്രതിനിധി
    - അക്കാദമിക സ്ഥാപനങ്ങളിൽ നിന്നുള്ള മറ്റ വിദഗ്ധർ

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ സാങ്കേതികമായി ഷോർട്ടലിസ്റ്റ ചെയ്ത ബിഡഡർമാരുടെ ഫിനാൻഷ്യൽ ബിഡ്സുകൾ തുറക്കേണ്ടതും നടപടിക്രമങ്ങളും മാനദണ്ഡങ്ങളും പാലിച്ച അംഗീകരിക്കേണ്ടതുമാണ.

- തിരഞ്ഞെടുത്ത കരാറുകാരന/ഏജൻസിക്ക ലെറ്റർ ഓഫ അവാർഡ (L O A) നൽകുകയും കരാറിൽ ഏർപ്പെടേണ്ടതുമാണ.

നിർവ്വഹണം, മേൽനോട്ടം, ബില്ലുകൾ തയ്യാറാക്കൽ

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയറും മാലിന്യ പരിപാലന പ്രവർത്തനങ്ങളുടെ നിരീക്ഷണ ചുമതലയുള്ള ഉദ്യോഗസ്ഥനും അടങ്ങുന്ന ഒരു മേൽനോട്ട സമിതി (Superv s on Commttee) രൂപീകരിക്കേണ്ടതാണ

- R F P ഡോകുമെന്റിലും കരാറിലും ഉൾപ്പെടുത്തിയിട്ടുള്ള 'സ്കോപ്പ ഓഫ വർക്ക' കരാറുകാരൻ കൃത്യമായി പാലിക്കുന്നുണ്ടോ എന്ന നിരീക്ഷിക്കുന്നതിനായി തദ്ദേശ സ്വയംഭരണ സ്ഥാപനം മേൽനോട്ട സമിതിയെ ചുമതലപ്പെടുത്തേണ്ടതാണ.

- പ്രസ്തുത പ്രവൃത്തി 'സ്കോപ്പ ഓഫ വർക്കിൽ' നിഷ്കർഷിക്കുന്ന പ്രകാരമാണോ നടപ്പിലാക്കുന്നതെന്ന മേൽനോട്ട സമിതി കൃത്യമായും പരിശോധിക്കുകയും നിരീക്ഷിക്കുകയും ചെയ്യേണ്ടതാണ.

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ കരാറുകാരന/ ഏജൻസിയ്ക്ക സൈറ്റ ഹാൻഡ ഓവർ ചെയ്ത നൽകേണ്ടതും പ്രവൃത്തി നടപ്പിലാക്കുന്നതിനുള്ള/ നിർവഹിക്കുന്നതിനുള്ള പിന്തുണ നൽകുകയും ചെയ്യേണ്ടതാണ.

- മാലിന്യ പരിപാലന പ്രവർത്തനങ്ങൾ നിരീക്ഷിക്കുന്നതിന്റെ ചുമതലയുള്ള ഉദ്യോഗസ്ഥൻ പ്രസ്തുത പ്രവൃത്തിയിൽ ഉൾപ്പെടുന്ന മാലിന്യ പരിപാലനവുമായി ബന്ധപ്പെട്ട പ്രവർത്തനങ്ങളായ വിൻട്രോ ഫോർമേഷൻ, മാലിന്യം

തരംതിരിക്കൽ, മലിനീകരണ നിയന്ത്രണ മുൻകരുതലുകളും ആരോഗ്യപരമായ കാര്യങ്ങളും ഉറപ്പുവരുത്തൽ എന്നിവയ്ക്ക മേൽനോട്ടം വഹിക്കേണ്ടതും കരാറുകാരന/ഏജൻസിക്ക മേൽനോട്ട സമിതി മുഖേന ആവശ്യമായ നിർദ്ദേശങ്ങൾ നൽകേണ്ടതുമാണ.

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ എംബുക്കിൽ 'ഇനിഷ്യൽ', 'ഇന്റർമീഡിയറ്റ്', 'ഫൈനൽ' ലെവലുകൾ എന്നിവ എടുത്ത അളവുകൾ രേഖപ്പെടുത്തേണ്ടതും, തദ്ദേശ സ്വയംഭരണ വകുപ്പിന ബാധകമായ അധികാരമനുസരിച്ച ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ വകുപ്പ (എൽ.ഐ.ഡി & ഇ.ഡബ്ല്യു) എഞ്ചിനീയർ ചെക്ക മെഷർമെൻറ നടത്തുകയും ചെയ്യേണ്ടതാണ.

- കരാറിൽ വിശദമാക്കിയിട്ടുള്ള ജോലിയുടെ വിവിധ ഘട്ടങ്ങൾ പൂർത്തിയാക്കിയ ശേഷം കരാറുകാരൻ/ഏജൻസി ക്ലെയിം ചെയ്യുന്ന പ്രവൃത്തിയുടെ വർക്ക ബില്ലുകൾ തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ തയ്യാറാക്കേണ്ടതും തദ്ദേശ സ്വയംഭരണ സ്വയംഭരണ വകുപ്പിന ബാധകമായ അധികാരമനുസരിച്ച ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ വകുപ്പ (എൽ.ഐ.ഡി & ഇ.ഡബ്ല്യു) എഞ്ചിനീയർ ചെക്ക മെഷർമെൻറ നടത്തുകയും ചെയ്യേണ്ടതാണ.

- <u>GUIDELINES FOR IMPLEMENTATION OF PROJECTS FOR RECLAMATION OF LEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION (BIO MINING AND MANAGEMENT OF RECOVERABLES AND REJECTS)</u>

As per the provisions of Solid Waste Management Rules 2016, local bodies are mandated to remediate legacy waste dumpsites and reclaim the land based on the guidelines issued by CPCB. Remediation of legacy dumpsites involves various activities such as assessment of the nature and quantity of waste to be remediated, excavation works to open the dumps, screening and sorting to segregate the waste fractions, reuse and sale/marketing of recovered materials, scientific disposal of rejects as per the norms. The remediation of dumpsites is further directed by Honorable NGT in its order on OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. However, the progress of implementation of such projects has not been satisfactory so far. One of the main reasons is that there is a lack of clarity in the procedures to be followed for legacy waste remediation projects right from the approval of the project to the mode of execution (including sale and disposal of recovered materials) by LSGIs since the nature of such projects is not similar to the general public construction/civil works. Also, the nature, quality and quantity of material that can be recovered from an existing legacy dumpsite cannot be accurately predetermined without opening up such dumpsites and hence it is not practical to prepare a workable estimate for the same like other public works . In order to tackle these issues, Swachh Bharat Mission(Urban) and CPHEEO have issued an "Advisory on Landfill reclamation", and suitable provisions of this advisory can be adopted for the State of Kerala. In these circumstances, the Government has examined this matter in detail, and the following guidelines are issued for the implementation of projects for remediation of legacy dumpsites by Local Self Government Institutions.

**<u>Standards, guidelines and advisories to be followed</u>**

- "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" issued by Central Pollution Control Board
- "SBM-U Advisory on Landfill Reclamation" published by MoHUA and

CPHEEO

- Guidelines issued by Government of Kerala in this regard from time to time

**Models for implementing legacy waste dumpsite remediation by LSGI's**

- 100% outsourced model (As per "SBM -U Advisory on Landfill Reclamation" published byMoHUA and CPHEEO)

**Implementing officer for legacy waste dumpsite remediation projects**

The implementing officer for legacy waste remediation shall be the Engineer of the LSGI

**Quantification of legacy waste to be remediated**

- The volume of legacy waste (in m3) to be remediated shall be generally assessed through Total Station Survey. If a total station survey is not feasible, a drone survey may be adopted for large dumpsites having a volume of more than 1 (One) Lakh m3.
- If required, external survey agencies may be engaged following laid down procedures and the cost for the same shall be met by LSGI from available funds.
- Contour mapping of the site shall be prepared and approved by the Engineer of the LSG

**Project Cost Estimation and Formulation by LSGI**

- Detailed report regarding the site conditions, nature of dump, history of dumping and other basic details shall be prepared in the format given in **Annexure - I**
- The estimate for biomining shall be prepared as per the specification and data given in
  - **Annexure -II**
- The overall cost for the implementation of the project shall be considered as part of the proposal.
- Project shall be taken up as per annual projects and funds from available sources shall be ear marked

**Technical Sanction**

- Technical sanction for the project shall be issued by the concerned Engineer in LSGD (LID & EW) as per the existing financial powers and necessary reporting to the Chief Technical Examiner (Finance Wing) may be ensured for compliance as per norms

**Implementation steps for remediation of legacy waste dumpsites by LSGIs**

**Tendering**

- Request for Proposals (RFPs-Two cover bid) clearly mentioning the scope of work, terms and conditions for reclamation of legacy waste dump sites shall be prepared and published as per laid down procedures.
- Conditions/eligibility criteria in the RFP shall be fixed based on the guidelines given in"**SBM-U Advisory on Landfill Reclamation"** published by MoHUA and CPHEEO
- It shall be ensured to mention in the scope of work that remediation of legacy waste dumpsites shall be undertaken as per the **"Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)"** issued by Central Pollution Control Board.
- The technical proposals received should be evaluated and technically qualified bidders shortlisted for further stage of bid approval. A Technical committee shall be formed at LSGI level for evaluation of the technical bids with the following members;
    - Secretary
    - LSGD (LID & EW) Engineer
    - Health Official (in the case of Urban local bodies)
    - Technical expert from District Suchitwa Mission
    - Representative from District Pollution Control Board
    - Other experts from academic institutions if any
- Financial bids of the technically shortlisted firms should be opened at LSGI level and approved as per procedures and norms
- Letter of Award (LoA) is to be issued to the selected contractor agency and agreement executed

**Execution, Supervision and preparation of bills**

- LSGI shall constitute a supervision committee consisting of LSGI Engineer and the officer in charge of monitoring waste management activity
    - LSGI shall authorise the supervision committee to monitor that the contractor correctly follows the scope of work included in the RFP document and agreement
- The supervision committee shall inspect and monitor that the work is being carried out as per the scope defined.
- LSGI Engineer shall hand over the site and provide support for execution of work at the site by the contractor/agency
- The officer in charge of monitoring waste management shall oversee the waste management related activities such as formation of windrows, segregation of waste into various streams,ensuring pollution control measures and health matters involved in the project and shall give direction to the contractor/agency through the supervision committee.

- LSGI Engineer shall measure, record quantities by taking initial, intermediate and final levels in M-book and Check measurements shall be done by the officials of LSGD (LID & EW) as per the powers vested with in the Local Self Government Department.
- LSGI Engineer shall prepare the work bills claimed by the contractor/agency after completing stages of work detailed in the agreement and check measurement shall be made by the officials of LSGD (LID & EW) as per the powers vested within Local Self Government Department.

അനുബന്ധം - I

PROPOSAL FOR BIO MINING / BIO REMEDIATION OF LEGACY WASTE DUMPSITE AT ..... CORPORATION /MUNICIPALITY/ GRAMA PANCHAYAT

BASIC DETAILS OF DUMPSITE

| | | |
|---|---|---|
| Name of LSGI | : | |
| Name of location of legacy dumpsite | : | |
| Extend of land (Acres) | : | |
| Survey No | : | |
| Land owned by | : | |
| Volume of waste (m3) | : | |
| Maximum depth below ground level (m) | : | |
| Maximum height above ground level (m) | : | |
| Approx. level of water table (m) | : | |
| GPS location (Co-ordinates & link to google map) | : | |
| Period from which dumping is done (in Years) | : | |
| Whether waste is still dumped at the site (Yes/No) | : | |
| Availability of water source for remediation process (Yes/No) | : | |
| Availability of electricity (Yes/No | | |

I/5470223/2022

DE AILED REPOR

- Introduct on (Br ef about the s te nc udng s te photograph)
- Survey deta s (Methodo ogy adopted, Deta s of eve measurements and quant ty ca cu at on)
- Cost est mate
    - Abstract est mate
    - Deta ed est mate
    - Data

S gnat**ure**

Des**g**nat on **o**f E**ng**neer n **c**harg**e**

Nam**e o**f LSG**I**

അനുബന്ധം - II

SPECIFICA ION & OBSERVED DA A FOR RECLAMA ION OF LEGACY DUMPSI E HROUGH BIO R M DIA ION ( o m g, man gng ecove abe and eje t

Bo remedat on (Bo mnng, managng recoverab e and rejects) by

**a.** Excavat ng the ex st ng mxed compacted garbage wh ch underwent b o og ca degradat on n the and port on a ocated and spray ng w th m croba nocuum for san t s ng and stab s ng the excavated mass, s ev ng them us ng Mechan ca s ev ng mach ne or any other equ pment,

**b.** Contro of ma odour us ng deodor z ng agent and stab z ng the waste us ng Bo Cu ture for aerob c ompo t g

**c** o f e dy d o po t g po e o de to ed e t e mp t of d mp g te t e dj e t e

**d** eg eg te t e e v ted g b ge t e d po to e m ked, to m y k d d tego e poss b e by mechan ca means nc udng the cost of any power or fue consumpt on.

**e.** Creat on and mantenance of nfrastructure, fac t es and amen t es for s ev ng, the excavated garbage, stor ng the segregated mater a s.

**f.** Dep oyment of necessary manpower, mater a s, equ pment, too s and creat on of fac t es for hand ng, separat ng, segregat ng and stor ng for the operat on of the p ant.

**g.** Leve ng the earth's surface by bu -dosser or any other earth mov ng equ pment

h. Provding security arrangements for the plan project site, machineries, equipment etc.

DSR 2018 Cost Index- 1.00 (For reference)

| Code | Description of Items | Unit | Quantity | Rate | Amount |
|---|---|---|---|---|---|
| | *Details of cost for 50 m3/day* | | | | |
| | LABOUR | | | | |
| 115 | Cooli | day | 20.00 | 558.00 | 11160.00 |
| | MACHINERY | | | | |
| MR | Double stage screener with conveyor | day | 1.000 | 7200.00 | 7200.00 |
| MR | Magnetic separator- capacity 5HP | day | 1.000 | 600.00 | 600.00 |
| MR | Dust screenning remover | day | 1.000 | 900.00 | 900.00 |
| MR | Baling press | day | 1.000 | 450.00 | 450.00 |
| 17 | Hire and running charges of tipper 5 m3 | day | 2.000 | 1700.00 | 3400.00 |
| 20 | Hydraulic excavator 3D with driver and fuel | day | 1.000 | 7000.00 | 7000.00 |
| 18 | Hire and running charges of loader | day | 1.000 | 5000.00 | 5000.00 |
| 9999 | Deodorizer & Inoculum | L.S | 124.860 | 2.00 | 249.72 |
| | Total | | | | 35959.72 |
| | Market Rate cost | | | | 9150.00 |
| | Add water charges 1% on MR | | | | 91.50 |
| | Net Total ( A) | | | | 9241.50 |
| | Total excluding Market rate | | | | 26809.72 |
| | Add water charges 1% on this | | | | 268.10 |
| | Net Total (B) | | | | 27077.82 |
| | Total A + Cost Index B | | | | 36319.32 |
| | Add CPOH 15% | | | | 5447.90 |
| | Total for 50 m3 | | | | 41767.22 |
| | Hence for 1 m3 | | | | 835.34 |

NB:- **Rates shall be prepared based on the cost index applicable to each locality*

# Thankyou!

Local Self Government Department, Upper Ground Floor, Trans Towers,
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# Part B

# Social Impact Assessment

## ATHITHATTU DUMPSITE-IRITTY MUNICIPALITY

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## 1. Introduction

Social safeguards aspects during dump site remediation mainly focusing on meaningful stakeholder engagement, understanding stakeholder's risk perception and restoring them to a safe and environmentally sustainable state. It involves a series of systematic social actions which include social inclusion, effective labor management, and prevention of gender violence during the process, successive rehabilitation of the affected people and reduction of health risk of the host community. The bio mining process of Iritty municipal dumpsite, at Kannur district, has been included in the World Bank supported KSWMP project.

### 1.1 Profile of the municipality

Iritty is located on the banks of Bavali river. Thalassery-Coorg-Mysore highway passes through this municipality. The municipality has a terrestrial character of the hilly region. Bavali river, is flowing through Iritty, commonly known as Iritty Puzha (Iritty River). The famous steel girder bridge, built in 1933, over the river. Pazhasi dam is built in the river which is around 10 km away from the municipality.

Socio-Economic profile of Iritty is presented below in the **Table** 1

**Table 1 Socio Economic Profile Data**

| **Socio Economic Profile Data** | |
|---|---|
| Name of District | Kannur |
| Total Population | 34198 |
| Total Male Population | 16396 |
| Total Female Population | 17802 |
| Total Scheduled Castes Population | 431 |
| Total Scheduled Castes Male Population | 200 |

| | |
|---|---|
| Total Scheduled Castes Female Population | 231 |
| Total Scheduled Tribes Population | 13 |
| Total Scheduled Tribes Male Population | 5 |
| Total Scheduled Tribes Female Population | 8 |

*Table 1 Socio Economic profile* *Source: Census handbook of Kannur 2011*

## 1.2 Profile of Dumpsite

Athithattu dumpsite in Iritty municipality at ward no.12 has a total waste quantity of 1254 Tons, spreading over 0.11 acres. The site is located between Lat- 11°58'04.44"N and Long - 75°40'54.066"E and has an elevation of MSL +39 (m). During the monsoon season, the positioning of the dumpsite causes legacy waste to flow downhill. A side wall is protecting the downward flow of legacy waste. But the leachates flow down during the monsoon season. Iritty municipality proposes biomining and bioremediation in the Athithattu dumpsite site under the KSWMP supported project funded by the World Bank. A Feasibility Report (FR) has been prepared for this subproject. Considering the environmental and social impacts associated with biomining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP

## 1.3 Socio economic baseline of Host community

It is identified that there are 10 households situated within 200 meters from the dumpsite. In the premises of the dumpsite, a Thumboormuzhi model aerobic compost unit and windrow compost unit are functioning. These units are managed by 6 temporary women sanitation workers. The dumpsite is in an isolated hilly area. The dumpsite has sufficient road access and thus there will not be any disruption to the nearby households. No public facilities, properties or commercial establishments are existing near to the dumpsite. There are no scheduled tribes, rag pickers and other vulnerable communities living near the dumpsite.

### 1.4 Vulnerability mapping of host community

There are no scheduled tribes, rag pickers are living near the dumpsite. 6 women sanitation workers are also engaged in the segregating process here.

| Sl.No | Particulars | Number |
|---|---|---|
| 1 | Number of Senior citizens residing near dumpsite | 12 |
| 2 | Number of single women staying near the dumpsite | 0 |
| 3 | Number of persons with disabilities | 0 |
| 4 | Number of persons with severe disease | 0 |
| 5 | Number of persons with respiratory issues | 0 |
| 6 | Number of Kids | 4 |

*Table 2 Vulnerability Details of host community*

### 1.5 Stakeholder analysis

There are 10 households situated within 200 meters from the dumpsite. The episodes of public protest reported due to the indiscriminate dumping of BDW collected from streets. Street sweeping waste is managed by the 6 women workers, who are working in the dumpsite premises. Among these workers, four are attained the age of 60 years. They are managing the BDW management facilities, viz; Thumboormuzhi model aerobic compost unit and windrow compost unit. are managing the site. The livelihood of these women workers is the sale of compost and valuable NBDW collected along with street sweeping debris.

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| Service Providers | | |

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| 1 | ULB Council | Providing ground support to the remediation process |
| 2 | Govt institutions like PCB, KSEB, KWA etc | To deliver necessary approvals and provide necessary services for remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | DPMU | Monitoring and Evaluation |
| 5 | TSC/PMC | Technical support and consultation |
| 6 | Contractor | Execution of the Remediation process |
| 7 | Service providers/HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| Community | | |
| 8 | 6 Workers in the Bio waste processing unit | Support and cooperation for the remediation process |
| 9 | Members of 10 HHs in the 200 m radius of the dumpsite | Support and cooperation for the remediation process |
| 11 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |
| 12 | Waste Generator in Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |
| 13 | Scrap dealers | Informal participation in NBD waste management to prevent further dumping after remediation |

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| 14 | End recyclers | Process the inert and legacy waste safely after remediation |

*Table 3 Stakeholder analysis*

# 2. Output of Social Screening

## 2.1 Social Screening Checklist

The social screening has been conducted with a social screening checklist to identify the potential social risks anticipated during dumpsite remediation. Major findings during the screening process are shown below.

- The dumpsite is located in an isolated hilly area.
- A windrow compost unit and Thumboormuzhi model aerobic compost unit are functional. The units are managed by 6 women workers. A building for RRF constructed by the municipality, but is not functional.
- The dumpsite remains in close proximity to ten houses within 200 m distance.
- There will not be any adverse social impacts on dwellings, land, and community resources of host communities.
- There are no scheduled tribes, rag pickers living near the dumpsite.
- Since there is not much risk with respect to the social and economic conditions of the host communities, the dumpsite can be categorized into "Moderate Risk".

## 2.2 Transect walk

A transect walk conducted on 3rd June, 2023. Twelve persons actively participated in the transect walk. Local residents, HKS, municipal workers, Kudumbashree members and project officials were the participants. A consultation meeting was conducted and a social map was prepared with the support of participants followed by the transect walk through a predetermined route.

A Thumboormuzhi model aerobic compost unit is functional within the dumpsite compound. A windrow compost unit is also functional. It is also operated by the six women sanitation workers. This unit is operated by six temporary sanitation workers (daily wage) members. They are doing segregation of the street sweeping waste. BDW are given to a composting unit and NBDW are handed over to HKS for further processing. Income from the sale of compost and recyclables are the source of livelihood for this Kudumbashree unit.

No rag pickers earn livelihoods from the dumpsite. Vulnerable population is found near to the site even though it is a less populated area. The details of the vulnerable population are given in the above table. The project does not affect land of any individual living close to the area. The transect walk was useful to understand the social risk and social impacts to identify and prepare the mitigation plans and strategies.

### 2.3 Stakeholder Consultation meeting

A stakeholders' consultation meeting in connection with the Athithattu dumpsite was conducted on 10.11.2023 in the municipality. The municipal Chairperson chaired the meeting. Health Standing Committee Chairperson, Ward Councillor, Secretary, political leaders, Kudumbashree members living near to the dumpsite, ward convener, KSWMP project officials, etc participated in the meeting. The agenda of the meeting was the procedures of dumpsite remediation and realize the concerns of community.

The Municipal Chairperson emphasized the need for dumpsite remediation and available support from the government. The dumpsite is already closed. But the accumulated legacy waste, till the closure, is there and the menace of dumpsite can be removed only after the bio-mining process. Chairperson added, the dumpsite remediation is possible with the effective use of available funds and technical support. Municipal secretary requested the officials to expedite the process. The ward councilor extended the support of the people residing near the dumpsite. The Kudumbashree members and ward convener raised a concern of dumping of waste again in the remediated land. The project officials intimated in the meeting that the technical processes started and hopefully the subproject can tender before the end of 2023. They briefly explained about the process and positive impacts of dumpsite remediation.

The output of the meeting: The concerns of the community will be taken up before the commencement of work. The maintenance of BDW facilities and livelihood of workers during the bio-mining process will be taken care. The community extended their support to the remediation.

### 2.4 Key Informant Interview

As part of the assessment, key informants' interviews (KIIs) with the selected persons of the affected communities and gathered data on socio-economic conditions, health status, waste management practices, and opinion on the proposed remediation project to develop suitable and adequate mitigation plans. The KIIs was conducted on 10.11.2023. As part of the KII, the counselor and sanitation worker were interviewed at the dumpsite.

A ward councilor Smt. Idumathi NK and a woman sanitation worker, Vimala, were interviewed as part of KIIs. A predefined schedule was used to gather information from the informants. Open ended questions with sub questions were used to get maximum information and clarifications given. The interview was productive. The history and emergence of the dumpsite, people's protest, social and health issues and public views on the dumpsite were gathered as part of data collection. The major concerns and their expectations were delivered during the interview.

### 2.5 Focus Group Discussion (FGD)

A focus group discussion (FGD) was organized at the ULB to gather information from the selected people, including Municipal Chairperson, Councilor, Municipal Secretary, Kudumbashree members, Social and communication expert from DPMU, SWM Engineer and TSC members. The group opined for the use of inoculum or like solution to avoid the issue of flies, foul odor etc. Emergence of any issues during the bio mining process may attract disruption in the society. The Municipal officials explained the process and informed that it would take all the necessary precautions before the commencement of bio-mining with the support of DPMU, technical experts and contractor. All the members actively participated in the discussion. The participants supported the removal of the menace of dumpsite by bio-mining method.

### 2.6 Feedback from stakeholders

- 10 households are found with a diameter of 200 meters from the dumpsite.

- Six women sanitation workers are working here in the waste processing units located in this site.
- No rag pickers are associated with the dumpsite.
- There is no requirement for land acquisition for the dumpsite remediation project. The currently designated plot or right-of-way has enough space for the transportation of inert waste or mobilization of machineries and materials.
- The total scheduled tribal population in the municipality is 1064, but there are no scheduled tribes staying near the dumpsite, and no impact on their land, customary rights, or livelihoods of tribes is observed.

## 2.7 Findings of the Social screening

- The dumpsite area is not adjacent to any dwelling unit.
- The dumpsite is not currently in use for the purpose. However, a small portion of the site is currently being used for dumping street sweeping waste.
- There is no livelihood loss for rag pickers and scrap dealers.
- During the process of bio mining, there are chances of loss of livelihoods of six sanitation workers working in the BDW management facilities.

## 2.8 Expected site specific social impacts on host community

### 2.8.1 Enhanced quality of life

The remediation can restore the aesthetics of the area, reducing visual blights, foul odour and improving air and water quality. According to the opinion of people residing near the dumpsite, the project can contribute to an improved sense of well-being. Also, it results in a clean and hygienic work environment for the workers engaged in RRF.

### 2.8.2 Livelihood and employment of vulnerable community

It is identified that no rag pickers are currently engaged in collecting waste from the dumpsite or making a living from it. Therefore, the proposed dumpsite rehabilitation project will have no impact on housing or livelihood of any rag pickers.

### 2.8.3 Access to service

It is observed that the project will not affect access to any facilities, services, or natural resources as there is enough space/land available in the existing site.

### 2.8.4 Land availability

Land is available in the existing dumpsite, which is owned by the Iritty Municipality, so there is no need for land acquisition/transfer or purchase. The dumpsite is situated near the residential area. Living near a waste dump site can significantly impact the quality of life for residents. The removal of these sites can improve the aesthetics of the area, reduce odour and noise pollution, and increase property values for surrounding residents.

## 3. Scoping of Social Impact Assessment

All the social risks were identified through the social screening and Transect walk conducted at site. Since there are families and institutions in the close proximity of the dumpsite, below shown action plans have been formulated to be followed at site

### 3.1 Labour Management Plan

An average 30 laborers are expected to be engaged in the remediation process at a time. A detailed labour Management plan has been prepared and attached as Annexure.

### 3.2 Labour Influx Management Plan

Anticipate labour influx to the site is an average of 30 labourers. Since 10 households are residing in 200 m, there are chances of influx issues. A detailed labour Influx Management plan has been prepared and attached as Annexure.

### 3.3 Preventive GBV Action plan

Since an MCF, RRF and Bio waste processing units are functioning inside the dumpsite and close proximity to households there is a high chance of occurrence of GBV incidents. A detailed GBV action plan has been prepared and attached as Annexure.

### 3.4 Citizen Engagement Plan

Being a socially sensitive area with past protest history, public protest might have happened during the execution period of the project. A detailed citizen engagement plan has been prepared and attached as Annexure.

### 3.5 Livelihood Action Plan

Temporary loss of livelihood can be expected during the bioremediation process for those who are engaged in the management of street sweeping debris. Six women sanitation workers are engaged in the Thumboormuzhi model aerobic compost unit and windrow compost unit. The Thumboormuzhi model compost unit exists close to the entrance of the dumpsite. A detailed Livelihood Action Plan will be prepared.

# 4. Required Action Plans

## 4.1Labour Management Plan

### 4.1.1 Details of Labors

The proposed remediation process at Athithattu, requires following category and number labors

*Table 31 Manpower details*

| S. No | Manpower | Nos |
|---|---|---|
| 1 | Site In-charge/Head | 1 |
| 2 | Environmental, Socialand Health & Safety (ESHS) Officer | 1 |
| 3 | Security (3 X 8 Hrs) | 3 |
| 4 | Operations Supervisor & Accountant | 2 |
| 5 | Machine Operator, Mechanic & Electrician | 2 |
| 6 | Labors for stone removal | 2 |
| 7 | Labors for spraying Bio culture | 2 |
| 8 | Labors near Screening machinery | 4 |
| 9 | Labors at Baling facility | 2 |
| 10 | Drivers for tipper trucks, excavators, backhoe loaders and tractors | 11 |
| | Total | 30 |

*Table 4 Required No of labors*

#### Working Hours:

8 hours per shift

#### Type of Engagement

Contract. (Direct workers/contracted workers/daily wage workers/etc)

### 4.1.2 Assessment of key potential labour risks

**4.1 Project Activities:**

The bioremediation of the dumpsite at Athithattu includes the following activities;

- Mobilization of plant and machinery for bio-mining
- waste excavation and forming of windrow
- Spraying with inoculum and waste stabilization

- Waste segregation and refinement
- sorting materials into recyclable, RDF, compost and inert
- Transport to the authorized recyclers and end users

### 4.1.3 Key Labor Risks

It is assessed that key labour risks would be associated with health and safety risks related to the construction activities such as exposure to physical hazards during construction activities such as: use of heavy equipment, exposure to noise and dust, falling objects, exposure to hazardous materials and exposure to electrical hazards from the use of tools and machinery, lack of proper sanitation facilities, availability of separate toilet for women workers. As the construction activities will involve hazardous work, persons under the age of 18 will not be employed by the Project. Many workers will be exposed to occupational health and safety hazards, primarily including but not limited to:

- Injuries/accidents/ fatalities leading to even death, while at work.
- Inadequate accommodation facilities at work force camps, including inadequate sanitation and health facilities.
- Non-payment of wages by Employer.
- Non-payment of benefits (compensation, bonus, maternity benefits etc.) by Employer
- Discrimination in Employment (e.g., abrupt termination from employment, working conditions, wages or benefits etc.)
- Engagement of child labour.
- Sexual harassment at work sites.
- Forced labour or trafficking.
- Security of women workforce.
- Inadequate facilities for pregnant women and lactating mothers.
- Inadequate facilities for the children of the workforce at workforce camp sites
- Possibility of Gender based violence as the work is mostly carried out within the premises of the existing facilities like MCFs/ RRFs etc where female

SWM workers are engaged.

- Absence or inadequate or in accessible emergency response system for rescue of labour/workforce.
- Health risks of labour relating to HIV/AIDS and other sexually transmitted diseases.
- Unclear terms and conditions of employment.
- Discrimination and denial of equal opportunity in hiring and promotions/incentives/training opportunities.
- Denial for workers' rights to form workers organizations, etc.
- Absence of a grievance redressal mechanism for labour to seek redressal of their grievances/issues.

#### 4.1.4 Brief overview of labour legislation: Terms and Conditions

| Sl No | Applicable Acts | Details |
|---|---|---|
| 1. | Employees Compensation Act 1923: | The Act provides for compensation in case of injury, disease or death arising out of and during employment |
| 2. | Contract Labour (Regulation & Abolition) Act 1970 | The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. |

| Sl No | Applicable Acts | Details |
|---|---|---|
| 3. | Minimum Wages Act 1948: | The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employment. |
| 4. | Payment of Wages Act 1936: | It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the workers. |
| 5. | Equal Remuneration Act 1976: | The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training, and promotions etc. |
| 6. | Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: | The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc. |
| 7. | Child Labour (Prohibition & Regulation) Act 1986: | The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of |

| Sl No | Applicable Acts | Details |
|---|---|---|
| | | Child Labour is prohibited in the Building and Construction Industry. |
| 8. | Employees State Insurance Act 1948: | The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the Central Government. The Act also provides for benefits to dependents of insured persons in case of death because of an employment injury. |
| 9. | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: | This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee |
| 10 | Industrial Disputes Act 1947: | The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the |

| Sl No | Applicable Acts | Details |
|---|---|---|
| | | requirements for laying off or retrenching the employees or closing the establishment. |
| 11 | Trade Unions Act 1926: | The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. |

*Table 5 Brief overview of labour legislation*

### 4.1.5 Responsibility Mapping

The ULB (Urban Local Body) will award the proposed work to the contractor through competitive bids. The contractor will be responsible for hiring laborers for both civil and skilled work. In the recruitment process, the contractor is obligated to provide opportunities to members of the host community who possess the necessary skills and willingness to engage in the activities available at the dumpsite for remediation.

The contractor is required to adhere to existing labour laws in the state of Kerala while employing laborers, ensuring compliance with all applicable welfare measures mandated by the relevant labour legislation and rules. Additionally, the contractor is responsible for implementing measures to protect and assist vulnerable groups of workers, including individuals with disabilities, migrant workers, and women workers. These protective measures should be explicitly outlined in the work agreement.

Furthermore, the contractor must prioritize occupational health and safety measures for the laborers. The ULB will actively monitor the contractor's compliance with legal and welfare requirements. The ULB will also organize training sessions for the workers and establish a forum at the ULB level to address any grievances raised by the workers.

It is a prerequisite for the contractor to possess a valid Labor License, and all laborers working on the site must be registered with the appropriate authorities. This comprehensive approach ensures the well-being and fair treatment of workers throughout the remediation project.

### 4.1.6 Code of Conduct

A code of conduct needs to be incorporated with the contract under the project. The contractor should conduct continuous awareness generation and training activities to ensure that the workers abide by the code of conduct. While preparing the code of conduct, following aspects should be ensured;

- Compliance with applicable laws, rules, and regulations of the jurisdiction
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment (PPE), preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment)
- The use of illegal substances
- Non-Discrimination (for example based on family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction)
- Interactions with community members (for example to convey an attitude of respect and non-discrimination)
- Sexual harassment (for example to prohibit use of language or behavior, towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate)
- Violence or exploitation (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favours or other forms of humiliating, degrading or exploitative behavior)
- Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behavior with children, limiting interactions with children, and ensuring their safety in project areas)
- Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by their employer and not open areas)

- Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favours, are not provided to any person with whom there is a financial, family, or personal connection)
- Respecting reasonable work instructions (including regarding environmental and social norms)
- Protection and proper use of property (for example, to prohibit theft, carelessness, or waste)
- Duty to report violations of this Code
- No retaliation against workers who report violations of the Code, if that report is made in good faith.

#### 4.1.7 Systematizing the code of conduct

Awareness raising: The Contractor is required to conduct ongoing awareness-raising and training activities to ensure that workers consistently adhere to the Code of Conduct. Additionally, the Contractor must take measures to ensure that local communities are well-informed about the Code of Conduct, enabling them to report any concerns or instances of non-compliance. This proactive approach aims to foster a shared understanding of ethical standards and accountability within both the workforce and the surrounding communities.

#### 4.1.8 Transparency in contract specific terms and conditions

All contracts must contain;

- Wages: Specific wages and payment modality, timeline
- Working Hours: hours of work, maximum number of hours that can be worked on the project, overtime, compensation
- Leaves: rest per week, annual leave, maternity leave, sick leave
- Benefits: medical treatments in case of accidents or otherwise
- Notice of termination of employment and details of severance payments in a timely manner
- Collective agreements that apply to the project, other specific terms, and conditions
- Details of the grievance redressal mechanism

### 4.1.9 Labour Management plan matrix

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To complete the registration by the Principal Employer, the ULB, as per the provisions of the Contract Labour (Regulation & Abolition) Act 1970 (CL Act), Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979 (ISML Act) and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 (BOCW Act) and procure certificate to that effect. | 3 Registration Certificates to be procured by the ULB under CL Act, ISML Act and BOCW Act respectively. | Before Awarding works | Registration Certificate issued by District Labour Officer under CL Act, ISML Act and BOCW Act | PIU |
| To Procure license under CL Act, ISML Act and registration under BOCW Act by the contractor | 2 Licenses and One registration under CL Act, ISML Act and BOCW Act respectively. | Before commencing the work at site | License and registration certificate issued by the competent Authority. | Contractor |
| To procure Workmen Compensation insurance policy proportionate to the number of labour force deployed. (By the Contractor) | One insurance policy. | Before commencing work at site | Copy of insurance policy | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To display a copy of the certificate of registration at the conspicuous place at the premises where the building and other construction work is being carried on. | One notice board | As soon as the work is started. | Photographs of the notice board where the license is displayed. | Contractor |
| To establish a labour information signboard at camp site by including following details like, date of payment of wages, working hours, holidays, wages rates for different categories of labours and name and contact details of local labour inspector and his/ her office and emergency contact numbers. | One notice board | Do | do | |
| To conduct pre- employment medical examination (as per the provisions of BOCW Act)- to ensure medical fitness of the employee. | All workers must be examined | No of workers employed by the contractor | Pre-Medical Examination certificate issues as per Rule 223(C) of BOCW Act (Form No. IX) by the Registered Medical Practitioner. | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To conduct Periodical Medical Check-ups (once in every six months) | All workers must be examined. | No of workers employed by the contractor | Medical Examination certificate issued by a registered medical practitioner. | Contractor |
| To provide safe drinking water- the contractor must provide safe drinking water at worksite as well as camp site* (Guideline is provided along with this document) | As per requirement | During the entire contact period | Photographs of supply of potable water, Bill of water purchase. | Contractor |
| To arrange first Aid facility at work site as well as camp site (Specifications and items to be maintained in the box is mentioned in this document) | As per requirement | During the entire contract period | First Aid Register, Bill of purchase, photographs of First Aid kit | Contractor |
| To arrange separate First Aid room at work site | Allot one specified room | To be made available during the constructio n period | Photographs of the facility | Contractor |
| To provide first Aid training to selected labourers or staff members through an authorized agency. | One training with authorized agency | Within one month of commence ment of the work | Training records & Photographs | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To establish linkage with local hospitals/ health care institutions for emergency medical assistance | Tie up with at least one hospital | Within one month of the commencement of the work | Letters issued by the hospital or correspondence and agreement with the hospital. | Contractor |
| To establish rest room at work site or camp site | | Before the commencement of the work | Photographs of the rest room | Contractor |
| To establish Canteen facility for labours if the contractor engages more than 250 labours | | Before the commencement of the work | Photographs of the facility, canteen register etc | Contractor |
| To maintain essential registers and records like Form A (Registration of employees), Attendance Register, Wages Register, and other registers like incidents registers including Accident register, Harassment complaints, recovery register, Maternity leave, Termination etc | | As and when the work starts | Copy of registers. | Contractor |
| Constitute GRC for labours (maximum members to be six. Number of members from employer and employee to be | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| equal. Female members should be minimum 50%. ) | | | | |
| Constitution of ICC (minimum members to be four. The presiding member should be a senior female employee) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| To publish the abstract of labour laws within the premises of the labour camp.<br>1. The Payment of Wages Act<br>2. The Employee compensation Act<br>3. The Building and Other Construction Workers (RECS) Act<br>4. The Contract Labour (A&R) Act<br>5. The Child and Adolescent Labour (P&R) Act<br>6. The Maternity Benefit Act | Abstract of Six acts | As and when the camp is established | Photos of the notices published. | Contractor |
| To establish code of conduct and provide induction trainings | | As and when new employees are joined | Training reports and other documents | Contractor |
| Conduct HIV/AIDS awareness programs | As per requirement | Once in six months | Reports, photographs etc | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| All the Drivers should possess effective and valid Driving License | Drivers should be selected after verification of DL | As and when drivers are appointed | Photocopy of licence ids to be collected | PIU |
| All the vehicles involved in the project shall be insured to cover the third-party risk | Vehicle must be allowed to be plied in the project only after procurement of third-party insurance to the vehicle | As and when vehicles are plied in the project | Photocopy of insurance is to be collected | PIU |

*Table 6 Labour Management plan matrix*

## Budget

| S.No | Item | Cost |
|---|---|---|
| 1 | Activities as per LMP | [redacted] |

### 4.2Labour Influx Management Plan

An average of 30 labourers will be engaged in the dumpsite remediation process. The labour influx matrix is given in the below table

| Risk | Mitigation Measures | Implementation responsibility | Monitoring indicators | Monitoring responsibility |
|---|---|---|---|---|
| Social and Community wellbeing | Joint Meeting with the community by ULB officials and Elected members | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Economic and Livelihood Issues | Skilled /Unskilled jobs for the Community embers in the sub-project | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |

| Risk | Mitigation Measures | Implementation responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|
| Accommodation /labour camp | • Ensure basic amenities are provided to the labourers ( Toiltes, Water, Kitchen facilities etc)<br>• Daily briefing to the labourers | Contractor | • Risk identification report<br>• Proposed action/mitigation plan<br>• List of facilities in labour camp<br>• Details of labours | TSC/DPMU |
| Communicable Diseases | • Access to Medical Check-up<br>• Awaresness to the laboures | Contractor | • SOP for prevention of communicable disease and health wellbeing on worksite and labour camp<br>• Report on medical check-up | TSC/DPMU |
| Crimes | • Intimation to the Local police about the camp | Contractor | • Work site complaint register | TSC/DPMU |

| Risk | Mitigation Measures | Implementation responsibility | Monitoring indicators | Monitoring responsibility |
|---|---|---|---|---|
| | | | • Number of cases reported, and action taken | |
| Child Labour | • Ensure Adhar card of all labourers at the site | Contractor & TSC | • Number of child labour issues reported<br>• Data of labours | ULB/DPMU |
| Gender-based violence, including sexual harassment child abuse and exploitation | Gender sensitisation briefing to the labourers | Contractor/TSC | • Number of cases reported<br>• Action taken report<br>• Number of cases resolved<br>• Time taken for resolving complaints | ULB/DPMU |
| Labour licences | Mandatory provisions to be followed | Contractor/PIU | • Number of labours having licence | DPMU |

*Table 7 Labour Influx Management Plan*

### 4.3Preventive GBV Action Plan

#### 4.3.1 GBV Action Plan – matrix

The purpose of the Gender-Based Violence Action Plan in the Kerala Solid Waste Management Project (KSWMP) is to prevent and address gender-based violence (GBV) in all aspects of the project. This includes during the planning, implementation, and monitoring of project activities. The GBV AP is an integral part of the KSWMP's Environmental and Social Management Framework (ESMF). The GBV action plan outlines a number of measures that will be taken to prevent and address gender based violence.

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| Formation of internal complaints committee | • ULB level ICC will be constituted | Before implementation | ULB | • Minutes and Reports | TSC |
| Map GBV issues | Ensure justice, safety and protection, reasonable wages, care and support, adequate Work space, | During implementation | Contractor/ULB | Issue tracking system in place Feedback report(monthly) | TSC |

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| | Avoid Gender discrimination Physical, Sexual , Psycological and socio Economic violence. stress, emotion, conflict, abuse, threatens | | | | |
| Map GBV service providers and quality assessment of services | • NGOs<br>• Police Station KELSA<br>• Women protection officer<br>• List of Nongovernm | Before implementation | TSC | • Directory of service providers<br>• List of key partners<br>• Mapping of roles and responsibilities | TSC |

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| | ent and private agencies providing GBV support<br>• Map local informal grassroot level organizations<br>• Review the quality of services in terms of prevention, protection, rescue, rehabilitation, restoration, reintegration, research, and documentation | | | • Monthly report on quality Assessment | |

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| Facilitate GBV awareness and sensitization programs | • Organize sensitization activities<br>• Display sign boards around the project site | During implementation | Contractor/ICC | • Detailed activity plan<br>• Progress reports<br>• Completion report | TSC |
| Create a GBV response and support mechanism | SOP for the actions to be followed in terms of any incidents related to GBV will be formed along with ICC. The SOP will detail the identification of support mechanisms | During implementation | ULB/ICC | • SOP for prevention, protection, and rehabilitation | TSC |

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| | and terms of conditions for compliance with existing rules and regulations and operational strategy. | | | | |
| Reporting, monitoring and review | • Create GBV data fields<br>• Quarterly reports<br>• Conduct review | During implementation | Contractor/ TSC | • Progress reports (Monthly, quarterly)<br>• CB report<br>• Monthly complaint status and action taken report<br>• Establishment of Feedback system | TSC |

*Table 8 GBV Action Plan – matrix*

### 4.3.2 Budget

| S.No | Item | Cost |
|---|---|---|
| 1 | Activities as per GBV plan | [redacted] |

## 4.4 Site Specific Citizen Engagement Plan

### 4.4.1 Stakeholder identification

As part of social safeguard initiatives for the Bioremediation of dumpsite at Athithattu, Iritty municipality. The social experts of DPMU, DPMC and TSC conducted brainstorming exercises with local community, municipal officials, and PIU. A detailed list of primary and secondary stakeholders is prepared on the basis of these exercises.

### 4.4.2 Waste Generators

The dumpsite is located in Athithattu ward No 12. The dumpsite is located inside the existing common solid waste management facility of the municipality. A Thumboormuzhi model aerobic compost unit and windrow compost units are working in the premises of the dumpsite. Currently the shops and streets are the waste generators directly related with the facilities inside. Street sweeping debris from the town is being brought to the site followed by segregation. BDW put in the aerobic compost units and NBDWs are handed over to HKS.

### 4.4.3 Service Providers

For the successful completion of the bioremediation sub project, service of many people, agencies and departments are to be ensured by proper advocacy and networking initiatives. Following is the list of service providers identified through stakeholder analyses and their expected role/responsibility in the project

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| Service Providers | | |
| 1 | ULB Council | Providing ground support to the remediation process |

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| 2 | Govt institutions like PCB,KSEB,KWA etc. | To deliver necessary approvals and provide necessary services for remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | Contractor | Execution of the Remediation process |
| 5 | Service providers/HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| Community | | |
| 6 | 6 Workers in the TMC unit and windrow compost | Support and cooperation for the remediation process |
| 7 | Members of 10 HHs in the 200 m radius of the dumpsite | Support and cooperation for the remediation process |
| 8 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |
| 9 | Waste Generator in Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |

*Table 9 Service Providers*

### 4.4.4 Need of the plan

Citizen engagement as part of the proposed bioremediation of the dumpsite in Iritty municipality aims to facilitate two-way communication between the project and its stakeholders in order to make better informed decisions. Such an engagement will certainly pave the way for better implementation of the project, and it will ensure public participation in trouble shooting at all the stages of the implementation of the project.

### 4.4.5 Objective of the plan

The citizen engagement plan for the proposed dump site remediation is prepared with following objectives;

- To create a conducive environment for the smooth implementation of the proposed bioremediation of the dumpsite by promoting constructive dialogues between the project and its stakeholders.
- To ensure stakeholder participation in the planning, implementation, and monitoring of the sub-project.
- To suggest appropriate activities with a monitoring plan and an expected budget for engaging the stakeholders with the motive of enhancing their ownership in the project through increased participation.

### 4.4.6 Stakeholder concern

**Waste Generators**

The management of wastes generated from street sweeping and the market are processed in the premises of the dumpsite. The waste collection may get delayed/stopped due the remediation process.

**Service Providers**

Major concerns of the service providers which has to be addressed by the citizen's engagement plan can be summarized as follows;

- Livelihood of temporary women sanitation workers currently working in the dumpsite may get affected.

- SWM related Service providers/HKS of the municipality should be trained and motivated for proper timely collection, segregation and transportation of waste to appropriate processing units to prevent the formation of such dumping yards in the future.

#### 4.4.7 Activities proposed

Community/citizen Awareness

- Focus group discussions to host community
- Organize exposure visit for the identified members from host community and council members
- Formation of GRM committee to take up any issue raised at site level and help to resolve an emergency.
- Sensitization programs to nearby vendors

Awareness to Service providers

- Sensitization on the bio-remediation activity is to be conducted for the Iritty Municipal Council and officials prior to the commencement of the actual bio-remediation process.
- Meeting with Contractor to understand their plan of operations/No labors involvement/timeline etc.
- Orientation to the Service providers/HKS of Iritty Municipality
- Sensitization meetings to the local and district level police officials on the proposed bio remediation of dumpsite and anticipated issues and action required
- Sensitization programs to Fire Force, and PCB regarding dumpsite remediation.
- Orientation regarding the dumpsite remediation process and its benefits to local community

### 4.4.8 Citizen engagement plan

**Citizen Engagement Plan matrix**

| S. No | Engagement Challenge | Impacts on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| 1 | Lack of Awareness on Project activities | Non co-operation of Community/stakeholders | Awareness campaigns /IEC material/ sensitization programs to the stakeholders | ULB/Contractor |
| 2 | Delay in decision making and timely support from the ULB | To establish transparency and building confidence in the project commitments to ULB elected members and officials | Sensitization on the bio-remediation activity for the elected representatives and officials prior to the commencement. | ULB/Contractor |
| 3 | Lack of proper GRM system | Delay in the execution of remediation work | Constitution of GRM Committee to take-up social issues raised at site level | ULB/Contractor |
| 4 | Lack of conducive environment for bioremediation activity | Delay in the execution of remediation work | Sensitisation meetings to various departments | ULB/Contractor |

*Table 10 Citizen Engagement Plan matrix*

#### 4.4.8.1 Monitoring Plan

| S. No | Activity | Means of Communications | Monitoring Indicator | Monitoring Responsibility |
|---|---|---|---|---|
| 1 | Sensitization on the bio-remediation activities for the Municipal Council and officials | Presentation and group discussion | No of councilors and officials attended | DPMU/DPMC/ TSC |
| 2 | Sensitization meeting to host community | Presentation and group discussion | No of persons attended. | DPMU |
| 3 | Formation of GRM committee | Office order/ proceedings on the formation of GRM committee | Office order/ proceedings | DPMU |
| 4 | Orientation to the Service providers/HKS | Presentation and group discussion | No of service providers/HKS attended | ULB/DPMU |
| 5 | One to one meeting district administration, line departments, PCB, KSEB, KWA, Fire & Safety and Police | Presentation | No of one to one meeting conducted / no of officials attended | ULB/DPMU |
| 6 | IEC display board | IEC boards | No of IEC developed and displayed | ULB/DPMU |

*Table 11 Citizen Engagement-Monitoring Plan*

#### 4.4.8.2. Budget

| S. No | Activity | Specification | Quantity / events | Cost |
|---|---|---|---|---|
| 1 | Sensitization on the bio-remediation activities for the Municipal Council and officials prior to the commencement of the work | Half day Programme for Councilors and municipal officials | 1 | [redacted] |
| 2 | Sensitization meeting to host community | Half day Programme by incorporating all host community members | 2 | [redacted] |
| 3 | Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency. | Committee formation | 1 | [redacted] |
| 4 | Meeting with Contractor to get an understanding of their plan of operations/No labors involvement/timeline etc. | One to one interaction | As required | [redacted] |
| 5 | Orientation to the Service providers/HKS | Half day programme | 2 | [redacted] |
| 6 | Issue based one to one meeting district administration, line departments, PCB, KSEB, KWA, Fire & Safety and Police | One to one | As required | [redacted] |
| 7 | IEC display board for information dissemination | IEC display in the site | 1 | [redacted] |
| | | | Total | [redacted] |

*Table 12 Budget*

**Summary of SMP budget**

| S.No | SMP Activity | Cost |
|---|---|---|
| 1 | Labour Management Plan | [redacted] |
| 2 | Labour Influx Management Plan | [redacted] |
| 3 | Preventive GBV action plan | [redacted] |
| 4 | Citizen Engagement Plan | [redacted] |
| **Total** | | [redacted] |

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

**SUBMITTED BY**

**KERALA SOLID WASTE MANAGEMENT PROJECT (KSWMP)**

# Part A

# Environmental Impact Assessment

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# EXECUTIVE SUMMARY

**INTRODUCTION:** Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio mining of multiple Legacy Waste Dumpsites in various districts. The selected dumpsite is Kalamassery which is located near Ward no 6 of Kalamassery municipality, Ernakulum District.

**RATIONALE FOR THE PROPOSED SUB-PROJECT:** Kalamassery ULB proposes bio mining and bioremediation of the Kalamassery legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

**PROPOSED SUB-PROJECT DETAILS:** Kalamassery dumpsite is located at a distance of 1 km from the centre of Kalamassery town in western side and encompasses a total area of approximately 1.95 acres of land. The coordinates of the dumpsite are 10.065159° N & 76.327607° E. Currently, the quantity of waste dumped at this site is about 55,927.88 Cu.m. The legacy waste is presented about 8.5 m below and 2.5 m above the ground level as per the geotechnical investigation studies conducted. Hence bioremediation of the dumpsite is essential to mitigate the environmental impacts.

**APPLICABLE NATIONAL, STATE LEGISLATIONS AND TECHNICAL GUIDELINES:** To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed and followed.

**THE WORLD BANK SAFEGUARDS POLICIES, AND KSWMP ESMF**: The World Bank policies and directives on environmental and social safeguards have been adhered to the proposed dump site remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are ensured.

**SUB-PROJECT SCREENING AND ITS CATEGORIZATION:** As per indicative categorization for dumpsite bio mining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite and waste spread of 1.95 acres, this subproject is individually considered as E2 and EIA is prepared accordingly.

**ENVIRONMENTAL BASELINE:** Physiographically, Kalamassery falls under Flat Terrain zone. As per Wind rose diagram, the most predominant wind directions are blowing from West and WSW direction throughout the year. As per the geotechnical investigation, the subgrade soil was encountered at 8.5 m below the waste depth of the dumpsite and the predominant soil is gravelly clay. The dumpsite is surrounded by predominantly of Commercial and Industrial land use. The cultural heritage zone near dumpsites is Edapally at a distance of 4.5 Km in South direction. Hence, no significant physical impact to the heritages sites is envisaged during remediation. As per the district disaster management plan-2015 and flood vulnerability map the dumpsite is under flood prone zone.

**DESCRIPTION OF ENVIRONMENTAL PARAMETERS:** The analysed air pollution data indicates that the levels are within acceptable limits of NAAQs. The ambient Noise Levels are well within the National Ambient Noise standards for Commercial Area. The ground water quality results indicate that the dumpsite has not caused any major increase of the parameters and the quality parameters are within the IS10500:2011. Similarly, the surface water sample shows that it is not largely influenced by the dumpsite as the quality is within the limits of IS 2296, except for BOD which shows a marginal increase in value of about 6.3 mg/l and coliforms. The leachate monitoring data indicates, very low

concentrations of tested parameters. The heavy metals are also found to be below deducted limit, hence the soil is unlikely to be contaminated by heavy metals from the waste.

**ANALYSIS OF ALTERNATIVES:** After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

**ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS:** Environment: During operational phase (bio-remediation), the main potential nuisances caused by a dump site are fugitive dust, odour, foul gases, smoke from the site (in case of fire), and leachate generation. Birds, vermin, and rodents, littering, noises both from machineries operating at the site and waste collection vehicles. Social: No specific social risk is identified for initiating the remediation process except the occupational hazards to the workers engaged in the remediation process. It can be overcome by using adequate protective measures properly.

**ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN:** The management plan proposed are for pre-remediation as well as during remediation stage and post remediation. The mitigation measures are recommended for impacts from air, noise, water, leachate, health and safety aspects. The proposed monitoring plan includes leachate, surface and ground water monitoring for a period of once in three months. The cost of [redacted] is required for implementation and supervision of EMP.

**SOCIAL MANAGEMENT AND MONITORING PLAN:** The social management plan proposed are for pre-remediation as well as during remediation stage. The mitigative measures proposed addressing concern of local community about remediation work, labour management issues, health and safety risks of labours, gender discrimination.

**EMERGENCY PREPAREDNESS PLAN:** The identified emergency situations which may arise from remediation activities are fire risk in summer, occupational health and safety related risks. The Kalamassery police station at 2 km, Public Health Centre at 1.5km, Kochi medical hospital at 5 km, Eloor Fire station at Pathalam within 3 km are the nearest emergency services. Periodic Compliance monitoring system will be done by the contractor during remediation.

**PUBLIC CONSULTATION AND INFORMATION DISCLOSURE: A** Transect walk was carried out on 06.06.2023 covering the surrounding area of the dump site. Effective IEC drive to be initiated to engage with the community to build support as the activity will create positive impact. Warning sign boards and project information boards with full details of grievance redressal mechanism along with all related contact details will be installed at site during the process at the site. Site control measures should be enforced to prevent unauthorized personnel into the work site.

***Note: All the references to Social Impact Assessment and Social Management Plan may be referred to Part B- Social Impact Assessment which is a separate document attached along with this document.***

# സംഗ്രഹം

[redacted]

[redacted]

[redacted]

[redacted]

# CHAPTER 1. INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-Financing Framework agreement and as agreed Project Co-Lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio mining of multiple Legacy Waste Dumpsites in various districts. There are 19 dumpsites identified for remediation under the Kerala Solid Waste Management Project. Several others have been taken up for remediation directly by the ULBs. Currently, 7 dumpsites considered within the three districts (Ernakulum, Alappuzha and Idukki), falling under Package B are selected by Kerala Solid Waste Management Project (KSWMP) for remediation under the project. One of the selected dumpsites is Kalamassery which is located at Ward no 6 of Kalamassery municipality, Ernakulum District.

## 1.2 The rationale for the Proposed Sub-Project

Kalamassery dumpsite in Kalamassery ULB at Ward no. 06 has a total waste quantity of 55,927.88 Cu.m, spreading over 1.95 acres of land. The site is located between Latitude 10.065159° N and Longitude 76.327607° E and has an elevation of MSL +9 (m), with a gentle slope towards the north-eastern part. During monsoon season, due to the slope of the site, Leachate from waste flows downhill towards nearby nallah located at northern side of the dumpsite. Kalamassery ULB proposes bio mining and bioremediation of the Kalamassery legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

## 1.3 Proposed Sub-Project Details

Kalamassery dumpsite is located at a distance of 1 km from the centre of Kalamassery town in western side and encompasses a total area of approximately 1.95 acres of land. The coordinates of the dumpsite are 10.065159° N & 76.327607° E. It is located in ward no. 6 of the municipality. Kalamassery municipality holds the ownership of the dumpsite. The dumpsite is surrounded by highway from north-western directions. In South-eastern direction, railway line passing through it. North-eastern side of the dumpsite is vacant land. A small nallah flows North-eastern side of the dump site within the distance of 30 m.

Currently, the quantity of waste dumped at this site is about 55,927.88 Cu.m. The legacy waste presented is about 8.5 m below and 2.5 m above the ground level as per the geotechnical investigation studies conducted. Hence bioremediation of dumpsite is essential to mitigate from the environment impacts. Dumpsite reclamation involves excavation, screening, and separation of material from dumpsites into various components such as soil, recyclable materials, and residues.

### 1.4 Objectives and Scope of the ESIA

As per indicative categorization for dumpsite bio mining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite and waste spread (1.95 acres) and absence of environmentally sensitive features around, this subproject is individually considered as E2 and EIA is prepared accordingly.

The EIA & SIA process involves the identification of the potential environmental and social issues in the project and during design interventions. The EIA & SIA further carries out impact prediction and evaluation of residual environmental and social issues of a Project. It then goes on to outline the proposed mitigation measures for residual impacts and enhancement measures for positive impacts which the Project will implement.

### 1.5 Structure of the Report

The Consolidated ESIA report has been structured into the following Chapters:

- Introduction and Project Description.
- Policy, Legal and Administrative Framework presents a review of the existing Institutions and legislation relevant to the project at the National and the State levels;
- Environmental Assessment Methodology discusses sequence of tasks carried Out in preparing EIA;
- Existing Environmental Scenario presents a consolidated picture of the existing Environmental setting of the project;
- Assessment of Potential Impacts identifies and quantifies the potential impacts on each of the environmental components due to the proposed project development;
- Analysis of Alternatives discusses the criteria for analysis of alternatives of technology for remediation.
- Mitigation Measures presents an elaborate listing of the nature of impacts on each of the environmental components and the avoidance and mitigation measures suggested.
- Public Consultation details the stages and types of public consultations carried out during the project preparation stage and people's perceptions of the project benefits and the Potential impacts;

# CHAPTER 2. POLICY AND REGULATORY FRAMEWORK

## 2.1 Applicable National, State Legislations and Technical Guidelines

**National Environmental Rules and Regulations: -**

To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed. A summary of environmental legislation/regulations relevant to project is furnished in the following **Table-2.1**.

**TABLE: 2.1 SUMMARY OF ENVIRONMENTAL LEGISLATION/REGULATIONS**

| SR. NO. | ACT / RULES | PURPOSE | APPLICABLE (YES / NO) | REASON FOR APPLICABILITY | AUTHORITY |
|---|---|---|---|---|---|
| 1 | Environment Protection Act, 1986 | To protect and improve the overall environment. This is an umbrella Act. | Yes | As all environmental notifications, rules and schedules are issued under this act. | MoEF&CC, CPCB, SPCB |
| 2 | Solid Waste Management Rules, 2016 | To manage collection, transportation, Segregation, Treatment, and disposal of solid wastes (other than Hazardous water, Plastic Waste, Bio Medical waste) | Yes | Dumpsite remediation/bio mining | MoEF&CC, CPCB, SPCB |
| 3 | Air (Prevention and Control of Pollution) Act, 1981 | To control air pollution by controlling emission of air pollutants as per the prescribed standards. | No | No, Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 21 of Air (Prevention and control of Pollution) Act 1981. | State Pollution Control Board, Kerala |
| 4 | Water Prevention and Control of Pollution) Act, 1974 | To control water pollution by controlling discharge of pollutants as per the prescribed standards | No | No, Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 25 of this Act. | State Pollution Control Board, Kerala |
| 5 | The Noise Pollution (Regulation and Control) Rules, 2000 & amendments | The standards for noise for day and night have been promulgated by the MoEF&CC for various activities. | Yes | This act will be applicable for all construction equipment deployed at worksite and in operation. | State Pollution Control Board, Kerala |

| | | | | | |
|---|---|---|---|---|---|
| 6 | Public Liability and Insurance Act, 1991 | Protection from accidents. | Yes | This act will be applicable for providing immediate relief to the persons affected by accident occurring during work | State Pollution Control Board, Kerala |
| 7 | Central Motor Vehicle Act 1988 | To check vehicular air and noise pollution. | Yes | This rule will be applicable to vehicles deployed for construction activities and construction Machinery. | Motor Vehicle Department |
| 8 | The Plastic Waste Management Rules, 2016 | For the storage and disposal of plastic wastes through authorized vendors. | Yes | This act will be applicable for the storage and disposal of all the plastic wastes. | State Pollution Control Board, Kerala |
| **Other Applicable Rules** | | | | | |
| 9 | Construction & Demolition, Waste Management Rules, 2016 | | | | |
| 10 | Batteries (Management and Handling) Rules, 2001 | | | | |
| 11 | E-Waste (Management) Rules, 2016 | | | | |
| 12 | Kerala Municipality Act, 1994 & Rules | | | | |
| 13 | Hazardous & Other Wastes (Management And Transboundary Movement) Rules, 2016 | | | | |
| 14 | Bio-medical Waste (Management & Handling) Rules, 1998 | | | | |

## Applicable Social and Other Legislation

**Other Legislations applicable to Construction activities under the project**

- Workmen's Compensation Act 1923 (the Act provides for compensation in case of injury by accident arising out of and during the course of employment);
- Payment of Gratuity Act, 1972 (gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years);
- Employees PF and Miscellaneous Provision Act 1952 (the Act provides for monthly contributions by the employer plus workers);
- Maternity Benefit Act, 1951 (the Act provides for leave and some other benefits to women employees in case of confinement or miscarriage, etc.);
- The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 is introduced to prevent and provide redressal of complaints of sexual harassment.
- The Protection of Women from Domestic Violence Act, 2005 defines domestic violence, describes the powers and duties of protection officers, service providers and lists the procedures for obtain reliefs.
- Contract Labor (Regulation and Abolition) Act, 1970 (the Act provides for certain welfare measures to be provided by the contractor to contract labour);
- Minimum Wages Act, 1948 (the employer is supposed to pay not less than the Minimum Wages fixed by the Government as per provisions of the Act);
- Payment of Wages Act, 1936 (it lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers);

- Equal Remuneration Act, 1979 (the Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees);
- Payment of Bonus Act, 1965 (the Act provides for payments of annual bonus subject to a minimum of 83.3% of wages and maximum of 20% of wages);
- Industrial Disputes Act, 1947 (the Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment);
- Industrial Employment (Standing Orders) Act; 1946 (the Act provides for laying down rules governing the conditions of employment);
- Trade Unions Act, 1926 (the Act lays down the procedure for registration of trade unions of workers and employers. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities);
- Child Labour (Prohibition and Regulation) Act, 1986 (the Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labour is prohibited in Building and Construction Industry);
- Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979 (the inter-state migrant workers, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home to the establishment and back, etc.);
- The Building and Other Construction Workers Act (BOCW), 1996 is a social welfare legislation that aims to benefit workers engaged in building and Other Constructions Works.

### 2.2 The World Bank Safeguards Policies, and KSWMP ESMF

The World Bank policies and directives on environmental and social safeguards have been adhered to the proposed dumpsite remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are summarized below.

**Environmental Codes of Practices (ECoP):** The ECoP's guidelines for environmental management of bio-mining and bio-remediation activities which are seen to be of limited extent of impacts/risk, temporary and reversible, and readily managed with good practices during the implementation. The following key points should be considered.

**Key Points of ECoP to be considered:**

- The bio-mining activities and preparatory activities shall follow the "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" published by CPCB in February 2019.

- Bio-mining methods include Tractor Tiller, Trench method, Cone Method, windrow, Thin Layer Method, etc. More appropriate may be the Cone method for legacy waste and window for relatively fresh waste.

- Leachate channelization and treatment facility shall be set up before starting the bio-mining works. Works shall take place only during the non-monsoon period; and there shall be

suitable precautions to prevent any rainwater disturbing the operations (like seasonal unexpected rains, storm water, runoffs from other sources).

- Ballistic separator and trommel may be used for screening. Screened fractions into which waste is segregated include RDF, inert, Compost, and C&D wastes.

**Applicable World Bank Operational policies**

OP 4.01 Environmental Assessment Help to ensure the environmental and social soundness and sustainability of investment projects. Support integration of environmental and social aspects of projects in the decision-making process.

OP 4.04 Natural Habitats Promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions.

OP 4.09 Pest Management includes training to prevent risk to human beings or animals from Bio-culture, enzymes, insecticides and such formulations used for remediation.

OP 4.11 Physical Cultural Resources (PCR) includes resources of archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites), aesthetic, or other cultural significance. Assist in preserving PCR and in avoiding their destruction or damage.

WB General EHS Guidelines Recommendations of these guidelines would be incorporated in ESMP and Bidding document for this sub-project.

The Environmental Management Framework (EMF) has been prepared to assist in the screening, assessment, and management of environmental risks of all solid waste management projects at an early stage during the planning and integration, mitigation hierarchy during the subproject design, implementation, and operation. The framework helps provide specific guidance on the policies and procedures to be followed for environmental assessment along with the roles and responsibilities of the implementing agencies.

# CHAPTER 3. ENVIRONMENTAL AND SOCIAL BASELINE

## 3.1 Project Location of the Site

Kalamassery dumpsite is located at a distance of 1.0 km from the centre of Kalamassery town in western side and encompasses a total area of approximately 1.95 acres of land. The coordinates of the dumpsite are 10.065159° N & 76.327607° E. The dumpsite is surrounded by NH-544 highway in NW direction, a railway line passing through in SE direction and vacant land in the NE side of the dumpsite. A small nallah flows in NE direction of the dump site at a distance of 30 m. The google map image showing the location of Kalamassery dumpsite is shown below in **Figure: 3.1**.



**FIGURE: 3.1 GOOGLE IMAGE SHOWING THE LOCATION OF THE EXISTING DUMPSITE AT KALAMASSERY**

## 3.2. Methodology for Environmental Baseline Studies

The baseline appraisal should consider all aspects of the environment that may be altered by the proposed project. These can be categorized as physical, biological or socioeconomic attributes. The baseline should be based upon the findings of the screening and scoping studies. Surface water and sediments, groundwater, air quality, noise, soils and land use Biodiversity Socio-economic (social), cultural heritage, traffic and transport Physical Biological Socio-economic. The scope of the baseline study, including attributes that will be appraised, and the geographical extent of the analysis, will typically have been agreed with the relevant decision makers as an outcome of the scoping phase. It is important to re-emphasize that the scope (and detail) of the baseline study should be commensurate with the size and scale of the project and hence the potential changes that the project may have upon the environment and society. The baseline study will typically be developed in three stages:

**Desktop study:** Office-based exercise during which readily available existing information (i.e. that can be used to describe the existing environment) is collected and reviewed to ensure its appropriateness for use within the EIA & SIA;
**Field study:** The stage within which additional data is captured in the field, with the intent of addressing any gaps that have been identified in the existing knowledge base; and
**Reporting stage**: Collation of the captured information into the baseline report.

The below table indicates the environmental attributes and location of monitoring.

**TABLE : 3.1 ENVIRONMENTAL ATTRIBUTES**

| S.NO | DESCRIPTION | PARAMETERS TESTED | SAMPLING LOCATION | JUSTIFICATION |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs. | Upwind direction in West South West (WSW) boundary of the dumpsite. Sampling at Distance 50 m from the boundary of dumpsite. | The AAQ locations were chosen based on the Wind rose data obtained for Kalamassery. The most predominant wind direction are from West and WSW. |
| | | | Downwind direction in North East boundary of the dumpsite. | |
| 2 | Noise (1 Location) | Ambient Noise level (E(P)) for 24 hours | Entrance of the dumpsite. Distance 20 m from the boundary of dumpsite. | Most vulnerable point in the site in regards of Noise quality is due to entry and exit of the waste loading and unloading vehicle and nearby highway NH-544 highway in NW direction. |
| 3 | Surface water (2 Location) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, E.coli and Total coliforms (IS 10500-2012). | One Surface water sampling location at 245 m distance in North West direction ie, upstream of the river muttar. | Surface water sample points are selected based on the water flow from upstream to downstream. |
| | | | Second surface water sampling location at 30 m distance in North direction ie, downstream of the muttar river called nallah. | |
| 4 | Ground water (1 Locations) | Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, E.coli and Total coliform (IS 10500-2012). | Groundwater sampling location at 100 m distance in East direction. | |

| TABLE : 3.1 ENVIRONMENTAL ATTRIBUTES | | | | |
|---|---|---|---|---|
| **S.NO** | **DESCRIPTION** | **PARAMETERS TESTED** | **SAMPLING LOCATION** | **JUSTIFICATION** |
| 5 | Bore Hole(1 location) | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, Strength compressibility (vertically-3 samples per borehole). | Centre of the dumpsite. | Volume of legacy wastes were found to be higher in the center part of the dumpsite during investigation. So the bore hole test was performed in the center. |
| 6 | Waste & Environmental Analysis | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammonical nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cynide, Chloride, Fluoride, Phenolic compounds. | North East boundary direction within the dumpsite - one point | |
| | | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | Within the dumpsite at 2 locations, one at East direction and at one at West direction. | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. So the two locations were considered for sampling. |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Poatassium (N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor | 1 | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. |

### 3.3 Environmental Audit of the existing Dumpsite

Inside the dumping yard, there are two MCFs, RRF and washrooms for the workers assigned for the collection and segregation process. The MCF are functional for dry waste management in the Kalamassery dumpsite, but not supported under KSWMP project. However, an environmental audit of the facility is important since is situated at the same site and might be impacted during the bio-mining activities.

| TABLE: 3.2 ENVIRONMENTAL AUDIT OF EXISTING FACILITIES | | |
|---|---|---|
| **S. NO** | **ASPECTS** | **REMARKS** |
| 1 | Structural Characteristics | Area – MCF 1-13.5*8.5 = 114.75 (in Sq. m)<br>MCF 2-15*7.5 = 112.5 (in Sq. m)<br>RRF - 13.5*5.3 = 71.55 (in Sq. m) |

| | | |
|---|---|---|
| | | Buffer/setback around the MCF – 5 FT<br>Distance from waste pile of dumpsite- 10 m.<br>Roof: (GI Sheet Roof, Damaged)<br>Floor (Cement Floor, Damaged)<br>Walls: No<br>Doors & windows: No |
| 2 | Functional Characteristics (MCF & BSF Units) | Activities in the MCF/RRF: Functional MCF. Bailing machine functioning now.<br>Materials and condition of stacking: Not organized<br>Activities spilling out onto the dumpsite: Yes<br>Access to the MCF (Common access for MCF/RRF & Dumpsite. Both are in the same premises.)<br>No: of workers – 22 in MCF |
| 3 | Facilities (MCF & BSF Units) | Parking area - Near yard in crematorium<br>Loading/unloading Area -Yes<br>Storage room & area: No<br>Worker snack/rest areas: No<br>Worker / other washrooms & sewerage: Yes<br>Water supply for Cleaning, Washroom: Yes<br>Greenbelt: NIL |

### 3.4 Physiography and Climate

**Physiography**

Physiographically, Kalamassery falls under Flat Terrain zone.

**Climate**

Kalamassery has a tropical climate. Rainfall is significant in most months of the year, and the short dry season has little effect. As per Climate-Data.org, the average annual temperature is 27.6 °C in Kalamassery. Precipitation here averages 3,570 mm. The month of January has 22 mm of rainfall. Most of the precipitation here falls in June-July with an average of 568 mm. The warmest month of the year is March with an average temperature of 29.4 °C. As per wind rose diagram, the most predominant wind directions are blowing from WSW and West direction, hence it was being considered for AAQ monitoring location. The wind rose diagram for Kalamassery (Ernakulum) is shown in **Figure: 3.2**.



**Source:** meteoblue

**FIGURE: 3.2 WINDROSE DIAGRAM FOR ERNAKULAM**

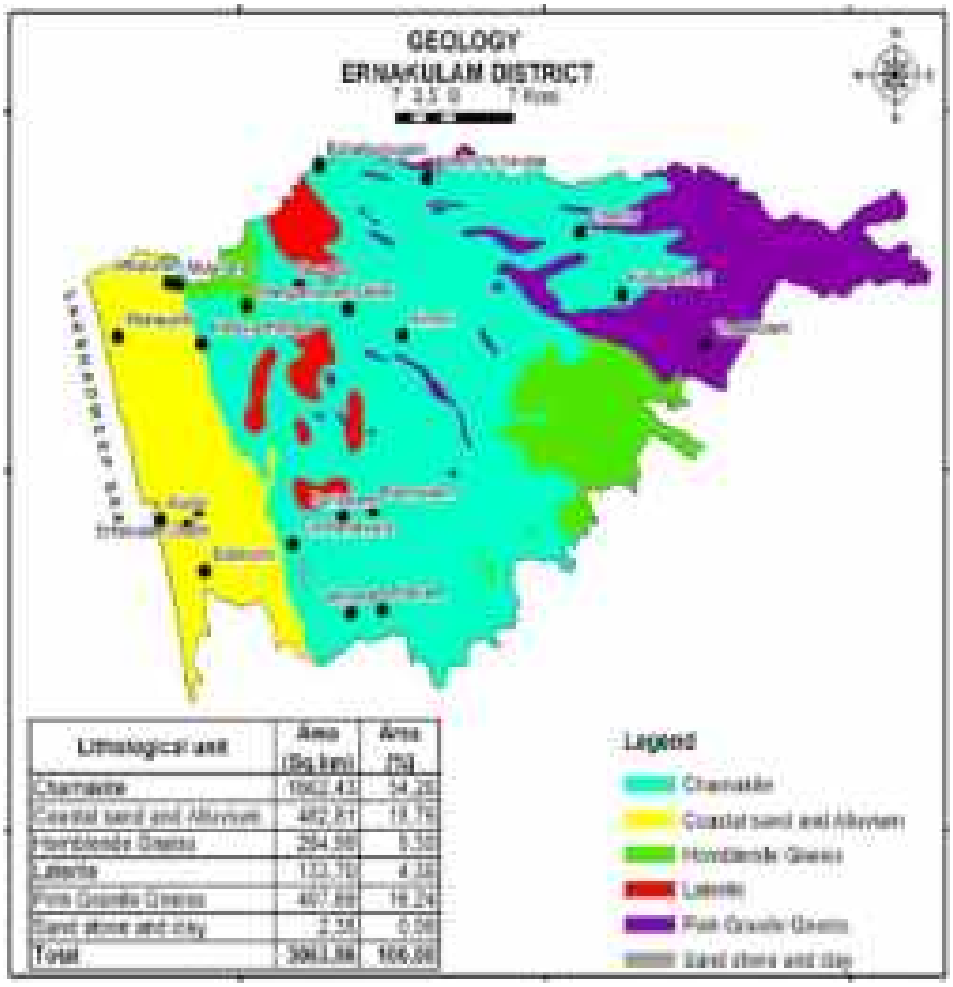
### 3.5 Hydrology, Hydrogeology, and Soil

**Hydrogeology**

The occurrence and movement of ground water is mainly controlled by factors like physiography, geological setting, etc. The aquifer type is phreatic aquifer and ground water table level ranging from 5 to 10 m during most of the year.

**Geology**

The geology of Kalamassery is predominantly of Charnockite group. The geology map of Ernakulum District is shown in **Figure: 3.3**.

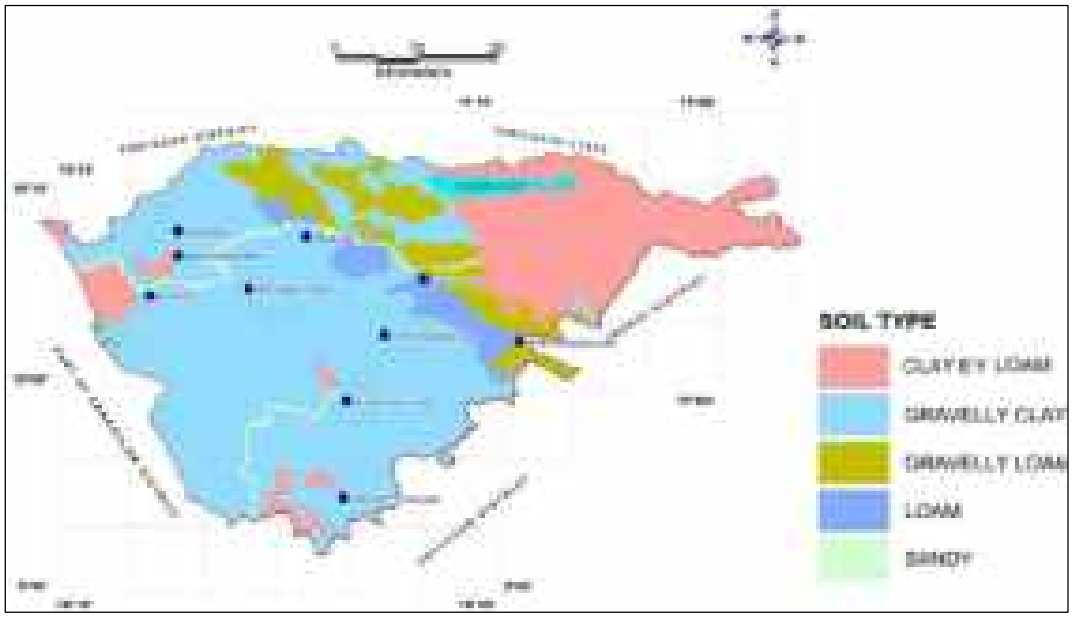



**Source:** CGWA, Ernakulum

**FIGURE: 3.3 GEOLOGICAL MAP OF ERNAKULAM DISTRICT**

**Soils**

As per the geotechnical investigation, the soil was encountered at 8.5m below the waste depth of the dumpsite and the predominant soil is gravelly clay. The detailed geotechnical investigation report is enclosure in the FR. The map showing soil type of Ernakulum is shown in **Figure: 3.4**.

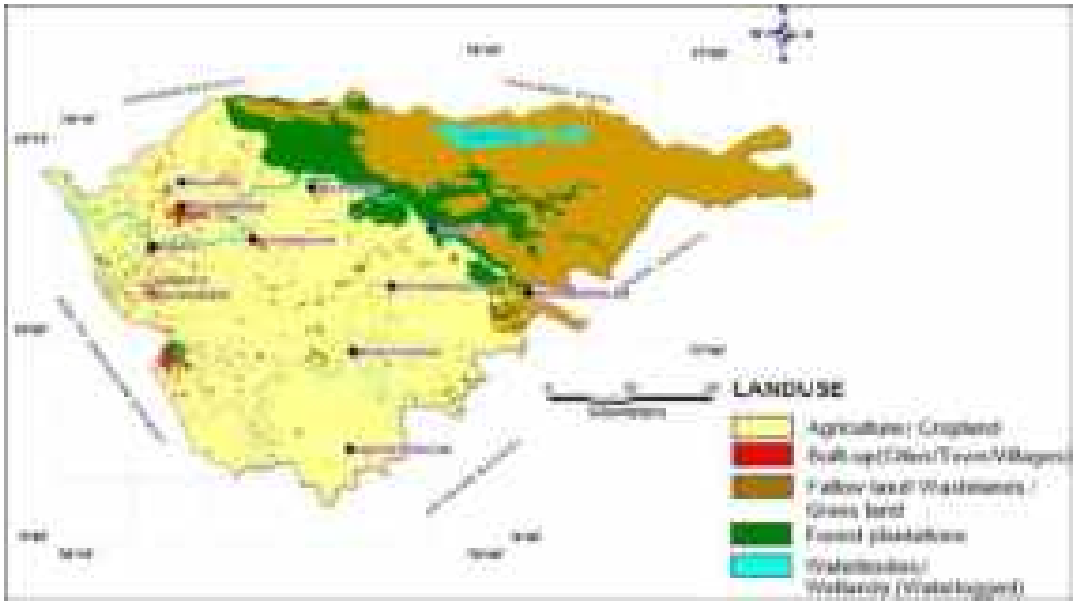



**Source:** CGWB, Ernakulum

**FIGURE: 3.4 MAP SHOWING SOIL TYPE OF ERNAKULAM DISTRICT**

### 3.6 Land Use & Land Cover

The highest percentage of land use falls under residential/agricultural mix of (47.96%), which include mainly dry agriculture lands where in residential developments are co- existent, forest land (23.17%), agriculture (9.22%), residential (5.67%), water bodies (5.7%), plantation (5.52%), marshy land (1.87%) and the remaining areas are under other built up land use. The land use & land cover map of Ernakulum District is shown in **Figure: 3.5**.




**Source:** CGWB, Ernakulum

**FIGURE: 3.5 LANDUSE & LANDCOVER MAP OF ERNAKULAM DISTRICT**

### 3.7 Cultural Heritage

The cultural heritage zone near Kalamassery municipality is Thrikkakkara Vamana Moorthy Temple- 4.5 Km away, South direction from the dumpsite. Hence, no significant physical impact to the heritages site is envisaged during remediation.

### 3.8 Ecology and Biodiversity

The wild faunal species present are, mainly dogs, rodents and flies are seen near the dumpsite. Also, crow, egrets, and other birds are seen feeding on the wastes. The flora mostly covers shrubs, tubers, and trees.

### 3.9 Site Connectivity

The nearest National Highway is (NH-544)- 4 lane (Two Way) in NW direction which is adjacent to the dumpsite. The dump site has well connected road access facility for transportation.

### 3.10 Natural Disasters

As per the district disaster management plan-2015 and flood vulnerability map, the dumpsite is not under flood prone zone.

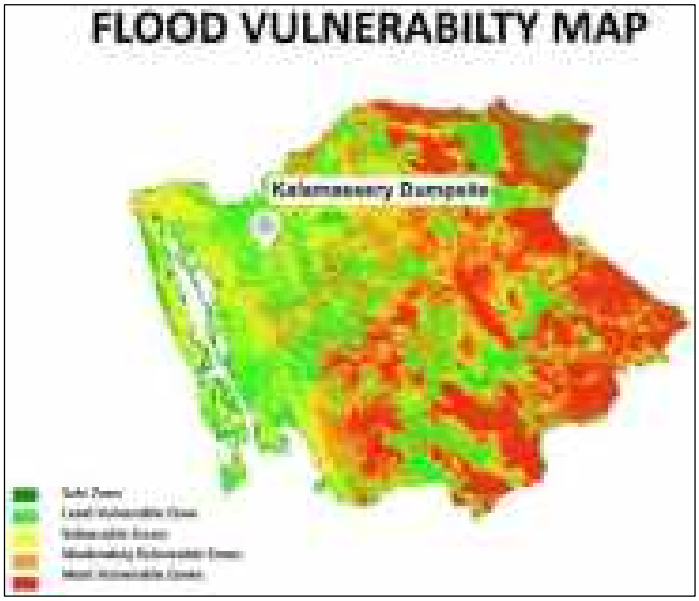



**FIGURE: 3.6 MAP SHOWING FLOOD VULNERABLITY MAP OF ERNAKULAM DISTRICT**

### 3.11 Description of Environmental Parameters

**TABLE- 3.3 DESCRIPTION OF ENVIRONMENTAL BASELINE PARAMETERS**

| S NO | ENVIRONMENTAL ASPECT | DISCUSSION ON BASELINE SCENARIO | REMARKS ON DEMAND SUPPLY GAPS (AVAILABILITY, QUALITY) & ASPECTS TO BE ADDRESSED IN THE SUBPROJECT |
|---|---|---|---|
| 1 | Water Source<br>a) Surface water<br>b) Ground Water | A) Surface water: One Surface water sampling location at 245 m distance in North West direction ie, upstream of the river | Site Drainage & leachate Impacts due to bio mining activity (especially during any seasonal rain) is important as far as |

| TABLE- 3.3 DESCRIPTION OF ENVIRONMENTAL BASELINE PARAMETERS | | | |
|---|---|---|---|
| **S NO** | **ENVIRONMENTAL ASPECT** | **DISCUSSION ON BASELINE SCENARIO** | **REMARKS ON DEMAND SUPPLY GAPS (AVAILABILITY, QUALITY) & ASPECTS TO BE ADDRESSED IN THE SUBPROJECT** |
| | | muttar and Second surface water sampling location at 30 m distance in North direction ie, downstream of the muttar river called nallah– all parameters are well within limits except BOD.<br>B) Groundwater sampling location at 100 m distance in East direction- all parameters are well within limits. | the nearby soil & water environment are concerned. |
| 2 | Leachate | The data indicates very low concentrations of tested parameters. The heavy metals are also found to be below detected limit, hence the soil is unlikely to be contaminated by heavy metals from the waste. | |
| 3 | Air Quality | Air samples were collected from 2 locations at 50 m from the boundary of dumpsite and North East boundary of the dumpsite and results found to be well within the permissible limit. | The vehicular movement of machinery and recovered material during dump site remediation will be the additional source of Air Pollution. |
| 4 | Noise Level | Noise Level monitoring samples collected at Entrance of the dumpsite. Distance 20 m from the boundary of dumpsite. Noise levels are well within the National Ambient Noise standards for Commercial area. | Proper remedial measures for increased noise level shall be ensured by the contractor while bio mining activity. |

# CHAPTER 4. ANALYSIS OF ALTERNATIVES

## 4.1 Alternative 1: No Project Alternative (without Dumpsite Remediation)

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevent further contamination of the site.
If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows.
1. Foul Odor Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.
2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.
3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.
4. Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the surrounding environment, disrupting natural habitats and causing long-term ecological imbalances.
5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

## 4.2 Alternative 2: Mode of Execution / Management Alternative

Muvattupuzha Municipality intends to complete the remediation project as earlier. However, considering the time required for mobilization, installation, sieving and handling recoverable etc., a time frame of about six months will be considered. The broad timeline chart for the execution of this project is given below Table – 4.1.

**TABLE – 4.1 TIMELINE CHART FOR EXECUTION**

| S. No. | Task Name | M 1 | M 2 | M 3 | M 4 | M 5 | M 6 |
|---|---|---|---|---|---|---|---|
| 1 | Planning & Mobilization | ■ | | | | | |
| 2 | Foundation & Civil Works (Cover Shed installation) for machineries , Hiring & Installation of Machineries, Electrical Works | ■ | ■ | ■ | ■ | ■ | ■ |
| 3 | Excavation of Legacy Waste | | ■ | ■ | ■ | ■ | ■ |
| 4 | Site Development for Windrows & Leachate Collection | | ■ | ■ | ■ | ■ | ■ |
| 5 | Windrow Formation & Spraying of Bio culture | | ■ | ■ | ■ | ■ | ■ |
| 6 | Sieving Operations | | ■ | ■ | ■ | ■ | ■ |
| 7 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | ■ | ■ | ■ | ■ | ■ |
| 8 | Project Closure Activities:<br>• Levelling of Reclaimed Land using Bio-soil<br>• Handover the available infrastructure at site to the ULB<br>• Closure Report Submission to ULB, | | ■ | ■ | ■ | ■ | ■ |
| 9 | Buffer Period (Rainy Season) | ■ | ■ | ■ | ■ | ■ | ■ |

### 4.3 Alternative 3: Technology Alternatives

The selection of the appropriate method or technique for remediation is determined by considering several parameters. These include the significant aspects and suitability of remediation types such as,

1. Capping without land recovery,
2. Bio-mining – reclamation/recovery of 100% land
3. Capping with partial land recovery.

Additionally, factors like available resources such as manpower, machinery, finances, and physical site conditions, including the quantity and characteristics of legacy waste, Environmental baseline, social concerns, regulatory compliance (KSPCB/NGT), the need for complete land recovery, and opportunities for utilization of processed aggregates/by-products are taken into account.

After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

# CHAPTER 5. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

Bio mining and bioremediation of existing legacy dumpsites brings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more man-days at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, bio-mining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration) are important in this case. In addition to the below mentioned,

(i) Drainage and leachate flow into regional waterbodies (& esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies,
(ii) Pollution on land/soil, dust and odour nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks,
(iii) Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and
(iv) Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at this stage, while some would be known only based on the project details that would be known from the work plan of the contactor once on board.

## 5.1 Impact Assessment Methodology

Impacts are assessed based on Magnitude, Duration, and Significance of the impacts and sensitivity of the receptors present within the 200 m aerial distance of Kalamassery dumpsite.

### 5.1.1 Magnitude and Duration of Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Bio-mining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;
- The spatial extent of the potential impact;
- Reversibility of the Impact;
- Legal standards and established criteria.
- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table Aspects for Determining the Magnitude of Impacts. Magnitude is assessed as medium, considering shorter duration of the activity. However, magnitude of cumulative impacts of various dumpsite remediation might be High.

| TABLE: 5.1 ASPECTS FOR DETERMINING THE MAGNITUDE OF IMPACTS | | | | |
|---|---|---|---|---|
| **Aspects** | **Large** | **Medium** | **Small** | **Negligible** |
| **Duration of the potential impact** | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or Less than the lifespan of the program | Temporary with no detectable potential impact |
| **Spatial extent of the potential impact** | Regional – much beyond project boundaries | Beyond immediate Program components, site boundaries or local area | Within program boundary (but cumulative impact of various dumpsite bio mining activities will be on larger extent) | A specific location within program component or site boundaries with no detectable potential impact |
| **Reversibility of potential impacts** | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months | Baseline remains constant |
| **Legal standards and established professional criteria** | Against national/approved standards and or international guidelines/obligations | Complies with limits given in national standards but not confirming to international lender guidelines in one or more parameters | Meets minimum national standard limits or international guidelines | Not applicable |
| Likelihood of potential impacts occurring | Commonly occurs under typical operating or construction conditions (Certain) | Usually seen occurring under most situations (Likely) | Occurs under abnormal, exceptional or emergency conditions (Occasional) | Unlikely to occur |

NOTE: Anticipated Project Duration - 5 to 6 months

### 5.1.2 Sensitivity of Receptor

The dumpsite is surrounded by Within Apollo junction and SCMS Cochin School of Business and there are no many habitats within 200 metres. Hence sensitivity of receptors will not affect much due to the bio-remediation process of the dump site and can be categorized as low Vulnerable receptor capacity to absorb proposed changes or/and good opportunities for mitigation. In addition, there is a nallah which flows at a distance of 30 m from the dumpsite in

North direction, there is chance of runoff and leachate towards the nallah during rainy season. Hence, the sensitivity of this receptor is estimated as high.

### 5.1.3 Significance of the impact

The significance of the Sub-project impact is tabulated below: -

| TABLE: 5.2 SIGNIFICANCE OF THE PROJECT | | | |
|---|---|---|---|
| **PROJECT DETAILS** | **SENSITIVITY** | **VULNERABILITY OF RESOURCE** | **IMPORTANCE OF RESOURCE** |
| No project Impacts | High | Medium | Medium |
| Project with Bio Remediation (Bio-mining) | Low | Low | Low |

Overall, Bio mining will have a low to medium impact, with more of a positive Impact on the Environment and Human health in the longer term.

**Source-Pathway-Receptor Analysis**

A) **Source:** The source of contamination is the legacy waste remaining and being deposited at the Kalamassery closed dumpsite, more specifically the landfill gas and leachate generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. The total waste volume 55,927.88 cu. m with the dumpsite spreading over 1.95 acres and the legacy waste presented is about 8.5 m below and 2.5 m above the existing ground level. In addition to the landfill gas and leachate, windblown dust and litter are also considered as sources of contamination.

B) **Pathways:** The following pathways for migration of contaminants have been identified: Wind- The main pathway for litter and dust dispersion is the wind. As long as the waste is kept uncovered, the dust and litter will continue to be blown off the dumpsite to the surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. Rainwater runoff through the dumpsite acts as a pathway for transport of leachate to the soil and groundwater. The rainwater flowing off the dumpsite along the slope towards North Eastern direction acts as a pathway for the uncovered waste to flow into the canal along the boundary to Northern side, which runs alongside the dumpsite at distance of 30 m.

   The leachate flows with groundwater and acts as the pathway. Surface water contaminants like run-off from the dumpsite, leachate and windblown dust and litter that reach nearby surface water bodies like canals and rivers are further transported by surface waters and in this case the surface water acts as the pathway.

C) **Receptors:** Receptors are air, surface water (drain passing through residential areas) and ground water. No households within 200 m from the dumpsite. As the dump is not contaminated by hazardous wastes, remediation would improve the pollution scenario provided the bio-earth used is pollution free and of good quality. However, other impacts are expected on the final destinations of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF/MRFs in the region. Depending on the locations of end use of fractions retrieved from bio-mining, the contractor shall assess the impacts on communities and workers on site & nearby; and near locations of end-use. Key impacts may

result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after bio-mining activity, activities in bio-mined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post bio mining activity.

**5.2 Impacts on Air Environment**

Key impacts on air include:

- Emission of Methane and other Greenhouse gases; and its impacts on scavengers, workers on site/other facilities on site (MCF & RRF in this case), nearby communities of Ward 06.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odour, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.
- When the legacy site is opened, existing gases would get emitted. Further, any delay /unexpected stoppage of bio mining activity, might further aggravate the process of gas formation depending on waste composition, leading to odour and fire risks.

***5.3. Impacts on Water Environment***

**Ground water:**

- The ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. Oozing & pooling of leachate & it draining to nearby areas during rains would be an important aspect to be managed during bio mining to prevent ground water contamination
- Leachate samples: BOD and COD values may impact the ground water quality in nearby residences, wells, and long term soil pollution.
- Borehole data: Dump below water table may impact water resources and wells nearby.
- Ground beneath the dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. There are no parameters exceeding the permissible limits for heavy metals.

**Surface water:**

- The dumpsite experienced flooding during 2018 floods and the site is not vulnerable to flooding. The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas. A nallah is at a distance of 30 m from the dumpsite.
- Predominant slope is from North Western towards North East Direction. During rainy season leachate from the site flows to nallah which flows through nearby nallah. It is important to contain and treat leachate from the proposed bio mining activities on site. Treated leachate may be recirculated or used for other purposes.

**5.4 Impact due to Odour**

Dumpsite of organic, or partly organic waste, always results in anaerobic degradation of the waste and consequently, the production of landfill gas, consisting mainly of methane, $H_2S$, Ammonia, and carbon dioxide. If not properly managed the gas can cause odor problems in the neighborhood and since landfill gas is a highly potent greenhouse gas it will also contribute to the increased level of greenhouse gases (GHG) in the atmosphere. Dumpsite gas may also increase the risk of fires or explosions at the landfill site and surroundings.

**5.5 Impact on Noise**

A potential nuisance is a noise from transport of vehicle and machinery operating during remediation phase of the Dumpsite and transports of waste to the Dumpsite. The topography is favorable to attenuate noise to the surroundings. Apollo junction and SCMS Cochin School of Business and there are no many habitats within 200 metres. Hence, the impact will be lower during remediation to the residents.

**5.6 Impacts on Soil**

- Historic land use assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it shall be excluded from the site as bio mining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.

- Spillover of activities to nearby road and land would result in pollution of all types on these areas. Hence it is important to restrict all activities to the site for legacy waste bio mining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.

- Ground beneath dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. In Kalamassery, all heavy- metals are falling within the limit as per Fertilizers Control Order 1985 and its amendments. Kalamassery does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste (including legacy asbestos), e-waste or biomedical waste is found while bio mining, same shall be retrieved, transported, treated and disposed as per specific waste guideline of the Central Pollution Control Board, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste), Feb 2019 and World Bank EHS Guidelines. A plan shall be prepared to auditing of all wastes, management, eliminating pollution & OHS risks; and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.

**5.7 Other impacts on Biodiversity - Fauna/Flora**

- There are no sensitive biodiversity areas within 10 km of the site. However, since the project involves transport of wastes, it is important to consider the impact beyond the project boundaries. Within 42 Km, east direction from the site, there is a Kothamangalam Forest Range.
- Fauna: impacted by direct consumption of the solid wastes, sharps, entanglement, or by consumption of plants and/or animals contaminated by wastes, or as a result of leachate effects on groundwater and surface water.
- Flora: Plants near open dumpsites can be impacted directly by the waste, dust or smoke from burning. Disturbance to vegetation due to machinery, trampling by foot, vehicle or animals, or contamination by waste or leachate, the migration of landfill gas, or as a result of burning or smoke.
- Disturbance to other fauna and flora on site: onsite activities including those related to MCF and RRF may also impact fauna/flora through high noise levels of pre-construction / construction activities.
- Biodiversity of existing site: Only naturally occurring plants and animals were noticed, no threatened or endangered. There is no key species identified which are listed by IUCN.

**5.8 Other Impacts on existing or proposed activities on site/s**

- There may be approvals from various agencies for bio mining activities and associated facilities; depending on utilities and uses on site & associated activities. These permits shall be obtained prior to initiating activities on site.
- Impacts of bio mining on existing facilities on site such as RRF, MCF, etc. (disturbance to activities & people due to dust, leachate, noise, odour; additional load of wastes to these facilities, vibration impacts & structural damage, etc.).
- Post bio mining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped, or if this is dumped elsewhere or not processed, it will lead to health and environmental issues. This alternate location, being associated facility need mitigation measures to avoid/minimize pollution, Health & Safety impacts on workers, communities. Also, forward linkages are considered as associated facilities/linked activities. Impacts of transportation of these fractions (traffic increase, odor, leachate, dust), impacts during rains & emergencies, handling, storage at the identified locations, reuse etc, shall be mitigated.

# CHAPTER 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN

## 6.1 Proposed Environmental and Social Management Plan

The proposed Environmental and Social Management plan is presented in the below table.

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| ***A*** | | **Planning and Pre-Construction Stage** | | |
| ***1*** | | ***Planning for bio mining facility*** | | |
| 1 | Bio mining & Bioremediation Plan & Capacities | ▪ Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / bio mined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these bio mined material in line with the agreements with such facility owners and National, State regulations and WB EHS<br>▪ Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate Management Plan.<br>▪ The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers.<br>▪ Contractor to get all required licenses & permits before start of any activity on site | Contractor | SPMU/DPMU /ULB |
| 2 | Site Access Closure | ▪ The total cessation of dumping in the site will be implemented before any works.<br>▪ All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public.<br>▪ The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance to indicate that the waste dump has been closed from the operation.<br>▪ To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br>▪ Grading shall be performed where necessary to provide a neat appearance | ULB or Contractor as per Bidding mechanism | SPMU/DPMU /ULB |
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – *impact on air quality,* | ▪ Carry out site assessments as per Guidelines for Bio mining of Legacy Waste Dumpsites of CPCB<br>▪ Consider safe bio mining & gas / leachate generation from existing capped portion of the site<br>▪ Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means | TSC, ULB, Contractor | SPMU/DPMU /ULB |

| | | | | |
|---|---|---|---|---|
| | *odor, water contamination due to leachate, health and safety impacts of the people working in the site assessment* | ▪ Provision of appropriate PPE's to the team undertaking the site assessments<br>▪ Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>▪ Plan for machinery operated which will be operated by skilled operators at all times.<br>▪ Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures.<br>▪ Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | | |
| 4 | Absence / Delay in Permissions for Developing the bio mining facility and associated works as per National regulations | ▪ Required permissions for undertaking bio mining at the existing dumpsite and assessments conducted for undertaking bio mining as per existing Laws, Regulations; including for associated infrastructure, DG Sets, Consent to Establish; and other licenses including those as per Labor Laws, before the start of works on site | Contractor, ULB | SPMU/DPMU /ULB |
| 5 | Dust impacts due to Site works, screening & stacking of retrieved wastes *(Air Pollution) and Visual Blight due to excavation* | ▪ Plan to Provide temporary high screen, buffers around the site before the start of work to curtail dust emissions<br>▪ Arrange a green belt as early as possible on the area of the site with no / less dump. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers)<br>▪ PPEs to be used by workers<br>▪ Awareness to communities & suggest to use PPEs | Contractor and or ULB depending on agreement on bidding mechanism/DPR | SPMU/DPMU /ULB |
| 6 | Material sourcing, transport, and stacking of construction materials *(Occupational Health and Safety issues and Air noise pollution)* | ▪ Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism<br>▪ Prior intimation to nearby Primary Health Centre on work activities need for medical support, emergency support needs, type of laborers on-site and labor camp if any<br>▪ Materials shall be sourced only from approved quarries<br>▪ Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions.<br>▪ The driver should be with required license and follow speed regulations<br>▪ Materials shall be transported preferably through well-surfaced roads. If road it kuchcha, water sprinkling shall be done to prevent dust emission before and after truck passes<br>▪ Material transport and unloading activities should not result in noise disturbance to locals and should be during daytime | Contractor | SPMU/DPMU /ULB |

| | | | | |
|---|---|---|---|---|
| | | ▪ Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors.<br>▪ Provide vehicle wheel wash area on site<br>▪ Workers to be provided with Personnel Protection Equipment (PPE) including safety boots, jackets, ear muffs, gloves.<br>▪ Proper rest area on site shall be provided with water, first aid, toilets | | |
| 7 | The layout of Labour camp *(Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)* | ▪ Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp<br>▪ Nearby health center shall be informed about the labor camp & appropriate medical checkup shall be arranged periodically<br>▪ Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters)<br>▪ It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with landowners wherever the labour is accommodated<br>▪ Camp must not be provided in an area prone to Hazards<br>▪ Camp should be adequately at higher plinth levels to prevent water intrusion<br>▪ Rooms shall be of appropriate sizes with adequate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG)<br>▪ Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female labourers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc.<br>▪ The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security<br>(Refer ECOP section 06 and section 11 of EMF for KSWMP) | Contractor | Site engineer of SPMU, Labour Commissioner, PCB |
| 8 | Nearness/disturbance to sensitive areas such as forests, wildlife habitations, etc. especially in case of providing support facilities *(Impacts on Fauna / Flora)* | ▪ Ensure site selection for any support facilities or activities (such as vehicle storage etc. if no in bio mining site) based on the screening checklist and the master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate, Reduce. Obtain requisite permissions from respective authorities such as Pollution Control Board, ULB etc.<br>▪ Identify appropriate government site to avoid land acquisition and resettlement impacts<br>▪ Covered and well-marked storage area with cut off drains & odour/fly/dust/ fire prevention shall be ensured for excavated wastes and washing, segregation of the same are to be arranged with due consideration to nearby residences, slope and other land uses | Contractor | SPMU/DPMU /ULB |
| 9 | Contamination of groundwater due to leaching. Leachate | ▪ During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, | Contractor | SPMU/DPMU /ULB |

| | | | | |
|---|---|---|---|---|
| | parameters; BOD, COD, TDS, E.coli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution | it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant<br>▪ Depending on the contractors plan for bio mining of the site, adopt plans to manage leachate | | |
| 10 | Impacts on flora, fauna" consumption of wastes, leachate impacts, dust smoke burning, trampling/machinery | ▪ Movement routes of vehicles to be planned to avoid key fauna/flora on site<br>▪ Leachate collection & storage/treatment and recirculation shall be planned to avoid impacts on flora, fauna | Contractor | SPMU/DPMU /ULB |
| 11 | Nuisance hazards to neighboring areas | ▪ Ensure proper design and adequate compound wall; high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements<br>▪ In case of waste mound and site edges are sliding or unsafe; provide engineered retention walls. | Contractor | SPMU/DPMU /ULB |
| 12 | Treatment & Disposal of wastes and rejects | ▪ Contractor to Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & inert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventorised and quantified, including Bio earth, rejects, inerts. These shall be tested and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertiliser Control Order 1985 and their amendments. Asbestos Management Plan shall be prepared for management if Asbestos wastes retrieved if any<br>▪ Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period. | | |
| ***B*** | **Implementation or Bio mining & Bioremediation stage and Construction of ancillary facilities such as access road improvements, compound walls, greenbelts, drainage etc.** | | | |
| **Implementation of bio mining of the dumpsite** | | | | |

| | | | | |
|---|---|---|---|---|
| 1 | Impact due to the vehicular movement<br>*(Air and noise environment & Vehiclular - Vehicular & Vehicular - Pedestrian Conflicts)* | ▪ Vehicles and machinery are to be maintained so that emission conforms to National Ambient air quality standards.<br>▪ All vehicles and machinery should obtain Pollution Under Control Certificates<br>▪ HORN PROHIBITION signpost to be erected.<br>▪ Rumble strips/speed breaker to be provided on access roads.<br>▪ Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed.<br>▪ Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle<br>▪ Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements.<br>▪ Avoid heavy vehicle movement through adjacent NH road during peak hours 7 a.m. to 10 a.m. mention: school hrs. / peak hrs.; and during important period / festivals when people use the road to access temple<br>▪ Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents. | Contractor, ULB | SPMU/DPMU /ULB |
| 2 | Impact due to the use of heavy vehicle and equipment<br>*(Air and Noise environment)* | ▪ Mixing equipment (in case of construction of ancillary facilities) should be well sealed and be equipped with a dust-removal device.<br>▪ Equipment Operators & labourers should wear dust masks, ear protection, and hard hats.<br>▪ Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load.<br>▪ Labor to be provided masks / PPEs.<br>▪ Construction / Bio mining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spreading into neighboring sensitive land uses<br>▪ Noise standards at operation machines are to be strictly monitored to prevent exceeding of GOI noise standards.<br>  ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines.<br>  ▪ Using modern, well-maintained and regularly serviced vehicles.<br>  ▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>  ▪ Provision of earmuffs and ear protection to workers and employees in high noise areas.<br>▪ Workers in the vicinity of strong noise to wear protectors and their working time should be limited as a safety measure.<br>▪ As Kalamassery dumpsite has sensitive receptors and settlement areas within 150m of it (no households at 200 m distance, noisy works shall be stopped from 22:00 to 06:00. | Contractor | SPMU/DPMU /ULB |

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| | | ▪ Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum.<br>▪ Avoid noisy activities/machines near South side of the site where settlement exist within 50m. Noise barrier shall be provided at all noise-sensitive locations / for noise generating equipment such as DG sets, mixers (for ancillary facilities) especially near South side of the dumpsite<br>▪ Adopt required measures as per CPCB guidelines, and site & work specific safety requirements | | |
| 3 | Impact during the construction activities *(water environment)* | ▪ Labour camps if any (depending on Contractors work plan & arrangements) are to be located away from water bodies.<br>▪ Vehicle washing or maintenance near water bodies are to be avoided.<br>▪ Contaminated water from construction / bio mining activities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated on site. | Contractor | SPMU/DPMU /ULB |
| 4 | Leachate and Runoff from bio mining activities *(Soil contamination and groundwater contamination)* | ▪ Provide site cut off drain around the site to divert off storm water from entering the site, and to prevent contaminating downstream resources with run off from the dumpsite<br>▪ Depending on the contractors plan for bio mining of the capped area on site, implement leachate management to cause no harm to communities & environment<br>▪ Ensure storm water drains will lead to drain outlets<br>▪ Provide leachate drains lined from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area<br>▪ Provide proper treatment of leachate and storm water that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by bio mining activities like excavation and waste segregation and stabilization<br>▪ The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB.<br>▪ The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata<br>▪ Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff and hence reduce infiltration<br>▪ Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism<br>▪ Plan the works on-site only during non-rainy seasons and to complete the works before rains | Contractor | SPMU/DPMU /ULB |

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| | | ▪ Store leachate preferably in aboveground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide for emergency containment additionally | | |
| 5 | Soil decontamination from accumulated waste levels *(Impact on leachate, odor)* | ▪ Decontaminate the soil / stabilized layers remaining after sieving out wastes using windrow and bio culture of appropriate quality in line with standards / regulations or appropriate means as per CPCB Guidelines<br>▪ Vegetative layer using contaminant absorptive root varieties like Vetiver may be tried on soil and along the edge of the green belt or floating wetlands may be deployed in water channels nearby to maximize absorption of leachate in the soil by root-zone phytoremediation<br>▪ Soil and water testing shall be done and changes in contamination shall be noted. | Contractor | SPMU/DPMU /ULB |
| 6 | Excavation of waste from the waste mound *(Health and safety impacts)* | ▪ The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound.<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided<br>▪ Machinery operated for excavation should be operated by skilled operators at all times.<br>▪ Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on wastes.<br>▪ Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound<br>▪ In case of the waste mound and site edges are sliding or unsafe; provide engineered retention walls or string boundaries.<br>▪ When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection & treatment mechanism. | Contractor | SPMU/DPMU /ULB |
| 7 | Transportation of wastes or retrieved or other material in overloaded and open vehicles *(Air, Odour nuisances; spills and littering impacts on Air, Water, Land)* | ▪ All vehicles shall carry only approved load of weight<br>▪ Regular cleaning of roads & drains and removal of spills if any.<br>▪ All waste transport vehicles shall be covered and movement shall be during non-peak hours.<br>▪ Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities.<br>▪ Adopt required measures as per CPCB guidelines, and site specific safety requirements. | Contractor | SPMU/DPMU /ULB |
| 8 | Occupational health and safety impacts of the workers during the bio | ▪ Avoid direct & double handling of wastes through avoidance measures(suitable planning & equipment's), engineering controls & use PPEs<br>▪ Work area & Labour camps shall be provided with First Aid and other related activities.<br>▪ Emergency Preparedness plans shall be prepared and implemented for all manpower working | Contractor, ULB | SPMU/DPMU /ULB |

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| | mining & construction of support facilities:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage of chemicals/other materials, bio cultures or wastes etc; by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | centers and its field extension centers.<br>▪ An Environment Health & Safety policy shall be prepared and implemented<br>▪ Adequate manpower shall be provided & manager & staff shall listen and act upon the manpower related grievances.<br>▪ Workers will be provided with PPE such as face mask, gloves, shoes, nose masks & goggles<br>▪ Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed with out slip, trip, fall especially on waste, leachate or trenches<br>▪ Proper training will be provided regarding the maintenance of health<br>▪ Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks & water supply), food, and water in a hygienic environment (with proper hand wash). Provide clean eating areas where workers are not exposed to contaminated, hazardous or noxious substances.<br>▪ First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus<br>▪ Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health checkups. Arrange daily health checkup for workers working on waste heaps<br>▪ Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals.<br>▪ Measures such as deferred timings and stretch break to be adopted<br>▪ Secure all installations from unauthorized intrusion and accident risks;<br>▪ Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every days start of works / activities. Key hazards would be (but not limited to) are flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and leachate from existing capped area on site, electric shocks, works with heavy machines & equipment's, slips of men & material (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc.<br>▪ EHS specialist with adequate experience & third party supervision are important for bio mining activity<br>▪ Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites<br>▪ Provide visitor orientation if visitors to the site need to gain access to areas where hazardous | | |

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| | | conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible<br>▪ Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;<br>▪ Ensure moving equipment is outfitted with audible back -up alarms & flag men with whistles or speakers;<br>▪ Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit.<br>▪ Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenance to be marked well & safe kept before activity start near those In close proximity to this location, there is a transformer. Disallow worker exposure to noise level greater than 85 dB (A) for more than 8 hours a day without hearing protection<br>▪ All workers shall be registered as per prevalent labor laws (including a workforce of subcontractors) and provided insurance cover & others as per existing acts/laws<br>▪ Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractor's person/insurance agent<br>▪ While using heavy machinery like JCB, cranes, etc, inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle.<br>▪ While using heavy machinery like JCB, cranes, etc, inform communities to prevent children and others from going near operating / movement areas including roads.<br>▪ Flagmen shall be arranged if work is near schools, hospitals, major roads, and traffic control is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if possible<br>▪ A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs;<br>▪ No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor<br>▪ All works related to working at heights will be undertaken only during the daytime when sufficient sunlight is available; | | |

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| | | ▪ Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done;<br>▪ All excavation activities to be conducted in supervision of the site contractor;<br>▪ Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured.<br>▪ All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans prepared and implemented, as per Banks Incident Reporting Tool | | |
| 9 | Risk of fire due to conditions leading to spontaneous combustion *(Air environment, disturbance to communities and workers, health impacts, safety issues)* | ▪ Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for Implementation of SWM Rules 2016 –Fire Incidents at MSW Dumpsites (https://cpcb.nic.in/openpdffile.php?id=UHVibGljYXRpb25GaWxlLzQyNDRfMTY1NDE2Mzk3N19tZWRpYXBob3RvNzYxMi5wZGY= ), LSGD Kerala Government GO on Fire Safety of MRF, MCFs (for the MRF on site if used for storage of wastes)and other Regulations, guidelines applicable<br>▪ Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3; and National/State regulations & WB EHS<br>▪ Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes<br>▪ Avoid conditions that can lead to spontaneous combustion such as:<br>o Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard<br>o Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.<br>▪ Design the facility for access by firefighting equipment, including clear aisles among waste heaps or work areas and access to adequate water supply.<br>▪ Ensure workers are briefed of fire hazard & its management<br>▪ No unauthorized entry shall be permitted to the site; including of workers during holidays, nighttime, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating “trespassers not allowed”<br>▪ The following activities should be implemented to prevent fires from occurring at the facility<br>o adequate fire-fighting equipment should be made available on-site and stored in an accessible manner,<br>o all operating staff should be trained and able to manage fire outbreaks at any part of the facility.<br>o clear signage should be established to inform workers and the public that flammable | Contractor, ULB | SPMU/DPMU |

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| | | liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area.<br>o Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows.<br>o all fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the bio mining, storage, and processing areas.<br>o all flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating storm water.<br>▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the bio mining activity in line with National State regulations, guidelines and international good practices<br>▪ Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.<br>▪ Contain all local smokes/small fires inside the dump asap. Fire brigade help shall be sought on all smokes/fires outside the dump<br>▪ Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured.<br>▪ Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers | | |
| 10 | Construction of new facilities in retrieved land | ▪ The excavated site shall be protected from any dumping during or after the bio mining activity and shall be reserved for SWM activities in line with SWM Rules 2016<br>▪ Any new facility under KSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations | ULB | SPMU/DPMU |
| 11 | Pest / Vermin Control & Visual impacts<br>(Odour, flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center<br>▪ Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups<br>▪ Bio pesticides / biological control shall be followed. However, bio pesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used<br>▪ Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate management | Contractor, ULB | DPMU, SPMU |

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| 12 | Odour nuisance | ▪ Waste with a strong odor to be covered immediately they are emptied from vehicles.<br>▪ Control and manage leachate treatment to minimize odor.<br>▪ Provide buffers screens to curtail odor from reaching surrounding communities especially to North side of site.<br>▪ Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor. | Contractor, ULB | DPMU, SPMU |
| 13 | Storage, Collection, Transport, Treatment & Disposal of wastes and rejects | ▪ Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste<br>▪ Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters<br>▪ Waste handling shall be in line with existing regulations & guidelines & avoid health & safety impacts<br>▪ No material is allowed to remain on site after the contract period<br>▪ Adequate fire safety arrangements & awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported<br>▪ Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/interts in designated or agreed area & are in line with schedule; using GPS.<br>▪ Given that the access road is used by the public, it is imperative to implement the required safety precautions and environmental protection measures when transporting the waste. | Contractor, ULB | DPMU, SPMU |
| 14 | Other activities | ▪ No activity other than bio mining shall take place on site & any activity shall cause no adverse impacts on the environment or people<br>▪ If existing MCF shall be used for storing bio mining wastes, its safety shall be ensured in terms of fire & structural safety before starting to use the facility. Further usage of the MCF after bio mining works shall be after proper cleaning / washing & disposal of all rejects/inerts & tools to ensure good housekeeping & no H&S impacts<br>▪ If existing MCF shall be used by the ULB for storing dry wastes from Town, during bio mining period, alternate access shall be arranged & workers shall be adequately protected against any health & safety impacts | | |
| 15 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & bio mining / construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees<br>▪ Waste water and Leachate to be treated & recycled/reused | Contractor | ULB |
| **C** | **Future Site Usage (EMP shall be updated in line with EMF & used if future site usage is proposed under KSWMP). This section is not the responsibility of the Contractor for Bio mining, but of the future facility operator & ULB** | | | |

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| 1 | Future use of the bio mined site: Green Park, MCF, MRF, RRF, Treatment plants, landfill cell or any other, preferably for SWM | ▪ ULB to ensure that the site will not be used for future dumping.<br>▪ Activities at existing MCF to be upgraded to ensure that no waste (even dry wastes) gets dumped around.<br>▪ ULB shall plan the future use of the site shall be in consultation with the communities.<br>▪ Phase 1 Environmental Assessment to be caried out, EA for existing facilities & EIA for proposed development in line with EMF in case this is proposed to be developed under KSWMP<br>▪ All applicable clearances, permits shall be arranged in line with applicable regulations for the proposed new use of the site, and appropriate designs/plans to be prepared & implemented | Future Facility Developer/ Operator & ULB | ULB (SPMU in case it is under KSWMP) |
| 2 | Vehicle movement for new activities: MCF/MRF, RRFs, Treatment plants, landfill cell<br><br>*(Air, water environment, a nuisance to biodiversity, communities, Health impacts)* | ▪ The movement route shall be scheduled for each vehicle.<br>▪ Enforce speed limits applicable and make drivers aware of this<br>▪ Vehicles movement shall be tracked by Health Supervisors to ensure keeping up to schedule; preferably using GPS<br>▪ Any adulterated fuel shall be avoided. There shall be periodic emission tests for vehicles<br>▪ Provision of Personal Protective Equipment such as face mask, gloves, nose masks & goggles to all workers in C&T vehicles, Maintenance yards<br>▪ Proper lubrication shall be provided to minimize squeaking noise due to friction<br>▪ Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br>▪ The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public<br>▪ Traffic will be managed at the site by providing adequate space for parking of vehicles<br>▪ Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design<br>▪ No waste or material shall be disposed in any place other than the designated area; including water bodies, coasts/forests, or sensitive areas. | Future Facility operator | ULB |
| 3 | Exhaust emissions<br>*(Air impacts)* | ▪ No idling of vehicles on site.<br>▪ Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed | Future Facility operator | ULB |
| 4 | Plying of vehicles through kutcha / unsurfaced roads and idling<br>*(Air pollution: SPM, CO, CO2)* | ▪ Vehicle movement shall be well planned – through topped roads. In case of necessity to move through Kutcha roads, ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Future Facility operator | ULB |
| 5 | Impact on the ambient noise quality during the operations | ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines;<br>▪ Using modern, well-maintained and regularly serviced vehicles; | Future Facility operator | ULB |

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| | *(Noise, nuisance to sensitive receptors, health impacts)* | ▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>▪ Provision of earmuffs and ear protection to workers and employees in high noise areas | | |
| 6 | Occupational health and safety impacts of the workers:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | ▪ All OHS and CHS measures to be followed in line with applicable regulations, guidance<br>▪ Workers & communities shall be made aware of OHS, CHS risks and impacts & mitigation measures adopted<br>▪ Emergency management plan to be prepared & followed<br>▪ Workers shall be appropriately trained or OHS during construction & Operation of all future facilities | Future Facility operator | ULB |
| 7 | Pest / Vermin Control (Odour, flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted<br>▪ Bio pesticides / biological control shall be followed.<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used | Future Facility operator | ULB |
| 8 | Fire Safety | ▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented in line with National State regulations, guidelines and international good practices | Future Facility Operator | ULB |
| 9 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees<br>▪ Waste water to be treated & recycled/reused | Future Facility Operator | ULB |

### 6.1.1 Disposal phase of By-products from Bio-mining process

The bio-earth and coarse fraction soil recovered from dumpsite will be used for filling low lying areas. The RDF material recovered from dumpsite will be transported to nearby cement factory and recyclable material will be handed over to the authorized recycling agency. If the by-products are not removed from the site within a three-month period, penalties will be imposed on the contractor.

## 6.2 Disaster Management and Emergency Preparedness

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care, and other necessities of life. In the case of Dumpsite remediation, Disaster Management Plan is aimed to ensure the safety of life, protection of the Environment, protection of installation, restoration of the remediation process, and salvage operations in this order of priorities.

For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel training is to be provided through rehearsals/drills. The disaster management Plan consists of Onsite Emergency Plan and an offsite Site Emergency plan, which is outlined here for Emergency Preparedness. Nearby Kalamassery police station at 2 km, Public Health Centre at 1.5km, Kochi medical hospital at 5 km, Eloor Fire station at Pathalam within 3 km are the nearest emergency services.

### 6.2.1 Approach to Disaster Management Plan (DMP)

The objective and approach of the Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effect the rescue and medical treatment of casualties;
- Safeguard other people;
- Minimize damage to property and the environment;
- Initially contain and ultimately bring the incident under control;
- Identify any dead;
- Provide for the needs of relatives;
- Provide authoritative information to the news media;
- Secure the safe rehabilitation of the affected area;
- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency.

In effect, it is to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy. Disaster Management Plan should include Emergency Preparedness Plan, Emergency Response Team, Emergency Communication, Emergency Responsibilities, Emergency Facilities, and Emergency Actions.

#### 6.2.1.1 Identified Emergency Situations

Major disasters which can affect the remediation process are as follows:

- Floods due to heavy rainfall
- Fire risk in summer
- Occupational and health risks during the remediation process
- Safety-related accidents during the remediation process

#### 6.2.1.2 Proposed Organizational Structure for Disaster Management Plan

**Response team:** Setup an Emergency Organization. Emergency Organization includes the senior executive (head of EO as a Site controller), Manager Safety (Incident controller), Shift in charge, and Emergency Coordinators.

- All Incident control would be reported to the Site Controller. Each Incident Controller organizes a team responsible for controlling the incident with the personnel under his control.
- **Shift In-charge** would be the reporting officer, who would bring the incident to the notice of the Incidence Controller and Site Controller.
- **Emergency Coordinators** would be appointed who would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential and support services. For this purpose, security in-charge, personnel department, essential services personnel would be engaged. All these personnel would be designated as key personnel.
- In each shift, the electrical supervisor, in charge, and other maintenance staff would be drafted for emergency operations. In the event of power or communication system failure, some of the staff members in the office/facility would be drafted and their services would be utilized as messengers for quick passing of communications.

### 6.3 Proposed Monitoring Plan

The proposed monitoring plan is presented in table below,

**TABLE -6.3 PROPOSED MONITORING PLAN AND FREQUENCY**

| Monitoring media/parameters | Items and parameters | Frequency | Location |
|---|---|---|---|
| **Ambient Air Quality** | PM10, PM2.5, NOx, CH4, CO, Ammonia | Quarterly (1 sample) | 2 point |
| **Noise** | $L_{eq}$ Day and Night | Monthly | 2 point |
| **Health safety Hazards** | Medical records, documentation of injuries and accidents, Health and safety assessments | As and when accident/injury occurs | Incident reports |
| **Leachate** | • pH<br>• Biological Oxygen Demand- BOD<br>• Chemical Oxygen Demand-COD<br>• Nitrogen (Ammonia, Nitrate, Nitrite)<br>• Oxidation-Reduction Potential- ORP<br>• Electrical Conductivity-EC<br>• Total Organic Carbon (TOC) Dioxins<br>• Heavy Metals (As per the schedule II of SWM Rules, 2016) | Quarterly | 2 point |
| **Groundwater quality** | Parameters will be defined and sampling, preservation, and analysis of water will be carried out following those stipulated in the subsections below and Standards Methods for Testing Water and wastewater, 21st edition, published by American Public Health Association (2005). | Quarterly | 8 points |
| **Surface water quality** | | Quarterly | 6 points. 2 upstream and 4 downstream |

### 6.4 Estimated Budget for Implementation and Supervision of EMP

The estimated cost of [redacted] is required for budget provision for implementation and supervision of EMP. The remediation will be only during shorter time duration and hence the recurring cost won't be incurred. The estimated cost particulars for EMP is mentioned below.

**TABLE -6.4 ESTIMATED BUDGET FOR EMP**

| Particulars | Capital Cost (In Lakhs) |
|---|---|
| Dust Mitigation Measures Including site barricading, water sprinkling and Wheel Washing, leachate management | [redacted] |
| Mobile Toilet, Pest Control, Disinfectant | [redacted] |
| Medical cum First Aid facility | [redacted] |
| PPE for workers & welfare, Fire Fighting Equipment | [redacted] |
| Monitoring / testing (air, noise, water, soil, leachate) | [redacted] |
| **Total** | [redacted] |

# CHAPTER 7 INSTITUTIONAL ARRANGEMENTS

## 7.1 Proposed Institutional Arrangements

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of ToR for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation. The Support Organization will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments. Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level. The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances. The PIU will submit the compliance reports on clearances, permits, and environmental and social safeguards to D-ESDU.

## 7.2 Capacity Building

- Sensitize and orient different stakeholders of the project with adequate communication of benchmark standards on various project components. Ensure up gradation of awareness generation at different levels. Special focus: Health Hygiene and sanitation Sub Activity
- Training program for HKS (Health & Hygiene, source level waste segregation and source level treatment, Fire and Safety)
- Training program for ULB Councilors and Ward convener (Proposed SWM project plan of KSWMP)
- Training program for Political and trade union leaders (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for Residence Association leaders (Health, Hygiene different composting methods and source level waste segregation, littering of waste, Public Health, Fire and Safety)
- Training program for workers of Municipal Sanitary workers (Health, Hygiene and source level waste segregation, Fire and Safety)

- Training program for school / college students (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for ULB officials (Proposed SWM project plan of KSWMP, proposed policies, existing policies etc... to improve the existing pattern into zero waste concept of the municipality)
- Training program for School children, Parents and Teachers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Massive awareness campaign on 5R (Reuse, Recycle, Repurpose, Reduce and Refuse)

**Importance of Capacity Building**

Capacity building is defined as the "process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in the fast- changing world. It is the development of knowledge, skills and attitudes in individuals and groups of people relevant in the design, development and maintenance of institutional and operational infrastructures and processes that are locally meaningful. It is generally defined 'capacity building' as the creation of an enabling environment with appropriate policy and legal frameworks, institutional development, including community participation, human resources development and strengthening of managerial systems. It is a long-term, continuing process, in which all stakeholders participate. The main aim of capacity building under solid waste management is to build a basic understanding regarding the solid waste management project at each step of value chain (waste generation, segregation & storage at source, primary collection, secondary collection, transportation, processing and disposal) and importance of their work and develop a sense of belonging towards the work.

## 7.3 Grievance Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizen can lodge complaint either directly to ULBs, toll free number or through digital platforms (website/email – grmkswmp@gmail.com / Toll free number-18004250238). The complaint will automatically be recorded in login of ward level official of ULB and an escalation system is constituted according to the category of each complaint to close the complaint in time. The complainer can close the complaint through a feedback form according to their satisfaction.

# CHAPTER 8. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

## 8.1 Approach to Public Consultation

**KSWMP** has developed a detailed strategy and installed various inclusive mechanisms in the different stages of the remediation process considering the project affected persons, families, and commercial establishments.

As the initial step, a **Transect walk** was carried out on **06.06.2023** covering the surrounding area of the dump site. The aim of the transect walk was to assess the site and gather information about its location, potential social risks, existing infrastructure and the impact on surrounding communities. The group exercise that entails walking between two points to intentionally cross or transect a community. The group explores environmental and social resources, conditions and systems by observing, asking, listening, looking and producing a transect diagram. Information collected can be used to reveal land use practices, hazards and vulnerabilities to inform disaster mitigation and water management.

**A public consultation meeting** was conducted on **24th July 2023** related to the formulation of Solid Waste Management Plan engaging a wide audience who are experienced in solid waste management sectors of the ULB. Municipal council members also participated in this meeting. Remediation of the proposed site was one of the agendas included in the discussion. **Ward level Consultation Meetings** will be conducted during the planning stage in the leadership of ward councilors by engaging the representatives from different resident's associations, commercial establishments and other institutions in the ward for explaining about the remediation process and thereby to gain public support and cooperation. Effective IEC drive to be initiated to engage with the community to build support as the activity will create positive impact.



**FIGURE: 8.1 PHOTOGRAPH OF THE PUBLIC CONSULTATION MEETING AT KALAMASSERY**

## 8.2 Information Disclosure

Warning sign boards and project information boards with full details of grievance redressal mechanism along with all related contact details will be installed at site during the remediation process at the site. Site control measures should be enforced to prevent unauthorized personnel from entering the work site. Work zones should be delineated around specific bore holes, excavations and other areas that may pose the risk of potential exposure to the hazards.

### 8.3 Information Education and Communication (IEC Plan)

**IEC Plan for Kalamassery dumpsite remediation**

| Target audience | Activity | Topic | Responsibility | Monitoring |
|---|---|---|---|---|
| 1.Street vendor running tea shop | 1 One to one interaction | 1. Process of dumpsite remediation<br>2.Risks involved in the process<br>3.Possible mitigation measures<br>4. Discussion on traffic arrangements<br>5. Listen their concerns & discussion on its remedies<br>6. Health and safety measures | contractor | |
| 2.The workers (Migrant Labours and HKS ) of the MCF functioning inside the dumpsite | 1.Interactive sessions<br>2. Video presentation of dumpsite remediation process through social media like WhatsApp | 1. Process of dumpsite remediation<br>2.Risks involved in the process<br>3.Possible mitigation measures<br>4. Discussion on traffic arrangements<br>5. Listen their concerns & discussion on its remedies<br>6. Health and safety measures | Contractor | PIU/TSC/DPMU/ DPMC |
| 3.General Public, Those who comes to the cemetery . | 1.Placing of hoardings in the visible area of the site | 1.Protocol to the public who reside in nearby areas and also trespassers.<br>2. GRM details | Contractor | PIU/TSC/DPMU/ DPMC |
| 4.General Public | Cautionary notification boards | 1.About vehicle movement and the transit of waste<br>2.precautionary measures should the general public take. | Contractor | PIU/TSC/DPMU/ DPMC |

# ANNEXURE –I

**Environmental Screening Form**

**INITIAL ENVIRONMENTAL EXAMINATION**

Environmental Screening during the Initial Environmental Assessment Stage has been provided below:

**Subproject Details**

| | |
|---|---|
| **Name of Subproject:** | Kalamassery Solid Waste Dumpsite Remediation by Bio mining |
| **Subproject Components:** | Dumpsite Remediation using bio-mining approach |
| **Subproject Location (City / Town/ Village with ward numbers):** | Premier Junction, North Kalamassery, Ward 06, Kalamassery Municipality |

**Stage 1: Exclusion List**

**Is the Project Excluded from Consideration due to the following:**

| ***Sl.No:*** | ***Non-permissible Activities*** |
|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i) any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides |

*This dumpsite remediation project involves 1. (i) no construction in demarcated Forest areas or protected areas or their buffers, (ii) no construction of landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) no treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). 2. NO activities which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas, 3. No activities with (i) any impact on or due to Dams or embankments (ii) and project will not purchase, store and use Banned Pesticides.*

*Hence, not excluded.*

*Proceeding to Stage 2 Screening*

**Stage 2: Environmental Screening Checklist**

| Project Details | | |
|---|---|---|
| **Sl.No** | **Components** | **Details** |
| 1 | Project components | Kalamassery Solid Waste Dumpsite Remediation by Bio mining |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste management, centralized non-biodegradable waste management facilities, centralized biodegradable waste management facilities, sanitary landfills, bio mining of dumpsites, including for Linked activities / associated facilities) | Bioremediation of Kalamassery Dumpsite: - A total station survey was conducted to determine the quantity of legacy waste, revealing a total of 55,927.88 cubic meters. |
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project; including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination)<br>Site Survey No:/s (attach map) with ownership details, Geographical co-ordinates of the site location [including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | **Location:** Premier Junction, North Kalamassery, Ward 06, Kalamassery Municipality**.**<br>**Survey Number:** 1066/14, 1066/3<br>**Ownership –** Kalamassery Municipality<br>**Land use –** Solid Waste Management Facility<br>**Geographical Coordinates:** Latitude: $10.065159^0$ N<br>Longitude: $76.327607^0$ E<br>**Earthquake zone**: III<br>**Cyclone:** Moderate<br>Access road of width 4m NH-544 (Kochi – Salem Highway) in the north-western direction<br>Dumpsites have been in existence for 40 years. |
| 4 | Land Area proposed to be used: Location wise (in sq. km / sq.m) | Current total land area of 1.95 acres will be fully remediated through bio-mining. |
| 5 | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | For domestic usage 2 KLD will be met from private supplier. |
| 6 | Power Required and Source of Power | No DG set requirement for this sub-project. Electricity connection is available within the site. Source: KSEB |

***Baseline Environmental Conditions***

| ***Sl. No*** | ***Environmental Aspects*** | ***Yes*** | ***No*** | ***Details (include distance in Km, info on its importance)*** |
|---|---|---|---|---|
| 1 | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers) | | | |
| *(i)* | Critically Vulnerable Coastal Areas (CVCAs), Eco-sensitive Areas (ESAs) | | ✓ | No Critically Vulnerable Coastal Areas and Eco sensitive Areas in the study area |
| *(ii)* | Cultural Heritage site, Protected monuments - listed by ASI/State | ✓ | | Thrikkakkara Vamana Moorthy Temple – 4.5 Km away |
| *(iii)* | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensitive | | ✓ | No Eco-Sensitive Areas in the study area. |

| | | | | |
|---|---|---|---|---|
| | area, with any schedule 1 species? If Yes, which is the area? | | | |
| *(iv)* | Other Wetlands/ Mangrove/ Estuarine Region | | ✓ | There is no Wetlands/ Mangrove/ Estuarine Region in the study area |
| *(v)* | Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves | | ✓ | There is no Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves in the study area |
| *(vi)* | Other Sensitive Environmental Components listed in EMF | | ✓ | There is no other Sensitive Environmental Components in the study area as listed in EMF |
| *(vii)* | Drinking water source, upstream and downstream uses of rivers, etc. | ✓ | | A Nallah 30 m away from the dumpsite north-east direction. |
| *(viii)* | Low-lying areas/areas of Tidal Influence (provide CRZ details) | | ✓ | The location is not in a low lying area and not in a CRZ region. |
| *(ix)* | Sensitive Receptors – a) Habitations / Households / Hostels, other special areas, etc. b) School c) Religious Places d) Tourist Areas | ✓ | | SCMS Cochin School of Business within 200 metre. There are no Residential habitats within 200 metres from the site. |
| *2* | Is the site in Critical / Over Exploited Ground Water Block. Provide the level of the groundwater table | | ✓ | The site is not in critical/over exploited block. Water level ranges from 5 to 10 m |
| *3* | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other (specify) | ✓ | | Yes, the site is vulnerable to fire. The site has history of Fire accident i.e. on Feb-2022. Bio-mining will be carried out by considering the fire control and safety measures. |
| *4* | Describe the type of soil and vegetation on site | ✓ | | Gravely Clayey soil is the most predominant soil type, presence of vegetation is (shrubs) |
| *5* | Is the site present in the flood plains as recorded in the last 100 years? Provide the HFL level of the site/region | | ✓ | Site is not located in a flood prone area. |
| *6* | Existing pollution/contamination or degradation on site | ✓ | | Dumpsites have been in existence for 40 years. |
| *7* | Any other remark on baseline condition | | ✓ | Based on the baseline data the AAQ, surface and ground water, noise analysis indicates that the respective results are well within permissible limits. |

***Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology, and Soils***

| *Sl. No* | *Impacts on Land / Soil Environment* | *Yes* | *No* | *Remarks* |
|---|---|---|---|---|
| *8* | Total extend of land to be covered/built | ✓ | | The existing dumpsite area of 1.95 acres will be remediated by bio-mining. |
| *9* | Total extend of land where the waste will be dumped openly / or expected to get contaminated by waste or leachate/material storage | | ✓ | The existing dumpsite area of 1.95 acres will be remediated by bio-mining. |
| *10* | Extend of Land to be remediated | ✓ | | The existing dumpsite area of 1.95 acres will be remediated by bio-mining. |
| *11* | Extend of land expected to be under green belt | | ✓ | Currently the dumpsite has no greenbelt. The Area of 1.95 acres will be fully remediated and utilized for further use by ULB. |
| *12* | Will the proposed project cause the following on Land / Soil: | | | After bio-mining the land will be remediated and will have a positive impact to the land and soil. |
| *(i)* | Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains | | ✓ | No Impact on Surrounding Environmental Conditions due to the proposed sub-project. |
| *(ii)* | Substantial removal of Top Soil (mention area in sq.m) | ✓ | | The dumpsite has legacy wastes of 8.5 m below ground level and 2.5 m above ground level.<br>However, the legacy waste is combined with soil will be remediated till the depth of 8.5 m below ground level. |
| *(iii)* | Any degradation of land / eco-systems expected due to the project? | | ✓ | No land use change or ecosystem change due to implementation of this project since the land will be reclaimed. |
| *(iv)* | Loss or impacts on Cultural/heritage areas/properties | | ✓ | No impacts or loss of cultural/ heritage areas/properties due the implementation of the project |
| *(v)* | Does the project activity involve cutting and filling/ blasting etc.? | | ✓ | The project activity not involve any cutting, filling or blasting. The bio-mining sub-project involves only excavation of wastes which is to be remediated. |
| *(vi)* | Will the project cause physical changes in the project area (e.g., changes to the topography) | ✓ | | Waste is about 8.5 m below Ground Level which is to be |

| | | | | |
|---|---|---|---|---|
| | due to excavation, earthwork, or any other activity? | | | excavated and remediated. So there is change in topography. |
| *(vii)* | Will the project involve any quarrying/ mining etc.? | | ✓ | The project does not involve quarrying/ mining |
| *(viii)* | Will the project / any of its component contaminate or pollute the Land? | | ✓ | The existing dumpsite will be remediated and utilized for further use, henceforth there won't be any contamination to the land. |
| *(ix)* | Will the project contribute to any long term significant adverse (negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | ✓ | Due to the proposed bioremediation, the site will be remediated and bio diversity of the surroundings will be enhanced and it will be positive impact in the longer term. |
| *(x)* | Will the Project or related activities cause negative impacts on the land in combination with other anticipated / existing projects in the region? | | ✓ | The proposed subproject involves only remediation through bio-mining. Hence no negative impact to the land. |

| ***Sl. No*** | ***Impacts on Air and Noise Environment*** | ***Yes*** | ***No*** | ***Details/Remarks*** |
|---|---|---|---|---|
| *13* | Will the project cause or increase air pollution due to dust and / or vehicle emissions? | ✓ | | The process of bioremediation may cause dust emission from process and vehicle movement which shall be managed by effective mitigative measures |
| *14* | Will the project cause or increase pollution due to GHG emissions? | ✓ | | Chances of GHG emissions due to un-stabilised waste. |
| *15* | Will the project cause or increase odor nuisance? | ✓ | | The process of bioremediation may cause odour during remediation for the shorter time duration, which shall be managed by effective mitigative measures |
| *16* | Is there a potential for release of toxic gases or accident risks (eg: potential fire outbreaks) | ✓ | | Chances of toxic gases release during excavation of legacy wastes. |
| *17* | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | | ✓ | Project activity stage (during the process of bio remediation, the noise may arise due to vehicular movements & working of machineries). The proposed mitigation measures will ensure the ambient noise within the permissible limits. The duration of work will be 8 hours/day. |

| ***Sl. No*** | ***Impacts on Water Environment*** | ***Yes*** | ***No*** | ***Details/Remarks*** |
|---|---|---|---|---|
| *18* | Will the activities proposed at the site(s) impact water quality (surface or ground) – leachate, runoff, wastes deposition, erosion? | | ✓ | Due to the proposed remediation will only enhance the ground water/surface water quality in the long term. |

| | | | | |
|---|---|---|---|---|
| *19* | Will the activities proposed at the site(s) impact water resource availability and use - leachate, runoff, wastes deposition, erosion? | | ✓ | The proposed remediation will only enhance the ground water/surface water quality in the long term. |
| *20* | Chances of Pollution of Water bodies/groundwater wells, nearby or downstream | | ✓ | The proposed remediation will only enhance the ground water/surface water quality in the long term. |
| *21* | Will the activities proposed at the site(s) hinder natural drainage | | ✓ | No the proposed remediation activity does not hinder natural drainage. |
| *22* | Will the activities proposed at the site(s) decrease permeability/rainwater percolation | | ✓ | The proposed remediation will clear the legacy wastes and the land will be remediated. After remediation the permeability/rainwater percolation of the soil will be increased. |

| ***Sl. No*** | ***Impacts on Biodiversity and Host Communities*** | ***Yes*** | ***No*** | ***Details/Remarks*** |
|---|---|---|---|---|
| *23* | Will the project necessitates cutting of Trees / Loss of Vegetation | | ✓ | Cutting of trees are not required for the proposed remediation activity. |
| *24* | Will the project necessitate substantial removal of Top Soil (mention area in sq.m) | ✓ | | The dumpsite has legacy wastes of 8.5 m below ground level and 2.5 m above ground level.<br>However, the legacy waste is combined with soil will be remediated till the depth of 8.5 m below ground level. |
| *25* | Any degradation of land / eco-systems expected due to the project? | | ✓ | The proposed process of bio-mining ensures that there will be no degradation of the land. |
| *26* | Will the project result in Health & Safety Risks in the neighborhood including the release of toxic gases, leachate, accident risks | | ✓ | There is no habitable area within 300 m from the dumpsite. However health and safety management measures will be maintained periodically for the workers involved in remediation activity. |
| *28* | Potential Noise, Light Pollution/movements causing disturbance to nearby habitats/communities | | ✓ | There is no habitable area within 300 m from the dumpsite. |
| *29* | Potential disruption to common property, accessibility, traffic disruptions, conflicts, or disruption to the local community within the subproject area? | | ✓ | No disruption, there will be a marginal increase in traffic of medium sized vehicle (trucks) due to the forward linking of recovered products from dump site (i.e. For compost, plastic and other recyclable waste). The total number of vehicles operational at the dumpsite is 5 numbers per day which increase the traffic load by only 0.1% per hour. |

**Enclosures:**

Construction Within the Dumpsite



General view of waste deposit





***Project Categorisation and Need for Safeguards Instruments, Oversight***

| ***Project Category*** | □ ✓***E2*** |
|---|---|
| **Key Reasons (for categorisation)** | During screening, it has found that the proposed subproject is moderately causing impact to the base line environment, land/ soil / water /noise environment, biodiversity or to the community. Site is not close to any Environmental Sensitive Receptor. Moreover, Project results positive impacts on Environment. The Environmental Baseline analysis reveals that dumpsite not having any Heavy metal contamination. Hence it is categorized as E2. |
| **Safeguards Instruments Required** | a) E2: Project-specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities) |
| **Additional Responsibilities Expected** (such as i) Specialists to be hired for Physical/Cultural resources, Natural Habitats/others, etc. for EIA preparation, and/or supervision), ii) Consultations, iii) any other aspect | |

| ***Status*** | ***Agency / Official*** | ***Name, Signature with Date and Seal*** |
|---|---|---|
| **Prepared by** | PIU or ULB (project in-charge) | |
| | Environmental Engineer | |
| **Checked, Categorised as ___ (E1, E2, E3) & ToR issued by:** | DESDU / SESDU | |
| | Environmental Specialist | |

# ANNEXURE II FIRE RISK ASSESSMENT

**Objectives:** The important elements of fire risk Management planning can be classified as:

- Identifying the disaster potential scenarios and advance planning to combat and minimize the damage.
- Vulnerable zone delineation.
- Assessment of loss probability and its severity.
- To deal with such emergencies expeditiously.
- Warning, protective actions like evacuation of personnel.
- To contain the disaster by isolating the area, firefighting etc.
- To make efforts to return to normal condition when the situation is controlled.

*Causes of fire and Risk:*

| Ignition (heat) sources | Fuel Sources | Oxygen Sources |
|---|---|---|
| Lit cigarettes/ butts, matches, lighters<br>Improperly stored batteries<br>Bushfire<br>Self-heating piles<br>Hot loads/contaminated waste<br>Hot work operations<br>Arson<br>Lightning<br>Fires from neighbouring activities<br>Faulty electrical wires | Flammable liquids, gases and solids<br>Combustible goods and waste (e.g. CRWM[2])<br>Contamination in CRWM storage<br>Dry and unmanaged vegetation | Oxidising chemicals such as oxy-acetylene sets, bleach, hydrogen peroxide, nitrates<br>Physical introduction of oxygen through unbaling or turning of loose piles |

**Fire Prevention & Management Plan**

It is a strategy well evolved, organized and rehearsed to contain the adverse effects of a possible disaster. It aims to mobilize the internal resources and use these with minimal dependence on external agencies for the following purposes:

- To control and contain incidents.
- To safeguard employees and people in the vicinity.
- To inform employees, the general public and the authorities about the hazards/risks assessed, safeguards provided, residual risk, if any, and the role to be played by them in the event of disaster.
- To effect rescue and treatment of casualties.
- To prevent recurrence of such a disaster.
- To establish machinery for review, rectification/modification of the emergency
- To ensure safety of works before personnel re-enter and resume work.

- To work out a plan with all provisions to handle and to provide for emergency preparedness and the periodic rehearsal of the plan.

**Pre-Disaster Stage**

The prevention of disaster is of vital importance and is the moral responsibility of each and every individual employed in the dumpsite site. It can be prevented by observance of precautionary and preventive measures. During pre-disaster stage following points will be followed to avert the occurrence of disaster:

The emergency operation procedures of the dumpsite site will be written down, so that no confusion is caused in the event of emergency taking place.

- To reduce the probabilities of accidental leakage of methane.
- Smoking will be prohibited in the areas where handling of dumpsite will be done. “NO SMOKING” boards will be prominently displayed in Local Language i.e., Malayalam and English languages.
- All electrical wiring, fittings, cables, equipment will be checked periodically. Temporary wiring will not be permitted to be installed inside the dumpsite area. No inflammable material including papers, Oils, wooden racks will be stored within 1 meter of any electrical fittings. No un authorized person will be allowed to tamper with electrical fittings.
- Welding, Burning, cutting, Chipping, soldering work, etc. will only be carried out by authorized person.
- Necessary compliance with various Statutory Guidelines and other relevant instructions as issued from time to time will be done by the contractor.
- Safety Department will arrange to educate all concerned regarding operational hazards of non-compliance of the safety guidelines. They will also provide necessary guidance and support in proper implementation of the program. They will also arrange mock exercises periodically.
- Safety Department will display at prominent places important telephone numbers and instructions, in Mizo & English languages. The Security Control Room located at the dumpsite site will be equipped with the following:
- Sufficient number of copies of On-Site Disaster/Emergency Management Plan.
- Master plan of the dumpsite site indicating vital locations and possible sources of disaster.
- Important Telephone numbers
- Emergency lights (portable) and Wireless sets if required and possible).
- First Aid boxes

**Disaster Stage**

The most probable disaster which may occur at dumpsite site is because of accidental leakage and fire. To control leakage and fire the following measures/precautions will be taken at the dumpsite site:

The guidelines as given below for the protection of fire will be followed:

- The dumpsite’s fire protection will consist of structural solutions, fire extinguishing systems and fire alarm systems. The fire extinguishing system will consist of the fire system with fire pumps, distribution pipelines, hydrants and fire hoses and the portable extinguishers.
- The fire alarm system will be a part of the primary systems and take care of the places which are unmanned or will not have any fixed fire extinguishing system.
- The major operation areas shall be equipped with fixed smoke detectors, CO2 extinguisher near the door in the control room.

- All the rooms in the office shall be equipped with fixed smoke detectors.
- The ventilation rooms shall be equipped with fixed smoke detectors. One CO2 extinguisher will be located near the door to ventilation room.
- The fire alarm and detection system shall be designed, installed, maintained and tested according to relevant standards.
- The water for firefighting shall be stored in the fire water tank (water reservoir).
- CO2 fire extinguishers contain extinguishing carbon dioxide which either by it or under expected conditions of use gives off CO2 to prevent fire.
- Dry fire extinguishers contain extinguishing medium which either by itself or under expected conditions of use will give fine powder to prevent fire to get oxygen.
- As soon as a fire takes place inside the premises of dumpsite, action to be taken by various persons/officials.

**Post Disaster Stage**

After the incident, an incident report will be prepared regarding occurrence of event/losses incurred and recommendations thereof for restoration of normalcy.

**Reporting of Accidents**

Situation in totality will be studied thoroughly, investigated with respect to the cause of the incident, extent of loss of life and property and a detailed report prepared by the individual/team nominated by dumpsite site authorities for this purpose. Based on the investigation report, rescue team would finalise time bound programmes for implementation of corrective measures proposed and regularly monitor the progress thereafter. Rescue, medical and welfare operations would be continued by the concerned agencies.

# ANNEXURE- III MAP SHOWING BASELINE MONITORING LOCATIONS OF KALAMASSERY DUMPSITE



GOOGLE IMAGE DEPICTING THE AAQ MONITORING LOCATIONS AT KALAMASSERY DUMP SITE



GOOGLE IMAGE DEPICTING THE NOISE MONITORING LOCATIONS AT KALAMASSERY DUMP SITE



**GOOGLE IMAGE DEPICTING THE SURFACE & GROUND WATER AND LEACHATE MONITORING LOCATIONS AT KALAMASSERY DUMP SITE**

KSWMP
KERALA SOLID WASTE MANAGEMENT PROJECT

# Feasibility Report

## Dumpsite Remediation

## Kalamaserry

Ernakulam District

KSWMP

GOVERNMENT OF KERALA

LSGD

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## Executive Summary

Kalamassery is a municipality in the Ernakulam district of Kerala, India. It is located 9.6 km northeast of the Kochi centre and is a part of the Kochi metropolitan area. Even though the ULB has an excellent practice of waste management, the primary environmental issue currently faced by municipal authorities revolves around a longstanding existing legacy waste dumpsite. Despite discontinuing the dumping activities, these dumpsites remain as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Consequently, these sites pose significant environmental, social, and economic challenges for the communities and ecosystems surrounding them. The SWM Rules 2016 directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the project for the remediation of legacy waste dumpsites in all the ULBs of Kerala. As part of the project, in phase1 the existing dumpsite at Kalamassery, ward no 6 was proposed for remediation.

The Kalamassery Municipality has an area of 27 sq.km with 42 wards. The municipality, with the financial and technical support of KSWMP, has taken up steps to remediate the existing legacy waste dumpsite located in around 1.95 acres of land in ward 06, and to recover land for future developmental activities. The Kalamassery dumpsite was used for dumping municipal solid waste from the year 1990. Considering the impending threat of fire hazards and leachate issues, the Municipal Council has taken up the remediation of legacy dumpsite as a priority and to utilize the remediated land for setting up other solid waste management facilities. Since the cessation of dumping activities in 2020, only sweeping waste from towns and streets were dumped at the facility daily and has now been discontinued.

The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes. To assess the quantity & composition of legacy waste & also evaluate the environmental baseline of the dumpsite, samples from representative locations were collected and analyzed for various parameters viz., physical and chemical analysis of Legacy waste, Soil, Air, Noise, leachate, Groundwater and Surface Water. As part of the study, detailed site investigations were carried out for; – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical and Environmental Analysis by M/s Polluchem laboratories. From the results of the investigations, it was found that the waste was seen up to a depth of 8.5 m. The total estimated quantity of legacy waste is around 55,927.88 Cubic meters. (Above GL 33569.128 and Below GL 22358.88 Cubic meter)

As per the SWM Rules 2016, selection of an applicable method/type or technique for dumpsite remediation needs to be arrived from the Feasibility study carried out, and based on the results, remediation can be done by a) Capping without land recovery, b) Bio-mining – reclamation/recovery of land & c) capping with partial land recovery. The selection of technology shall also depend on the available resources viz., manpower, machineries, money, and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for land recovery and forward linkages/utilization of processed aggregates/ by-products. Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. Selection of machineries for screening of the

stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by-products as per the requirements of the utilization/forward linkage. Based on the detailed assessment of the selection parameters, stationary trommel screening machineries shall be optimum for processing the legacy waste within the stipulated timeline of 31st March 2024.

Environmental & Social safeguards: The project attracts E2 Environmental category based on the project activities and status of the environment baseline. The project attracts moderate social risks based on the social mapping, transect walk and consultation with the people living around the proposed project site to assess the problems associated with the legacy waste dumpsite and the impact during the execution of the project.

The activities of bio-mining will commence from Dec 2023 and are expected to end by May 2024. An area of 1.95 acres will be reclaimed and will be utilized for setting up other solid waste management facilities. Total cost of the project is Rs. [redacted]

## 1.0 Introduction

In view of the environmental and social issues connected with dumpsites, the SWM Rules 2016, directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the remediation projects of legacy waste dumpsites in all the ULBs. As part of the project, in phase -1, the existing dumpsite of Kalamassery ULB was proposed for remediation.

For arriving at a methodology for remediating the legacy waste in the dumpsites, as per the Project Implementation Manual, a feasibility study outlining the technical, economic, and socio- environmental factors has been carried out. As a result of the feasibility study that involved detailed field investigations & assessment, and market sounding, the method proposed for remediation of legacy waste dumpsite is biomining, which will ensure long-term sustainability and environmentally sound treatment, which is found technically feasible, economically viable, and socially acceptable. The details of various steps involved in the feasibility study are described in the following sections.

## 2.0 General Description about the Project

Kalamassery, Ernakulam in the State of Kerala is experiencing the issues of treatment and disposal of MSW. The KSWMP project aims to improve the overall SWM system in all the 93 ULBs and covers the waste collection, transportation, processing, and disposal of rejects in a scientific landfill. The existing waste dumpsite at Kalamassery needs to be remediated scientifically and the land reclaimed for productive use. The site is close to a stream that eventually joins the Periyar River.

## 3.0 Profile of ULB- Kalamassery Municipality

### 3.1 Location

Kalamassery Municipality is located at latitude 10°3'53.611’N and longitude 76°19' 40.463"E. The total geographical area of Kalamassery municipality is 27 sq. km. The Municipality is divided into 42 administrative wards. Kalamassery was raised to the status of a Municipality in the year 1990 from a panchayat.



**Figure 3.1 Location Map of Kalamassery ULB**

## 3.2 Demographic & Socio-Economic Status

The municipality has a total population of 71,038 of which 35,331 are males while 35,707 are females as per report released by Census of India 2011 indicating a sex ratio is of 1.011 against state average of 1.084. The overall literacy rate of Kalamassery town is 95.87 % which is higher than the state average of 94.00 %. The estimated population in 2023 is 83,909 with a decadal growth rate of 16.71 %.

*Source: Census Data 2011*

## 3.3 Connectivity

Kalamassery town is well connected to neighbouring local bodies and towns through National Highways, State Highways, and other Major and minor road networks. National Highway 544 passes through the municipality. Kochi – Salem Highway also passes through the town. The Main Central Road section of about 6.45 kms is also passing through the municipality.

The nearest railway station is Kalamassery whereas Aluva railway station is located 7 kms from the town centre, which is the second largest railway station in Ernakulam. The nearest airport is Kochi International airport located 18 kms away from the town. The town is well connected by a water way network which brings a wide opportunity of inland navigation.



**Figure 3.2 Base Map of Kalamassery Showing Major Connectivity**

## 3.4 Climatic Condition

Kalamassery has a tropical climate. Rainfall is significant in most months of the year, and the short dry season has little effect. The average annual temperature is 27.6 °C in Kalamassery. Precipitation here averages 3,570 mm. The driest month is January, with 22 mm of rainfall. Most of the precipitation here falls in June-July with an average of 541 mm. The warmest month of the year is March with an average temperature of 28.3 °C. July and August are the coldest month, with temperatures averaging 25.3 °C. The data is presented in **Table 3.2**

**Table 3.1 Meteorological data for Kalamassery**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Avg. Temp °C** | 26.7 °C | 27.5 °C | 28.3 °C | 28 °C | 27.2 °C | 25.7 °C | 25.3 °C | 25.3 °C | 25.6 °C | 25.9 °C | 26.1 °C | 26.2 °C |
| **Min. Temp °C** | 23.1 °C | 24 °C | 25.2 °C | 25.6 °C | 25.3 °C | 24.4 °C | 24 °C | 23.9 °C | 23.9 °C | 23.9 °C | 23.7 °C | 23.1 °C |
| **Max. Temp °C** | 31 °C | 31.0 °C | 32.2 °C | 31.2 °C | 29.8 °C | 27.8 °C | 27.4 °C | 27.4 °C | 28.1 °C | 28.5 °C | 28.1 °C | 29.0 °C |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rainfall mm** | 22 | 27 | 66 | 177 | 337 | 568 | 514 | 379 | 264 | 303 | 169 | 56 |
| **Humidity (%)** | 71% | 70% | 73% | 81% | 85% | 90% | 90% | 89% | 88% | 87% | 84% | 76% |

*(Source: en.climate-data.org/asia/india/kerala/kalamassery), Time Period: 1991 to 2021*

Summer begins in March and ends in May. The climate in Kalamassery during the season is moderately hot and humid. Like all other places in Kerala, Kalamassery experiences heavy showers during the monsoon season. From June to August, the place get rainfall. The catchment area has very high humidity of more than 75%.

## 3.5 Ground Water Level

From monitoring wells dispersed across the state, the depth to water level is observed in the months of April, August, November, and January. According to information published by the CGWB, the Government of India, the water level in Kalamassery fluctuates from 1.2 to 2.77 MBGL.

## 3.6 Land use

The landuse survey of 2023 revealed that the predominant land use of Kalamassery Municipality is agricultural (45.91%). 24.72% of the total area is under residentials and commercial etc. Existing land use analysis shows following breakups as shown in table. The details of analysis of the land use survey and the resultant findings of existing land use are given hereunder. The glaring aspect of existing land use of Kalamassery municipality is blessed with potential resources such as agriculture land and water bodies.

The highest percent of land use falls under the category residential/agricultural mix, which include mainly dry agriculture lands where residential developments are co- existent. Rubber is the principal crop followed by paddy, coconut and tapioca. Existing land use analysis shows following breakups as shown in table below.

**Table 3.2 Land use Pattern of Kalamassery Municipality**

| Sl. No. | Zone | % of Total Area |
|---|---|---|
| 1 | Agriculture zone | 45.91 |
| 2 | Residential zone | 24.72 |
| 3 | Industrial zone | 21.13 |
| 4 | Public zone | 5.98 |
| 5 | Park and Playground | 2.23 |

*Source: Municipality, Kalamassery, 2023*

## 4.0 Detailed Description of the Dumpsite

### 4.1 Physical Feature of the Site

Kalamassery dumpsite is located approximately 1.0 Km from the centre of Kalamassery town on the western side and encompasses an area of approximate Kalamassely 1.95 acres of land. The dumps site is not very far from human settlement. The coordinates of the dumpsite are 10.065159° N & 76.327607° E. It is in ward no. 6 of the municipality. Kalamassery municipality holds the ownership of the dumpsite. The dumpsite is surrounded by highways from north-western directions. In the South-eastern direction, a railway line passes through it. The North-eastern side of the dumpsite is vacant land. A small stream flows on the North-eastern side of the dump site within the distance of 100 m.

The exact date for the start of the dumpsite was not available with the municipality; however approximately it had started 40 years ago, the information has been gathered during field visits. Presently, the quantity of waste dumped above ground level at this site is about 33,569 cum as per records available (topographical survey) with the ULB. As of now 60 % of the area is covered with solid waste. The dumping has been irregular with no proper liner system which would allow the leachate from percolating into the groundwater system. There is a high chance of water being contaminated in this area due to the irregular dumping and air pollution because of odour problem to the nearby residents. Average height of the waste heaps is 8.5 below the existing ground level.



**Figure 4.1 Photographs of Kalamassery Dumpsite**

**Table 4.1 Salient Features of Kalamassery Dump Site during Site Visit**

| | |
|---|---|
| Name of Dumpsite | Kalamassery dumpsite |
| Location of Dumpsite | Ward No. 6 of the municipality |
| Coordinates of Dumpsite | Latitude: 10.065159°N<br>Longitude: 76.327607°E |
| Distance from the central part of the town | 1.0 km |
| Total Area of dumpsite | 1.95 Acres |
| Ownership of dumpsite land | Municipality |
| Distance from nearby features- residential, school, offices, temples, institutions, industry etc.) | SCMS Cochin School of Business within 200 metres. There are no Residential habitats within 300 metres from the site. |
| Start year of dumpsite | 1990 |
| Quantity of waste dumped per day | None |
| Utilities on site | Existing Electricity connection is available |
| Details of manpower and vehicles available in ULB | 111 persons & 32 Vehicles |
| Site demarcated | Site is currently demarcated with a boundary wall. |
| Details of weighbridge available at dumpsite | No weighbridge at site |
| Availability of electrical power | 440 LV grid available at 100m from site |
| Availability of water | Water to be supplied by tanker |

## 4.2 Surrounding Features of the Dumpsite

The dumpsite is located adjacent to the National Highway 544 and therefore is easily accessible for the remediation activity. The site offers easy manoeuvrability for heavy vehicles which may be needed for transport of biomining products such as RDF, compost and bio earth. It is bounded by the streamlet on the North, highway to the west, the railway track on the east, ULB operated crematoria, Kalamassery railway station and the Fertilisers and Chemicals Travancore Limited (FACT) godown on the south and southeast. The dumpsite is sloping towards the stream and the railway track. Water may be procured by tankers if needed. The LV electrical line adjacent to the dumpsite is convenient for setting up the biomining facility

## 4.3 Information on Site Management

This section describes the current management of the dumpsite in terms of agency responsibility, profile of workers and numbers, nature of work the labour force is engaged, Waste pickers and other categories of workers at the site.

**Agency responsible for current management of the dumpsite:** Currently, the dumpsite is closed and non-functional. There is currently an MCF & RRF adjacent to dumpsite which is functional.

**Workforce engaged:**

About 69 HKS workers are engaged for collection of waste from the municipal jurisdiction. The MCF is being handled by 22 Workers from Clean Kerala Company Limited (CKCL) who segregate the dry waste. HKS workers are involved in collection and CKCL workers are engaged in segregation of dry waste.

**Waste pickers and other categories of workers at the Site:** The waste is segregated with the help of 54 contract labourers. Recovered materials are collected by the Clean Kerala Company.

## 4.4 Relevance in local or regional SWM plans

The ULB is planning to utilise the dumpsite land after biomining for the construction of a state of art Material Recovery Facility (MRF). MRF can be designed to incorporate the depression created by biomining as an underground parking lot for ULB-owned vehicles. The non-biodegradable waste from the ULB shall be brought to this facility and processed for further use. The project is proposed to be funded under the KSWMP project.

## 4.5 Litigation status of the Site

- This site has been used as a dumpsite for 30 years. The Hon'ble NGT (OA 395 of 2013 SZ) and PCB (PCB/ RO-EKM/ GEN-221/2019 dated 31.12.2021 and PCB/EKM/DO-1/Sup-com 2020 dated 4/01/22 addressed to Secretary Kalamaserry has issued direction to prevent dumping because the canal was polluted.
- Letter from State Pollution control board dated 06/05/2023 Regarding "Direction imposing Environmental compensation for Non-compliance Act,1986."

## 5.0 Scope of Work

Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at Kalamassery includes the following steps.

- Conducting detailed field investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical, and Environmental Baseline Analysis by M/s Poluchem Laboratories.
- Assessment & Analysis of detailed investigation report submitted by the Laboratories.

- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.
- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the By-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation (Optimum land recovery – Biomining, capping partially Biomining & Capping), Methods/Technologies (Stationary & Mobile- compact), Implementation mode, Forward linkages (Utilization/Management of By-products) and Environmental & Social categorization as per the ESMF developed for projects envisaged under KSWMP.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Delineation of baseline assessment, impact & risk assessment, mitigations measures, Environmental Management & monitoring plan, budget for EMP, EMOP, institutional responsibilities for implementing monitoring and reporting
- Social Safeguards - Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.
- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport.
- Environmental and social monitoring costs, Revenue from the project, Funding for project.
- Project Implementation plan –contractual models and timelines.

## 5.1 Objectives:

- To initiate dumpsite remediation from January 2024.
- To reclaim dumpsite land and by eliminating the chances of dumpsite fires, leachate generation, and foul odour.
- To reduce greenhouse gas emissions, soil pollution, and groundwater contamination.
- To increase nearby social value and benefit the citizens.

# 6 Detailed Investigation Strategy

## 6.1 Investigation Strategy

To understand the nature and composition of the legacy waste and the existing baseline environmental conditions, samples from waste, surface and groundwater, leachate, soil, air, and noise were collected. Samples were collected as mentioned below.

- Bore hole up to a depth of 10 m and collection of 3 (no's) samples from the soil at interval of 1.5 m.
- Waste analysis viz., leachate sample from 1 location and physical analysis from 2 (no's) locations, and chemical analysis from 1 (no's) location.
- Environmental baseline analysis surface water 1 (no's) location and ground water samples from 2 (no's) locations (Well Water Samples -1 up gradient, 1 down gradient) and Air sampling from 2 (no's) locations and noise sampling from 1 (no's) location.

## 6.2 Investigation Plan

The detailed investigations carried out for the legacy waste dumpsite in line with PIM is given in the table below:

| Sr.No | Parameters | Sampling Nos |
|---|---|---|
| 1 | **Geotechnical Investigation** | |
| A | Bore Holes up to 10m depth (1No./2 Hectares) (as per CPHEEO) | 1 |
| B | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, Strength compressibility (vertically-3 samples per borehole). | 1 |
| 2 | **Waste & Environmental Analysis** | |
| A | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammoniacal nitrogen (as N), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | 3 |
| B | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | 2 |
| C | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), Total carbon, C/N ratio, calorific value, Biochemical and Biodegradable factor. | 1 |
| D | Ground water (well water samples-1 up gradient, 2 down gradient)- (shallow and deep wells) Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, E. coli and Total coliform (IS 10500-2012). | 3 |

| Sr.No | Parameters | Sampling Nos |
|---|---|---|
| E | Surface water (pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, E. coli and Total coliforms (IS 10500-2012). | 1 |
| F | Ambient Air Quality (Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | 2 |
| G | Ambient Noise level [E(P)] for 24 hours. | 1 |

## 6.3 Sampling Methodology

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat/Long) were considered. The following table shows the strategic location details of samples selected for the detailed investigation.

**Table 6.1 Detailed Investigation Plan Executed for Waste Dumpsite at Kalamassery**

| S. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | Within the Dumpsite<br>Dumpsite boundary | Air monitoring points are selected as per the Wind-rose diagram of the Kalamassery site for the month of July. |
| 2 | Noise (1 Location) | Ambient Noise level [E(P)] for 24 hours | Entrance of the dumpsite | Noise Points are selected from the boundary points of the site, and it is east side for this site because of the close access to the metro railway track and highway. |
| 3 | Surface water (1 Location) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, E. coli and Total coliforms (IS 10500-2012). | Stream adjoining the dumpsite | Surface water sample points are selected based on the water flow from upwards to downwards and for this site, it is South-east to South-west. |

| S. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 4 | Ground water (1 Locations) | Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, E. coli and Total coliform (IS 10500-2012). | Nearby well (within 100m vicinity) | Nearest well water was considered for analysis of ground water. |
| 5 | Bore Hole (1 location) | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, Coeff of permeability, Strength compressibility (vertically-3 samples per borehole). | on the dumpsite | One borehole selected at the centre of the dumpsite as per the CPCB guidelines i.e., Up to one hectare requires one borehole. |
| 6 | Waste & Environmental Analysis | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammoniacal nitrogen, TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, cyanide, Chloride, Fluoride, Phenolic compounds. | 3 | |
| | | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | 2 | |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium(N-P-K), Total carbon, C/N ratio, calorific value, Biochemical and Biodegradable factor | 1 | |

For the borehole investigation the samples were collected by rotary drilling a 150mm bore hole using a fast rig attached to a drag bit. The soil drillings are removed by a circulating bentonite slurry which also aids in keeping the side walls stable. An SPT sampler was driven in to collect the representative samples, which is carefully packed in double walled polythene bags, sealed, and sent to laboratory for testing. Standard penetration tests were conducted on soil at every

1.5m depth and the number of blows to achieve 300mm penetration were noted. Fractions recovered from the mining of legacy waste should be tested, especially for the presence of toxic metals and organic contaminants.

The total quantity of waste present in the waste dump is calculated based on the topographic study executed by ULB (towards calculating quantum of waste above ground level) and the results of borehole investigation (towards calculating the quantum of waste below ground level).

## 6.4 Analysis and Interpretation of Exploratory Data

The baseline condition of the waste dumpsite at Kalamassery, has been assessed through the geotechnical investigation and Waste & Environmental baseline assessment executed through M/s Matter Material Testing & Research Laboratory (P) Ltd and M/s Poluchem Laboratories (P) Ltd respectively. The results of the Topographical survey conducted by ULB in the year 2022 are also considered for the analysis. The signed reports of all analysis are enclosed as Annexures detailed below;

Annexure 1 – Topographical survey report
Annexure 2 –Geotechnical Survey report
Annexure 3- Waste Characterization study report
Annexure 4 - Waste & Environmental baseline assessment reports

The initial site visit was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd on 29/05/2023 along with the experts of TSC and PIUs. Field Geotechnical investigation to collect the soil samples after drilling through the legacy waste was started on 28.05.2023 and was completed on 31.05.2023. Positioning of Air samplers & Noise monitoring equipment, sampling of surface/groundwater, leachate, and legacy waste were done on 30.05.2023 by M/s Poluchem Laboratories (P) Ltd.

### 6.4.1 Topographic Survey Results

Topographic survey was conducted for ULB by Spreads Survey in December 2022 towards assessing the quantum of the waste present in the dumpsite above the ground level. The Topographical survey report is presented in **Annexure 1**. The inference of the Topographical survey is as follows.

- Topographical Survey Map shows Approximate 1.95 acres of land used for waste dumping.
- Maximum height of waste dump above soil is 4.2 m

- Estimated waste volume is 33,569 cum which will constitute 28,030.11 MT of waste (Above ground level density of waste is 0.835 T/cum as per the characterization study results presented in subsequent sections)

### 6.4.2 Geotechnical Exploratory Details

The geotechnical investigation at the dumpsite at Kalamassery, Ernakulam district was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was drilled through the waste into the ground using a rotary drilling method. The maximum depth of investigation was 12.4 m (depth up to 8.5m is legacy waste and 3.9 m in soil). SPT and collection of undisturbed soil samples were carried out at regular intervals within the ground. Various laboratory tests were carried out on the SPT and undisturbed soil samples. The full geotechnical report is appended as **Annexure 2**. The major inference of the geotechnical investigations is as follows.

- In the borehole investigation it was asserted that the depth of the waste column below ground level is 8.50.m.

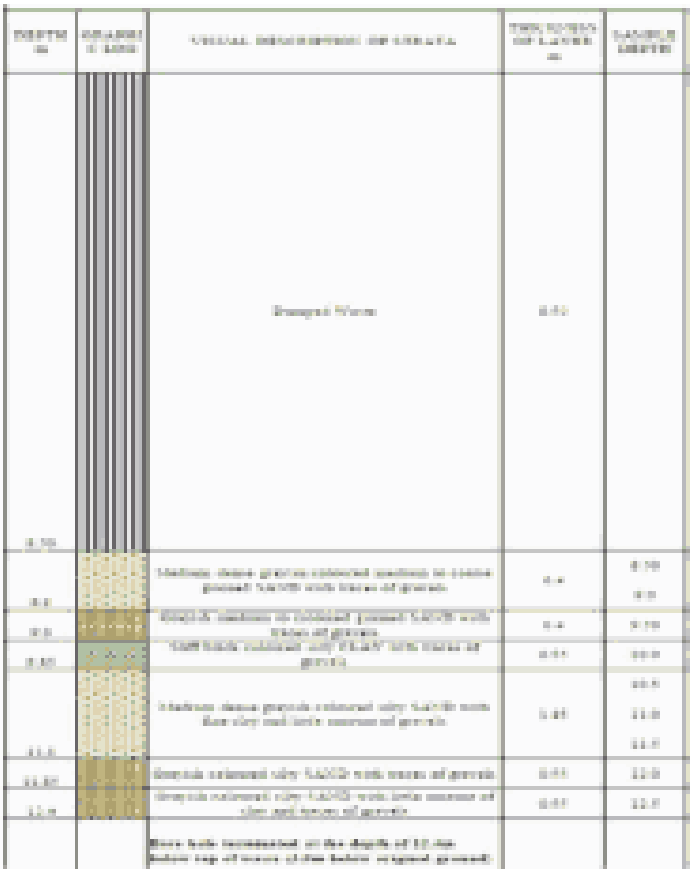


**Figure 6.1 Borehole Strata Obtained for Kalamassery Dumpsite**

- The soil exhibited a plasticity index varying between 17 to 49 and the clay fraction is between 25 to 37%.

- The base soil has a plasticity index greater than 10 and the clay and silt fractions account for more than 40%, which makes it a good soil for the sub-base. The safe bearing capacity of the soil is 150kPA, implying that the maximum height of fill may be only a maximum of 12m.
- During excavation, the side slopes should be maintained at 1 (V) and 3 (H).
- The Cation Exchange Capacity (CEC) of the soil is 11.91 meq/100 gm which can adsorb heavy metals in case it is present in the soil.
- The pre- consolidation pressure is between 70 to 109 KPa.
- The permeability value is between 1.05 to 1.11 E-03m/s.

### 6.4.3 Estimated Total Quantity of Waste

The total quantity of waste is estimated based on the contour/topography survey profile of the waste over the ground level and exploratory data of the bore log (Geotechnical investigations). As detailed under section 6.4.1 the estimated quantity of the waste above the ground level is 33,569 cum. Quantity of waste below the ground level is estimated as 22,358.88 Cum. The quantity of waste below ground level may vary as per actual site conditions. We recommend taking 4 more bore holes for estimating exact quantity prior to tendering process or the assessment of quantity below ground level may be included in the contractor's scope.

Thus, the total legacy waste present in the Kalamassery dumpsite is calculated as below.

**Table 6.2 Total Waste Quantification for Kalamassery Dumpsite**

| Level | Volume of Legacy Waste (m3) | Density of Waste | Total Quantity of Waste (MT) | Remarks |
|---|---|---|---|---|
| Above Ground | 33,569 | 0.835 | 28,030.12 | Volume is calculated using the Contour Survey Report by ULB |
| Below Ground | 22,358.88 | 0.835 | 18,669.67 | Volume is calculated using assumptions and depth obtained during bore hole test. |
| Total | 55,927.88 | | 46,699.78 | |

### 6.4.4 Legacy Waste Characterization

The characteristics of the **legacy** waste were assessed by collecting a 15 kg sample. The legacy waste samples were collected on 28.05.2023 by M/s Matters lab (P) Ltd. The assessment of waste characteristics. was done based on the results of the analysis. The details of the physical characteristics are provided in the tables below: The detailed legacy waste characterisation reports are enclosed as **Annexure 3.**

**Table 6.3 Physical characterization of legacy waste**

| S. No | Total Quantity of legacy waste (MT) | Parameters | Percentage of Weight (%) | Quantity (MT) |
|---|---|---|---|---|
| 1 | 46699.78 | Bio Earth (-4.75mm) | 29.6 | 13823.14 |
| | | Bio Earth (+4.75 to 8 mm) | 16.4 | 7658.76 |
| 2 | | C&D (+8mm) | 6 | 2801.99 |
| 3 | | Plastics | 34 | 15877.93 |
| 4 | | Paper | 6.4 | 2988.79 |
| 5 | | Cloths | 3.6 | 1681.19 |
| 6 | | Glass | 1.6 | 747.20 |
| 7 | | Metals | 1.2 | 560.40 |
| 8 | | Rubber | 1.2 | 560.40 |
| 9 | | Other | 0.008 | 3.74 |
| 10 | | Leather | 0.004 | 1.87 |

**Table 6.4 By Product Composition**

| Particular | Percentage of Composition (%) |
|---|---|
| RDF | 20.6 |
| Recyclable | 27.412 |
| Inert | 5.2 |
| Compost Soil Enricher | 46 |

**Table 6.5 Physical Characteristics of Waste**

| S. No | Parameter | Test Method | Unit | Value |
|---|---|---|---|---|
| 1 | Moisture @105°C | ASTM D 2216 | % | 14 |
| 2 | Bulk Density | USEPA | kg/m3 | 835 |

**Table 6.6 Chemical Analysis**

| SL No | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 8.44 |
| 02 | Biodegradable Factor | USEPA | % | 6.3 |
| 03 | Total carbon | USEPA 9060A | % | 4.8 |
| 04 | Phosphorus(P) | USEPA | % | 0.027 |
| 05 | Nitrogen(N) | USEPA | % | 0.41 |
| 07 | Potassium(K) | USEPA | % | 0.051 |
| 08 | C/N Ratio | USEPA | .. | 11.7:1 |
| 09 | Calorific Value | ASTM D 5865 | k.cal/kg | 895 |
| 10 | Bulk Density | USEPA | gm/cc | 835 |

*Note: The average Nitrogen, Phosphorus and Potassium (NPK) content in the legacy waste samples are far lower than 0.8, 0.4 and 0.8 as specified by the Fertilizer Control Order (FCO) 1985 for city compost and hence cannot be used as compost. The carbon: nitrogen ratio is 11.7:1 which is much lesser than the specified standard. This could be due to the materials being exposed to sun and air over the years or that the carbon content may have*

*leached into the ground through leachate during the rainy season. Another possible contributor to the reduced carbon levels could be multiple fire incidents at the site. Although the material has very less carbon content, the NPK value can be enriched by adding additives like poultry litter. The enriched material can be given to farmers or used for horticulture purposes.*

### 6.4.5. Soil Conditions of the Dumpsite

As it is an unlined dumpsite, there is a probability of finding traces of contaminant from waste and leachate in the underlying soil. Since it is an uncontrolled disposal site, the mixed waste contains different types of pollutants which may eventually have an impact on the soil. Results of soil analysis of the samples taken from the borehole in the Kalamassery dumpsite is as shown below:

**Table 6.7: Chemical analysis of soil extracted from borehole at Kalamassery dumpsite**

| Sl. No | Parameter | Result | US (NY State-Codes, rules and regulations) Industrial Use |
|---|---|---|---|
| 1 | Cadmium (Cd) mg/Kg | <5.0 | 60 |
| 2 | Chromium (Cr) mg/Kg | 157.4 | 800 (Hexavalent) 6800 (Trivalent) |
| 3 | Copper (Cu) mg/Kg | 120.5 | 10000 |
| 4 | Nickel (Ni) mg/Kg | 46.8 | 10000 |
| 5 | Lead (Pb) mg/Kg | 93.6 | 3900 |
| 6 | Zinc (Zn) mg/Kg | 2012 | 10000 |
| 7 | Mercury (Hg) mg/Kg | <0.1 | 5.7 |
| 8 | Arsenic (As) mg/Kg | 2.0 | 16 |

On comparing results of the report with the US Industrial Use benchmark, it is observed that the values are within the benchmark values. Bioremediation may be carried out to reduce traces of heavy metals in soil and for site clearance. The location may be used for industrial landuse as a site for the SWM facilities like Material Collection and Resource Recovery Facility. However, the solution may be considered after proper soil and groundwater investigation post dump-clearing stage.

### 6.4.6 Leachate Characterization and Quantification

There is no leachate collection/management system in the dumpsite. To address the concern of contamination of the groundwater and soil due to uncontrolled dumping, leachate samples are picked for analysis. The data is presented in **Annexure 4**. The data indicates that the TDS is

about 23,400 mg/l while the suspended solids is about 864 mg/l. The chlorides are high at 12535 mg/l, while the COD, BOD are 88,000 mg/l and 20,000 mg/l respectively. The sample does not indicate any traces of contamination hence the soil is unlikely to be contaminated by heavy metals from waste.

**Table 6.8 Leachate characteristics at Kalamassery Dumpsite**

| Parameters tested | Test method | Results |
|---|---|---|
| Sampling Location | N-9°59'23.582" E-76°33'51.031 | |
| pH | IS 3025 (P) 11 –1983RA2017 | 3.81 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 23400 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 864 mg/l |
| Chloride as Cl- | IS 3025 (P) 32 – 1988RA2014 | 12535.12 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 88000 mg/l |
| B O D (3 days at 27 degree C) | IS 3025 (P) 44 – 1993 RA 2014 | 20000 mg/l |
| Total Kjeldahl Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 3987 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 2577 mg/l |
| Phenolic Compound asC6H5OH | IS 3025 (P) 43-1992 RA2014 | 46.5 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL (MDL-0.1 mg/l) |
| Cyanide as CN- | IS 3025(P) 27-1986RA2014 | BDL (MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL (MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL (MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | 1.3 mg/l |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 3.6 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL (MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 7.4 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988 RA2014 | BDL (MDL- 0.01 mg/l) |

*BDL- Below Detection Level, MDL- Minimum Detection Level*

All the heavy metals are significantly low or below detectable limits. The ground water quality results (presented under ESIA Section) indicate that the dumpsite has not caused any major increase in pollution levels and the quality parameters are within the IS 10500:2012.

### 6.4.7 Environmental Baseline

The environmental baseline was assessed from the analytical results of air, surface & groundwater, noise and leachate. The samples by M/s Poluchem Laboratories (P) Ltd. The Environmental baseline was analyzed with reference to the lab analysis reports. The details of analysis & inferences are provided in the ESIA Section in **Annexure 5**

### 6.4.8 Risk Assessment

**Surface Water:** Dumpsites can release pollutants into nearby surface water bodies through leachate, which is generated when rainwater or other liquid comes into contact with the waste. Leachate can contain various contaminants such as heavy metals, organic compounds, and

pathogens. Proper containment and management of leachate are essential to prevent water pollution.

The analysis of surface water reveals that all the parameters are within the acceptable limit, except it is slightly acidic and the dissolved oxygen content is less than prescribed limit, so also the BOD is greater than the allowable limit, indicating that the water contains organic load.

**Table 6.9 Risk Assessment- surface water**

| Risk Assessment | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite -BOD Higher than the acceptable limits |
| **Pathway** | Water/Run off |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | High BOD Indicates the water is highly polluted and it is harmful to ecosystem as fish and other aquatic life may suffocate in oxygen-depleted waters. Also, it will contain more Pathogen and make the water unfit for human and animal |

**Ground Water**: Pollutants from dumpsite can infiltrate into underlying groundwater, particularly if the dumpsite is not adequately lined or if waste disposal practices have caused contamination of the soil. Once pollutants enter the groundwater, they can spread over a wide area, affecting drinking water sources. Remediation techniques often focus on preventing or minimizing further groundwater contamination.

The analysis of ground water samples taken at one location reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The pH of the sample analysis is 6.71, which is in a slightly acidic range which can make the water not fit for any industrial purpose as it is more corrosive.

**Table 6.10 Risk Assessment - Groundwater**

| Risk Assessment | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite - pH is acidic in nature |
| **Pathway** | Water, soil |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | Possible risk to human health is.<br>• Diarrhoea<br>• Nausea and Vomiting |

| | |
|---|---|
| | • Abdominal Pain<br>• Weakness<br>• Organ Damage<br><br>Possible risk to flora<br>It can decrease the availability of plant nutrients, such as phosphorus and molybdenum, and increases the availability of some elements to toxic levels, particularly aluminium and manganese. |

**Air**: Dumpsites may emit pollutants into the air through processes such as open burning of waste or the release of gases from decomposing organic materials. Airborne pollutants can include particulate matter, volatile organic compounds (VOCs), dioxins, and other hazardous substances. These pollutants can have adverse effects on air quality and human health. Measures to control and mitigate air pollution during dumpsite remediation include covering waste, implementing proper waste management practices viz., dust containment screens, etc. to be ensured.

**Table 6.11 Risk Assessment - Air**

| Risk Assessment | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Within the limits |
| **Pathway** | Air |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | No Anticipated risk |

**Soil**: Dumpsites can contaminate the surrounding soil with a wide range of pollutants. Hazardous chemicals, heavy metals, and organic compounds can leach from the waste and accumulate in the soil, potentially posing risks to plants, animals, and humans.

**Table 6.12 Risk Assessment - Soil**

| Risk Assessment | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pathway** | soil |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | Possible risk to human health: Soil that contains substances such as heavy metals which may be toxic to humans can pass those substances on to humans through crop uptake leading to unsafe foods.<br>Possible risks to animals: when farm animals consume the plant grown from contaminated soil it affected the health of animal |

| | |
|---|---|
| | Possible risk to flora: Soil pollution may after plant metabolism and reduce crop yield, also the trees and plants that absorb the soil contaminants enter the food chain |

**Bioaccumulation in Biota**: Pollutants from dumpsites can enter the food chain and bioaccumulate in plants and animals. As pollutants move up the food chain, their concentrations can increase, leading to potential health risks for humans and wildlife. Remediation efforts include restoring the land and minimizing the exposure of organisms to contaminated environments

**Table 6.13 Risk Assessment - Bioaccumulation in Biota**

| Risk Assessment | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate |
| **Pathway** | Air, water and soil |
| **Receptor** | Human, Animals, flora and fauna |
| **Risk** | Possible risks to human health, animal flora and fauna<br>Accumulated of contaminants in plants and animals indirectly through food chain affects human health |

## 7.0. Evaluation of Remediation Techniques

Reclamation of existing unmanaged municipal waste dumpsites is becoming a key requirement for ULB's in India as unscientific and unplanned methods of waste disposal in non-engineered landfills have led to lot of environmental issues including soil and groundwater contamination, uncontrolled landfill gas emissions into the atmosphere and exposure to disease vectors and scavengers. The Hon'ble NGT noted these problems across the country and has ordered the respective authorities to remediate this at the earliest.

The dumpsites have emerged as pollution hubs, especially those situated in human settlements, as cities have grown over the decades. It has, therefore, become a necessity for the city authorities to remediate the existing dumpsites in an environmentally sound and economically viable manner.

Remediation of waste dumpsite is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

- Environment Enhancement - reduction in greenhouse gas emissions, soil pollution, groundwater contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.

- Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in nearby real estate value and rental values.
- Land - Dumpsite land becomes available for utilizing the same for the establishment of other Waste Management Facilities.
- Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels

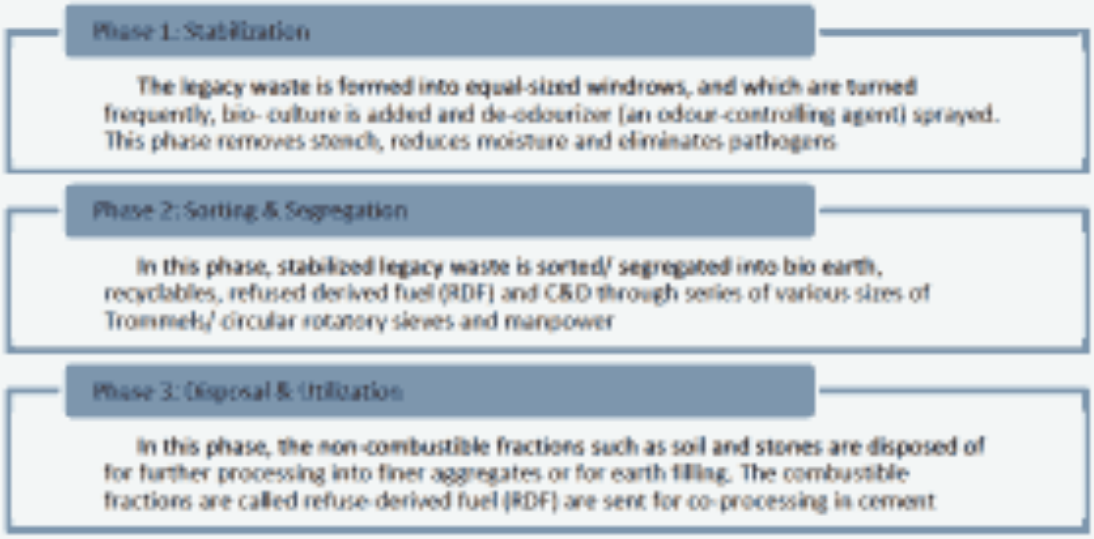
For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- A survey for assessment of volumetric quantity of legacy waste above the ground level.
- Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- History of the site, Physical features of site, as – is/current situation and compositional analysis of waste.
- Baseline study of heavy metals; subsurface soils and water; rainfall; soil type; surface hydrology; topography; wind direction etc. Shall be studied prior to bioremediation.
- Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area.

The details of the remediation techniques for the remediation of the legacy waste dumpsite remediation are as follows:

## 7.1 Bio-Mining – Reclamation/Recovery of Land

Bio- mining is the scientific technique to extract materials of economic interest from legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) and followed by sustainable management through recycling, co-processing, road construction etc.




| | |
|---|---|
| Salient Features | • Land recovery, increase in value of land and available for public use/habitation with immediate effect.<br>• Bio products/aggregates generated from the process can be used as alternative construction material, fuel and recyclables.<br>• Compliance to SWM Rules and NGT orders.<br>• Improvement in aesthetics and quality of life & health. |
| Applicability | • The ownership is well defined.<br>• Working space is available in the dumpsite.<br>• Linkage for utilization by-products is available |

## 7.2 Capping Without Land Recovery

Capping is a scientific process of profiling legacy waste and covering with barrier layers consisting of soil, high density polyethylene (HDPE) liner, gas collection system surface drainage system, and a vegetative cover to minimize the percolation of rainwater into the legacy waste.

| | |
|---|---|
| Salient Features | • The capped area becomes a green space and can be developed into parks/recreational areas after monitoring period.<br>• Capped area will be equipped with environmental monitoring systems for post-closure maintenance to monitor pollution levels in groundwater and surface-water sources and air (especially methane emissions) at least 15 years |

| | |
|---|---|
| | • Capped area needs to be inspected periodically for settlement due to physical, chemical and biological transformation, leachate generation, erosion and naturally occurring invasion by deep- rooted vegetation.<br>• Recurring expenditure will be incurred for regular maintenance. On July 17, 2019, the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested bio-mining as environmentally safe and the most preferable approaches to dumpsite remediation.<br>• SWM rules 2016 do not permit habitation over it for at least 15 years because of the danger posed by toxic gases released by the waste. |
| Applicability | • Simple & robust, least expensive method among various available technologies |

## 7.3 Capping with Partial Land Recovery

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bioremediation i.e., exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can be linked to relevant buyers and the inert material will be capped over lower footprints, with well-designed slopes to prevent further degradation of the environment.

The top layer of capped material may also be provided with gas collection wells and pipes to trap the methane and the collected gasses are typically passed through an oxidation layer of passive venting or flared. If the gas quantity is substantial then, power generation may be a possibility. The capped area should have drains to collect the surface water flow as well as any leachate that may be generated. Such leachate is collected and treated in leachate treatment plants. The reclaimed land may be covered with loamy soil that has plants with high transpiration rates.

| | |
|---|---|
| Salient Features | • The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.<br>• Ensures short -term sustainability and environmentally sound treatment of legacy waste.<br>• Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area |

| | |
|---|---|
| Applicability | ● Legacy waste dumpsite area is partially of steep terrain, inaccessible ravines and narrow valleys.<br>● Lack of linkage for disposal of inert<br>● Recovery land for public use is not a priority |

## 7.4 Selection of Remediation Option

Selection of the applicable method/type or technique is based on the factors like., salient aspects & applicability of remediation types viz., Capping without land recovery, Bio-mining – reclamation/recovery of land & capping with partial land recovery and also available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for land recovery and forward linkages/utilization of processed aggregates/by-products.

Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. Moreover, as per Solid Waste Management Rules, 2016 and several National Green Tribunal (NGT) directives have mandated that urban local bodies opt for bio-mining over capping

However, after the bioremediation municipality wants to use the land for setting up of Material Recovery Facility. Hence backfilling of the site with inert and soil enricher is proposed.

For the execution of dumpsite bio-mining two strategies can be adopted.

- *In situ biomining*: Here the biomining is carried out within the premises of the dumpsite after clearing the waste and reaching the original ground level or in a land adjoining the dumpsite. The advantage is that only the finished products are moved out of the premises, inert may be used for gradation and filling up low lying areas within the site, or in a newly developed sanitary landfill. This is quite economical when legacy waste quantities are significant. The possibility of gaseous emissions, noise and odor and formation of leachate exist as the processing takes place at the site. The location would remain affected for the time till all waste is processed.
- *Ex Situ biomining:* In small dumpsites, or where the area is a constraint, the entire waste is excavated and taken away to an alternate location for processing. The work in the dumpsite can be completed quickly and the disturbance due to the excavation can be minimized. The cost of transportation of the whole waste adds to the cost of bio mining. But since the process plant can serve multiple locations, economies of scale may be achieved and may also compensate for the added transport cost.

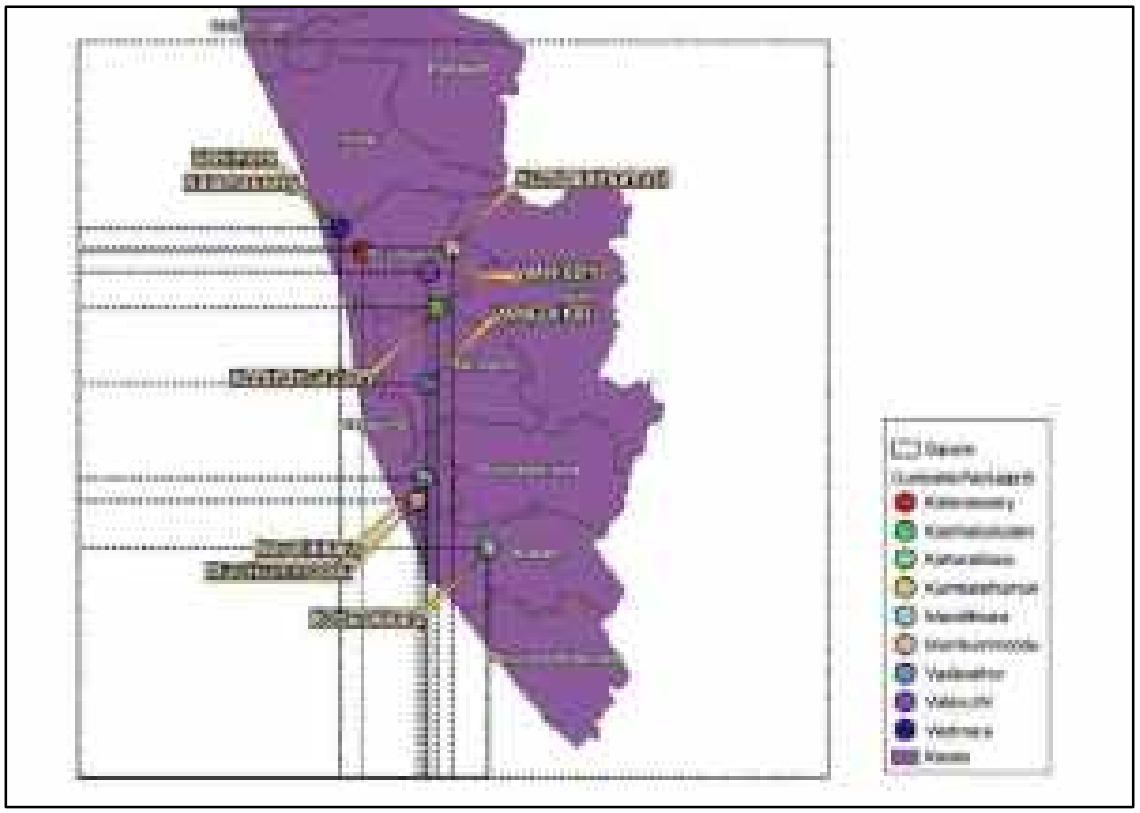


**Figure 7.1 Location of Other Dumpsites nearby**

## 8.0 Technical Description of the Selected Option

### 8.1 Methodology

The legacy waste dumpsite reclamation through bio-mining with recovery of land involves

Phase 1: stabilization

Phase 2: sorting & segregation

Phase 3: disposal & utilization

Phase 4: Back filling of boulders and inert

### 8.2 Selection of Machineries

The type of machinery, capacity and type of screens to stabilize of the legacy waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) will depend on the physical site conditions including quantity & characteristics of legacy waste and utilization of the aggregates/by-products/recovered material.

The type of machinery available for the bio mining are as follows:

- Stationary screening machinery and

- Mobile/compact machinery

### 8.2.1 Stationary Screening Machinery

A Stationary trommel is a specialized piece of equipment used in legacy waste bioremediation processes to separate and classify solid waste materials. It is designed to efficiently screen and sort different components of the waste based on size and other characteristics. Technical description of a Stationary Trommel used in legacy waste bioremediation are as follows:

- Structure: The Stationary trommel consists of a frame made of steel or other durable materials. It is designed to withstand the harsh conditions of waste treatment facilities. The frame supports a cylindrical drum that is inclined at an angle for optimal material flow.
- Drum: The drum is the main component of the Stationary Trommel and is typically made of perforated metal or mesh. It is cylindrical in shape and rotates on its axis using a motorized drive system. The drum's 3- 5 metre diameter and 10 metre length can vary depending on the specific requirements of the waste treatment process.
- Motor and Drive System: The Stationary Trommel is equipped with a motor and drive system that powers the rotation of the drum. The motor is typically electrically powered and is connected to the drum through a gearbox or direct drive mechanism. The rotational speed of the drum can be adjusted to optimize the screening process
- Inlet and Outlet: The Stationary Trommel has an inlet where the legacy waste is fed into the drum for processing. The waste material enters the drum at one end, typically assisted by a conveyor or loader. The screened waste material is discharged from the opposite end of the drum through an outlet.
- Screening Mechanism: As the drum rotates, the legacy waste inside it is subjected to a combination of tumbling and rolling actions. The perforated drum allows smaller-sized particles and materials to pass through, while larger items such as bulky waste, debris, and contaminants are retained inside the drum. The drum's perforation size can be customized to achieve the desired separation efficiency.
- Waste Sorting: The Stationary Trommel facilitates the separation of different components within the legacy waste. It effectively segregates organic waste, inert materials, recyclables, and other categories based on their size and physical properties. This sorting process prepares the waste for further treatment or disposal.

### 8.2.2 Mobile/Compact Screening Machinery

The Mobile Trommel is a technical apparatus utilized in legacy waste bioremediation processes. Its primary function is to separate and sort various types of waste materials, such as solid waste and organic matter, for effective bioremediation

***Structure***: The trommel consists of a cylindrical drum, typically made of heavy-duty metal, which is inclined at a slight angle. The drum is supported by a framework and set in motion by a motor or engine, causing it to rotate slowly. The rotation of the drum allows the waste materials to be fed into the trommel at one end, while simultaneously moving the materials along its length.

***Screening Mechanism***: The Mobile Trommel incorporates various mechanical features to facilitate waste separation. As the waste enters the drum, it encounters a series of screens or perforations arranged along the length of the drum. These screens have different mesh sizes, which allow for the separation of different-sized particles. The smaller particles, such as sand or fine soil, pass through the screens and fall through openings at the bottom of the trommel, while larger materials, such as plastics or larger debris, are retained and carried along by the rotation of the drum.

***Separation System***: Additionally, the Mobile Trommel may be equipped with paddles or lifters mounted inside the drum. These paddles help to agitate and tumble the waste materials, assisting in the separation process by ensuring proper contact between the waste and the screens. They also help to break up clumps or aggregates, aiding in the release of trapped organic matter. Four different screen inclination angles for operations between 20°-35° are available for selection provides flexibility.

***Treatment Process***: In the context of legacy waste bioremediation, the Mobile Trommel plays a crucial role in preparing the waste for subsequent treatment steps. By separating the waste into different fractions based on particle size, it allows for targeted bioremediation processes. For example, the fine fraction may be subjected to aerobic or anaerobic composting, while the larger fraction can undergo mechanical or physical treatments.

***Transport***: Quick and easy folding of conveyor helps in quick setup time.

***Discharge height***: Wider conveyor and higher discharge heights help in making bigger stockpile and eliminates the frequent loader usages

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by- products as per the requirements of the utilization/forward linkage.

Based on the detailed assessment of the selection parameters listed above, the site conditions, legacy waste characteristics, statutory requirements etc, stationary trammel machine shall be the optimum screening machinery

## 8.3 System Requirements

The following are the infrastructural facilities required for setting up of machineries and equipment in biomining of a dumpsite: These are required irrespective of the option of in-situ or ex-situ processing.

- Fencing and secure entrance gate
- Security and reception office
- Weighing bridge
- Records room
- Laboratory
- Medical room
- Workers' area
- Parking for vehicles (heavy earth equipment, trucks, etc.) with tire washing facility.
- Administrative building
- Fire control unit (Detailed fire management plan)
- Toilet–bath complex, with personnel protection equipment (PPE) storage room)
- Overhead water tank
- Leachate collection and treatment unit
- Environmental monitoring unit
- Segregation and processing area
- Temporary storage area for rejects, domestic hazardous waste and sanitary waste
- Material storage area
- Waste drying and windrow area.
- DG set

The total area required is about 900 sqm in an in-situ bio mining plant. Temporary construction power at 440V needs to be obtained from KSEB. This can be easily availed as there is an existing electrical infrastructure passing through the site. A 440V, 125KVA needs to be established for the project. Water storage tanks needs to be provided for the duration of the project. The water may be supplied by tankers. Labour will reside in Kalamassery and commute daily to the site, hence no labour sheds are envisaged during this project. The requirements are only indicative, and the contractor is required to propose own design and capacity to complete the works in the stipulated time and standards.

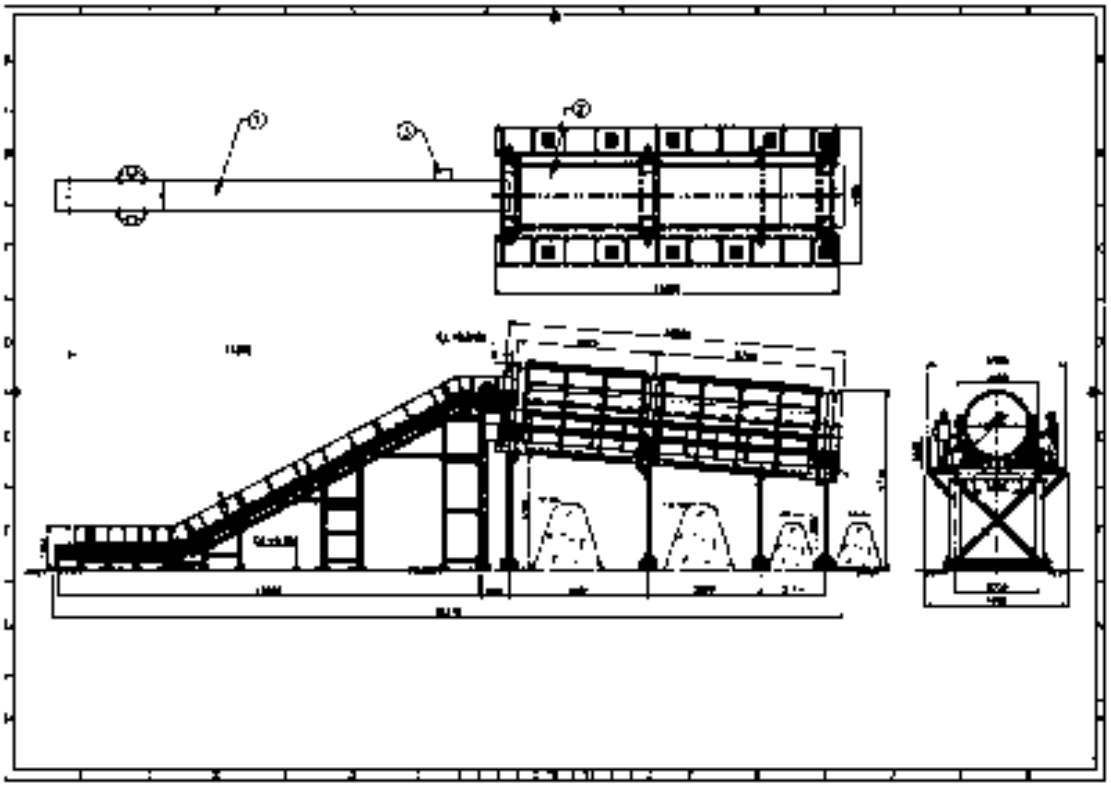


**Figure 8.1 Schematic of the Segregation System**

## 8.4 Site Reclamation Requirement

As detailed under section 6 the Kalamassery Dumpsite has a waste spread of Approx.1.95 acres of land with a max of waste dump height 4.2 m from the ground level. Estimated volume of waste above the ground level is: 33,569 Cum which will be around 28,030.115 MT by taking density as 0.835 T/cum. *(source: Topographical survey result for the Kalamassery Dumpsite conducted in the year 2022 by ULB)*

In the borehole investigation it was asserted that the depth of the waste column is 8.5.m and the quantity of waste below ground level is estimated 22,358.88 Cum as detailed under section 6. *(Source: Borehole investigation survey conducted by KSWMP through Matter Labs for the Kalamassery Dumpsite in June 2023)*

# 9 Scope of Disposal Including Location of Disposal for RDF, Bio Soils, Inerts

## 9.1 Utilization of By Products

The details of the utilization of aggregates/by–products screened out by processing of the stabilized legacy waste are provided in the table below

**Table 9.1 By Product Composition**

| By-products | Percentage Composition by weight (%) | Quantity (MT) | Utilization/Linkage/Usage |
|---|---|---|---|
| RDF | 20.60 | 9,620.15 | RDF will be sent to cement factories for co-processing i.e., for utilization as alternative fuel, supplementing the conventional fuel with necessary documentation for traceability. |
| Recyclables | 27.41 | 12,801.34 | To be sent for recycling to authorised recyclers. |
| Inert | 6.00 | 2,801.99 | Can be utilized for filling at the site itself / filling other low-lying areas inside the ULB boundary after ensuring that it is meeting the required standards and no hazardous contamination is found. |
| Compost/ Soil Enricher | 46.00 | 21,481.90 | Can be used as a soil enricher and given to farmers. The same cannot be sold as fertilizer unless it is enriched with carbon content to meet the standards suggested by FCO for city compost. |

RDF / SCF consists largely of combustible components which are shredded into a uniform size, in order to produce a homogenous material which can be used as substitute for fossil fuels in e.g., cement plants, lime plants, coal fired power plants or as reduction agent in steel furnaces. The calorific value of the RDF should be higher than 1500 kcal/kg for use in cement plants. The RDF material can be compacted and carried for disposal to WtE plants or cement factories which can use this material in their kiln for co-processing as long as it meets the specification for SCF/RDF. However, there may not be any financial value to the supplier or to the ULB as this is more for the disposal of RDF / SCF rather than a revenue-making stream.

The nearest cement Industry that can accept the RDF / SCF from Kalamassery city is located near Trichy, Tamil Nadu at a distance varying between 360-380 kms from the dumpsite site. The other sites in Karnataka are between 740 km to 1074 km, while cement plants at Andhra are at 740 km to 900 kms.

**Table 9.2 Distance to potential RDF / SCF users**

| Name of the cement plant | Location | State | Distance from Kochi (KM) |
|---|---|---|---|
| Dalmia Bharath | Ariyalur | Tamil Nadu | 458 |

| | | | |
|---|---|---|---|
| Dalmia Bharath | Dalmiapuram | Tamil Nadu | 424 |
| ACC | Wadi | Karnataka | 1,075 |
| Chettinad | Karikazhi | Tamil Nadu | 315 |
| Chettinad | Kallur | Tamil Nadu | 386 |
| Dalmia Bharath | Belagavi | Karnataka | 956 |
| JK | Muddapur | Karnataka | 965 |
| Dalmia Bharath | Kadapa | Karnataka | 739 |
| Bharathi VICAT | Kalburgi | Karnataka | 1,074 |
| JSW | Kurnool | Andhra Pradesh | 901 |
| Bharathi VICAT | Kadapa | Andhra Pradesh | 739 |
| Ultratech | Tadipatri | Andhra Pradesh | 815 |
| Zuari | Yerraguntla | Andhra Pradesh | 877 |

The screened compost materials having size less than 4 mm shall be heaped to form windrows, the leachate from excavation shall be used for enriching the compost qualities to the FCO standards and its amendments from time to time. The materials shall be tested for carbon content and NPK values during execution of works, the materials may be sold to farmers depending on the test outcomes. If the compost materials are not meeting with the standards, the same shall be used as soil enricher for refilling within the site itself.

Inert is a course fraction received from the biomining of MSW. It consists of stones, construction debris, ceramics, etc. This is helpful in backfilling in the site or can be used as a subgrade material for highways, low land filling.

## 10 Estimated Project Cost

The details of the estimated cost for bio-mining - recovery of land by remediating legacy waste dumpsite is provided in the table below:

**Table 10.1 Details of Estimated Project Cost**

| Sl. No. | Activity | Rate/ MT | Quantity (MT) | Amount (INR) |
|---|---|---|---|---|
| 1 | **Bio-mining Operations** | | | |
| a | Processing the Waste | [redacted] | [redacted] | [redacted] |
| 2 | Disposal Cost | | | |
| a | Disposal of RDF | [redacted] | [redacted] | [redacted] |

| | | | | |
|---|---|---|---|---|
| b | Disposal of Compost/ Soil enricher | [redacted] | [redacted] | [redacted] |
| c | Sale of recyclables | [redacted] | [redacted] | [redacted] |
| d | Disposal of Inert | [redacted] | [redacted] | [redacted] |
| | Total (1+2) | | | [redacted] |
| | E & S Safeguards from ESIA | | | [redacted] |
| | Contractors Profit and Overheads at 15% | | | [redacted] |
| | Net Cost | | | [redacted] |
| | Average Cost Index for Kerala based on DSR 2018 is –1.35 at present. Considering the same, the Grand Total | | | [redacted] |
| | Cost per MT (INR) | | | [redacted] |

## 10.1 Revenue from the Project

The anticipated sources of revenue from the processing of the legacy waste dumpsite viz., by selling Bio earth, C&D waste, organic compost, RDF and recyclables. But due to the following reasons mentioned below no revenue from the project is considered

- RDF is utilized as fuel (co – processing) in the cement industries, presently most cement industries are only accepting the RDF at free cost and transportation cost is also not borne by the cement industries.
- The uncertainty of quantity and quality of the recyclables from legacy dumpsite due to burnt or crushed or disintegrated, rusted and additional money is required for cleaning of the recyclables for saleable

## 10.2 Funding for Project

The estimated cost of INR [redacted] for the project Dumpsite Remediation. The sources and funding pattern is given below:

**Table 10.2 Sources of funds in Crores**

| Sr. No | Item wise funding pattern | | | |
|---|---|---|---|---|
| | Item | External (70%) (INR) | State Govt. (30%) (INR) | Total Cost (INR) |
| 1 | Dumpsite remediation for the Kalamassery | [redacted] | [redacted] | [redacted] |

## 11.0 Project Implementation Plan

Kalamassery Municipality intends to complete this project as early as possible. However, considering the time required for mobilisation, installation, sieving and handling recoverable etc, a time frame of about 06 months is considered.

### 11.1 Timeline

The broad timeline for the execution of this project is given below.

**Table 11.1 Project Timeline**

| TIMELINE CHART FOR EXECUTION | | | | | | | |
|---|---|---|---|---|---|---|---|
| S. No. | Task Name | M 1 | M 2 | M 3 | M 4 | M 5 | M 6 |
| 1 | Planning & Mobilization | ■ | | | | | |
| 2 | Foundation & Civil Works (Cover Shed installation) for machineries, Hiring & Installation of Machineries, Electrical Works | ■ | ■ | ■ | ■ | ■ | ■ |
| 3 | Excavation of Legacy Waste | | ■ | ■ | | | |
| 4 | Site Development for Windrows & Leachate Collection | | | ■ | ■ | | |
| 5 | Windrow Formation & Spraying of Bio culture | | | | ■ | ■ | |
| 6 | Sieving Operations | | | | | ■ | ■ |
| 7 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | | | | ■ | ■ |
| 8 | Project Closure Activities:<br>Levelling of Reclaimed Land using Bio-soil<br>Handover the available infrastructure at site to the ULB<br>Closure Report Submission to ULB | | | | | | ■ |

### 11.2 Contract Model

***Execution Method:***

Design, Own, Operate and disposal/Management of by-products/aggregates with -zero residues and land recovery. The work shall be carried out in compliance with SWM Rules 2016 and CPCB Guidelines for the disposal of legacy waste 2019.

***Working Model***

- 100% work to outsourced to selected private contractor
- TSC will assess the quantity of waste and the ULB will hand over the land for setting up the facility to the Contractor.

- Cost of Electricity connection to be provided by ULB for the plant.
- Electricity charges for the usage of the plant to be paid by contractor
- ULB shall facilitate the disposal/Utilization of By-products and contractor is responsibility for disposal of RDF, recyclables and aggregates

## 12. Benefits of the Project

The project benefits of dumpsite remediation at Kalamassery are;

- Reclamation of Land: An area of 1.95 acres (waste spread area) will be reclaimed which can be used for resetting SWM facilities of ULB
- Environmental Protection: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By cleaning up contaminated sites, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity
- Health Improvement: Remediation projects reduce these risks, leading to improved public health outcomes and a reduction in waterborne and airborne diseases.
- Enhanced Water Quality: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to safe drinking water.
- Aesthetic and Social Benefits: Remediation of legacy waste dumpsites can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents. Uncontrolled waste dumping will be stopped.
- Operational & Life cycle Aspects - Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through a bio-mining process.

## 13. Conclusion

- The activities of the bio-mining will be commenced from Nov 2023 to Mar 2024. An area of 1.95 acres will be reclaimed and will be used for setting up other solid waste management facilities in future.
- Minimum 85% of the land will be reclaimed and recovered through the biomining process, and this will by ensuring environmental safeguards.

For the optimum screening of the **55,927.88 m3** of legacy waste, mobile / compact screening machinery shall be used.

- Favourable site conditions for bio-mining:
  - The legacy waste dumpsite is located near NH 544 and easily accessible for multi-axial trucks or trailer trucks, which is needed for bioremediation activities.

- Electrical power infrastructure viz., power lines & electrical transformer is available adjacent to the boundary of the dumpsite. (Responsibility- Contractor)
- Piped water supply is available at the dumpsite. (Responsibility- Contractor)

- The project activity requires "Site Authorization, Consent to Establish and Consent to Operate" from KSPCB
- The implementation/execution of the project activities shall be conforming to SWM Rules 2016, CPCB 2018 Guidelines for legacy waste management, NGT orders, KSPCB norms, World Bank guidelines and KSWMP ESMF and other regulatory rules & norms Environmental & Social safeguards:
  - The project attracts E2 Environmental category based on the project activities and status of the environment baseline.
  - Site specific Environmental Assessment and Environmental Management Plan has been developed.
  - The project attracts moderate risk social category based on the social mapping & transect walk to understand the settlements/habitations/establishments etc., and consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.
- Total cost of the project is Rs [redacted]

# Annexures

| | |
|---|---|
| Annexure 1 | Topographical Survey Report |
| Annexure 2 | Geotechnical Survey Report |
| Annexure 3 | Waste Characterization Report |
| Annexure 4 | Waste & Environmental- baseline assessment reports |
| Annexure 5 | Site Plan |
| Annexure 6 | Operation Plan |
| Annexure 7 | Environmental and Social Impact Assessment Report |




Datum: 81.0



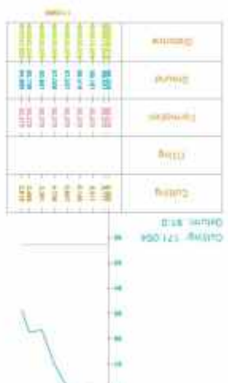

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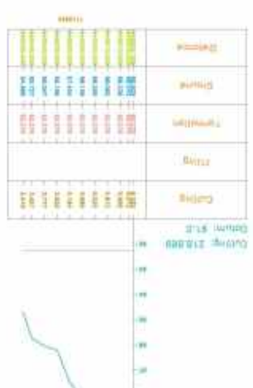

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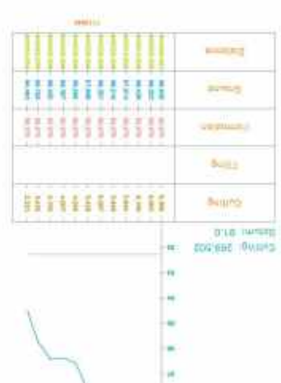

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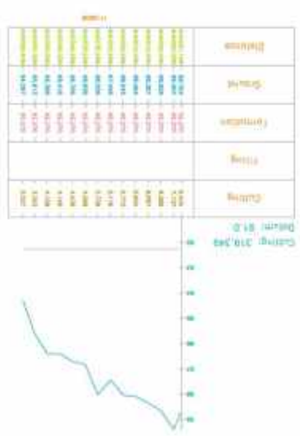

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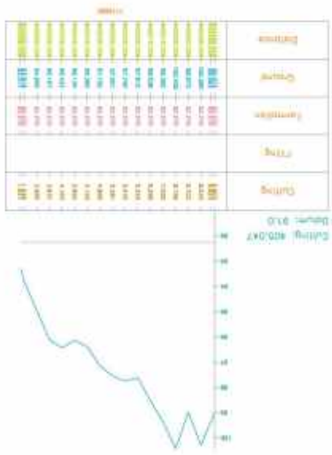

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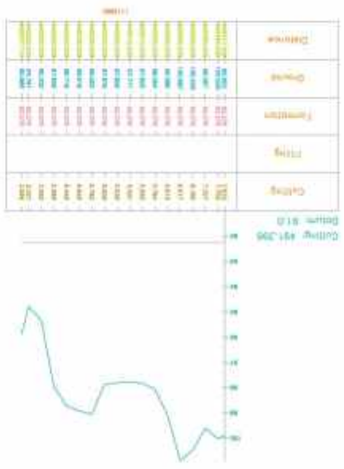

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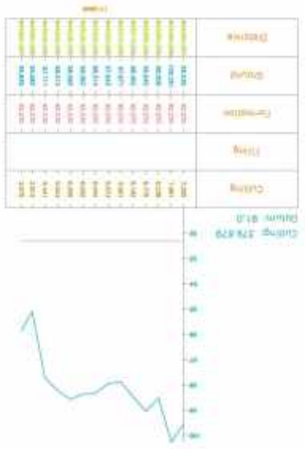

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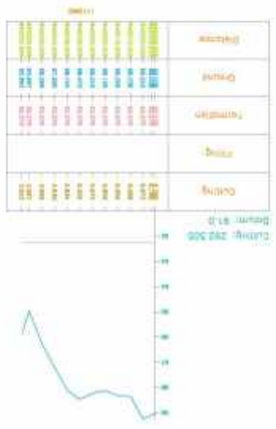

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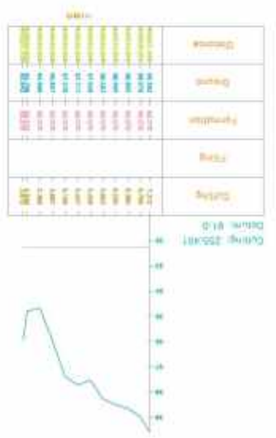

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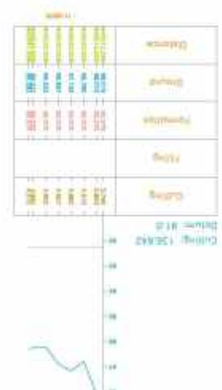

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Datum: 81.0




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Datum: 81.0

MatterLab

Report Number: **ML/GT/2841/224/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE B OF KSWMP AT KALAMASSERY, ERNAKULAM DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | IPE Global Ltd. |
| Address | : | 2nd Floor, 16/3878-3879, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact Person | : | Mr. Ranbir Dey |
| Project No | : | GT-219 |
| Project Name | : | Geotechnical examination of dumpsite under package B of KSWMP at Kalamassery, Ernakulam District. |
| Owner | : | KSWMP |
| Project Location | : | Kalamassery, Ernakulam |
| Tel / Fax No | : | - |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 03-08-2023 | 1st Submission | Dr. Gautham Adapa | |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Dr. Jimmy Thomas | Geotechnical Expert, Consultant, MatterLab | |
| Approved by: | Freddy Soman | General Manager, MatterLab | For |

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2 SCOPE OF WORK ..... 3

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4 GEOTECHNICAL INVESTIGATIONS ..... 4

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6 SUMMARY ..... 7

## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results of soil

Appendix III : Laboratory Test Results of waste

# 1 INTRODUCTION

Matter Material Testing and Research Laboratory Pvt. Ltd has been set-up as a result of increased demand locally from various industries for a multidisciplinary testing, materials consultancy & investigation facility in alignment with global standards and technology advancements. MatterLab is an independent professional and technical services provider to all who are concerned with quality and performance of materials & products.

IPE Global Ltd. which provides technical support consultancy services to the Urban local bodies in different municipalities for the Kerala State Waste Management Project (KSWMP) has entrusted the geotechnical investigative works as part of their DPR study for the bio-mining and remediation of dumpsite in Kalamassery, Ernakulam, Ernakulam district to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was bored using a rotary drill. The initial site visit was done on 23rd May 2023. During the site visit it was observed that the dumpsite is situated near to a stream flow and between road and railway tracks. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 28th May 2023 and was completed on 31st May 2023. Standard Penetration test (SPT) was conducted within the borehole as required. Disturbed soil samples as well as undisturbed soil samples were collected to conduct relevant laboratory tests to acquire the necessary parameters. This report presents results of the geotechnical investigation of the ground encountered after drilling through the waste at the dumpsite.

# 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil samples and performing necessary laboratory tests on the collected samples to obtain the desired parameters of the ground profile.
- Preparation of report with laboratory test results.
- Bearing capacity evaluation for the ground encountered after drilling through the waste.

## 3 OBSERVATIONS FROM SITE VISIT

Matterlab has deputed a team from our geotechnical department during the third week of May 2023, in order to collect the information regarding the site prior to mobilising the equipment for drilling, along with dumpsite specialists (Mr. Ajit Kumar Nayan and Mr. Ravi Kumar) related to IPE Global.

The location of the dumpsite is situated near to a cemetery ground and located between a highway and railway tracks. It was also noted that the surrounding area of the dumpsite is uninhabited.




**Figure 1 :** Location of the borehole drilled at the dumpsite

## 4 GEOTECHNICAL INVESTIGATIONS

### 4.1 Rotary drilling

Rotary drilling technique was adopted for advancing and clearing out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste in the landfill.

## 4.2 Drilling equipment

Mechanical rigs of rotary drilling machine were used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The boring diameter of 150mm was formed using a drag bit (Soil Cutter) in soil. The drag bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by drilling mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

## 4.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as representative samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved

in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log:

The commencement and completion date, location of borehole, elevation of top and bottom of boring, ground water table, boundaries of each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelog is attached as **Appendix-I.**

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant standard codes. A summary of laboratory tests carried out is shown below in **Table 1** and the complete results of laboratory testing of soil and waste are appended in **Appendix II** and **Appendix III** respectively.

**Table 1: Details of various laboratory tests of soil conducted and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 1 | Soil | Grain-Size Analysis | IS: 2720(Part-4)-1985 |
| 2 | | Atterberg's Limit | IS: 2720(Part-5)-1976 |
| 3 | | MDD/OMC(Light Compaction) | IS:2720(Part-7)-1980 |
| 4 | | Direct Shear | IS:2720(part-130-1986 |
| 5 | | Permeability | IS :2720 (Part-17)-1986 |
| 6 | | Consolidation | IS:2720(Part-15)-1986 |
| 7 | | Moisture Content | BS:1377-(Part-2)-1990 |
| 8 | | Bulk Density & Dry Density | BS:1377-(Part-2)-1990 |
| 9 | | Cation Exchange Capacity | USDA No. 16 |



**Figure 2** : Laboratory tests performed at MatterLab.

## 6 SUMMARY

The geotechnical examination on the soil samples collected after boring through the waste at the dumpsite at Kalamassery, Ernakulam was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a single borehole was bored using a rotary drill. The maximum depth of investigation was 13.0m (8.5m in waste and 4.5m in the ground).

It was observed from the laboratory results and samples obtained from SPT and the undisturbed samples collected, that the ground encountered after drilling through the waste is clayey layer sandwiched between sandy layers. As per the information provided by the client,

the waste in the dumpsite needs to be excavated, segregated using a few machinery and the inert material left after the bio-mining needs to be dumped within the site. As informed by the client, during the process of bio-mining the waste would be excavated from one feasible location of the site and transferred to another location of the site. During these operations, any temporary storage waste in the form of heaps should be carried out ensuring the stability of the sloping face of the waste. It is suggested that for slopes with height ≤ 1.5 m the angle of face should not be steeper than 45°. For slopes of height greater than 1.5 m the slope should be limited to 300 to horizontal or flatter. It is not advisable to use slope heights > 5 m without a proper stability analysis. If the inert material is being disposed at the site with no further plans of transporting it or transferring it, it is recommended to compact the material into layers using an 8-10 T roller with compacted lift thickness not exceeding 300 mm.

**The Safe Bearing Capacity (SBC)** is calculated as per IS 6403:1981 (Reaffirmed 2021). For any temporary structures planned at the site, the **recommended allowable bearing pressure** for isolated footings at a minimum depth of 0.5 m below **original ground level** is **150 kPa.** For any slope stability calculations involving the natural ground, the parameters presented in the summary sheet of laboratory results can be used.

The above recommendations are made based on the subsoil profile and laboratory test results obtained on the samples collected from the site. If there is any variation in soil profile during execution, fresh recommendation may be obtained from M/s Matter Material Testing & Research Laboratory (P) Ltd. or from a qualified and experienced geotechnical engineer.

# APPENDIX-I

# BORELOGS

Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT** | **: Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam** | **SHEET NO.** | **: 1 of 1** | **START DATE** | **: 28/05/2023** |
| **CLIENT** | **: IPE Global** | **BORE DIAMETER (mm)** | **: 150** | **END DATE** | **: 31/05/2023** |
| **Proposed Structure** | **: Dumpsite Rehabilitation** | **BORING TYPE** | **: Rotary** | **REDUCED LEVEL (m)** | **: -** |
| **LOCATION** | **: Kalamassery, Ernakulam** | **TERMINATION DEPTH (m)** | **: 12.5** | **EASTING (m)** | **: 76.32023** |
| **BOREHOLE NO.** | **: BH-01** | **WATER LEVEL** | **:** | **NORTHING (m)** | **: 10.065271** |

| DEPTH m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM N1 | N2 | N3 | SPT N VALUE | DEPTH V/S N VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.50 | | Dumped Waste | 8.50 | | | | | | | | |
| 8.9 | | Medium dense greyish coloured medium to coarse grained SAND with traces of gravels | 0.4 | 8.50<br>9.0 | SPT-3<br>UDS-4 | 8 | 10 | 11 | 21 | | |
| 9.3 | | Greyish medium to coloured grained SAND with traces of gravels | 0.4 | 9.50 | UDS-5 | | | | | | |
| 9.85 | | Stiff black coloured silty CLAY with traces of gravels | 0.55 | 10.0 | SPT-4 | 2 | 5 | 3 | 8 | | |
| 11.3 | | Medium dense greyish coloured silty SAND with fine clay and little amount of gravels | 1.45 | 10.5<br>11.0<br>11.5 | UDS-5<br>UDS-6<br>SPT-5 | 19 | 12 | 5 | 17 | | No sample |
| 11.85 | | Greyish coloured silty SAND with traces of gravels | 0.55 | 12.0 | UDS-7 | | | | | | |
| 12.4 | | Greyish coloured silty SAND with little amount of clay and traces of gravels | 0.55 | 12.5 | UDS-8 | | | | | | |
| | | **Bore hole terminated at the depth of 12.4m below top of waste (3.9m below original ground)** | | | | | | | | | |

Abbreviations
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
CR- Core Recovery, RQD- Rock Quality Designation

Sd/-
Site Supervisor

# APPENDIX-II

# LABORATORY TEST RESULTS OF SOIL

# SUMMARY OF LABORATORY TEST RESULTS

**Report Number : ML23/R-01956 Report Date:04/07/2023**

**Project : Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam**

**Borehole ID : BH-01**

| N value | MatterLab ref | Depth (m) | Type of sample (SPT/UDS/RC) | Soil description | IS Classification | Atterberg Limit | | | Grain size distribution | | | | | | Maximum dry density, gm/cc | Optimum moisture content, % | Cohesion (c), kPa | Internal friction angle, | Bulk density, gm/cc | Dry density, gm/cc | Moisture content, % | Permeability, cm/s | Consolidation | | | | Chemical |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit,% | Plastic Limit,% | Plasticity Index | Fine Gravel,% | Coarse Sand,% | Medium Sand,% | Fine Sand,% | Silt,% | Clay,% | | | | | | | | | Initial Void ratio | Preconsolidation pressure, kPa | Compression Index, $C_c$ | Recompression Index, $C_r$ | Cation exchange capacity (meq/100gm) |
| 21 | ML23/W-01956/S1 | 8 5 | SPT | Well graded sand with gravel and silt | SW-SM | | | | 18 | 19 | 46 | 10 | 7 | | | | | | | | | | | | | | |
| | ML23/W-01956/S2 | 9 0 | UDS | | | | | | | | | | | | 1 98 | 7 70 | | | | | | 1 05 E-03 | | | | | |
| | ML23/W-01956/S3 | 9 5 | UDS | | | | | | | | | | | | | | 5 | 34 | 2 00 | 1 86 | 7 7 | | 1 016 | 70 | 0 21 | 0 02 | 11 91 |
| 8 | ML23/W-01956/S4 | 10 0 | SPT | Silt of high plasticity with gravel and sand | MH | 105 | 56 | 49 | 19 | 8 | 7 | 4 | 25 | 37 | | | | | | | | | | | | | |
| | ML23/W-01956/S5 | 11 0 | UDS | | | | | | | | | | | | 1 96 | 8 10 | 9 | 29 | 1 67 | 1 54 | 8 1 | 1 11 E-03 | 1 456 | 109 | 0 66 | 0 03 | |
| 17 | ML23/W-01956/S6 | 11 5 | SPT | Clayey sand / Sandy clay | SC/CI | 33 | 16 | 17 | 4 | 9 | 25 | 20 | 17 | 25 | | | | | | | | | | | | | |
| | ML23/W-01956/S7 | 12 0 | UDS | | | | | | | | | | | | 1 99 | 7 80 | | | | | | | | | | | |
| | ML23/W-01956/S8 | 12 5 | UDS | | | | | | | | | | | | | | 14 | 36 | 1 80 | 1 67 | 7 8 | 1 10 E-03 | 0 788 | 97 | 0 23 | 0 01 | |

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Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvennur Nada (PO) Thiruvennur,
Kozhikode, Kerala, 673029

# Grain Size Distribution of Soil Test Report

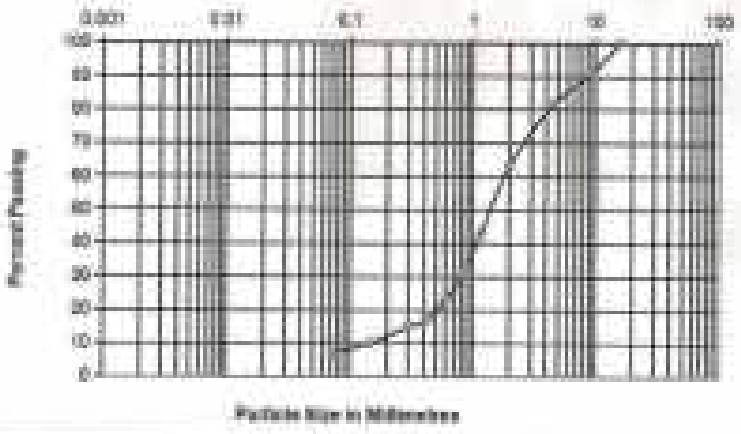
Report No: ML23/R-01938/1
Issue No: 1.1
Report Date: 14/06/2023

| | |
|---|---|
| Client: | IFE Global |
| Address: | Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 8.50m |
| Work Order ID: | ML23/W-01956 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01956/S1 | Source*: | BH 01, Depth 8.50m |
| Date Sampled: | 29/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested : | 10/06/2023 - 12/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 8.50m |
| Tested By: | SR/GK | Client Sample Desc.*: | Soil, BH 01, Depth 8.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Particle Size Distribution - Wet & Dry Sieving** — Method: IS: 2720 (Part 4)-1985




| Sieve Size (mm) | % Passing | Project Limit |
|---|---|---|
| 16.00 | 100 | - |
| 9.500 | 91 | - |
| 4.750 | 82 | - |
| 2.000 | 63 | - |
| 1.180 | 43 | - |
| 0.850 | 31 | - |
| 0.600 | 25 | - |
| 0.425 | 17 | - |
| 0.300 | 15 | - |
| 0.150 | 10 | - |
| 0.075 | 7 | - |

For and on behalf of MatterLab

**Comments**

*Information provided by client

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Mini Bypass Road, Thiruvennur Nada (PO) Thiruvennur,
Kozhikode, Kerala, 673029.

TC-9749

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/W-01866/2
Issue No.: 1
Report Date: 16/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveriott Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

ULR-IC070423000000452 8F

**Sample Details**

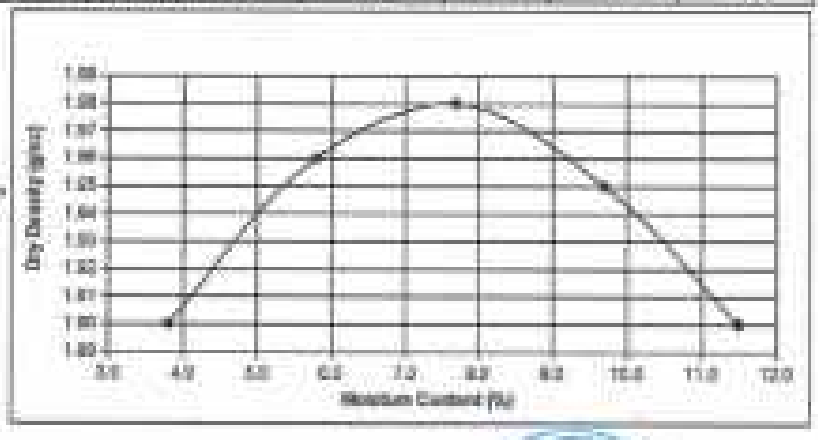
| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*): | Soil (UDS-1), BH 01, Depth 9.00m |
| Work Order ID: | ML23/W-01866 | Sample Submitted By.*): | Geotechnical Division |
| Sample ID: | ML23/W-01866/02 | Source*): | BH 01, Depth 9.00m |
| Date Sampled: | 28/05/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*): | Kalamassery, Ernakulam | Date Tested : | 13/06/2023 - 14/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 9.00m |
| Tested By: | DK | Client Sample Desc.: | Soil (UDS-1), BH 01, Depth 9.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Mould volume: | | $V_m$ (cm$^3$) | 996 | | | | |
|---|---|---|---|---|---|---|---|
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4063 | | | | |
| Mass of mould + compacted sample | | W (g) | 6031 | 6133 | 6193 | 6198 | 6178 |
| Mass of sample | | | 1968 | 2070 | 2130 | 2135 | 2115 |
| Wet density | $(W-W_m)/V_m$ | $\rho_b$ (Mg/m$^3$) | 1.97 | 2.07 | 2.13 | 2.14 | 2.12 |
| Mass of wet sample | | $W_w$ (g) | 548.9 | 520.2 | 531.7 | 500.9 | 511.8 |
| Mass of dry sample | | $W_d$ (g) | 528.5 | 500.2 | 493.7 | 456.8 | 469.0 |
| Moisture content | $[(W_w-W_d)/W_d]x100$ | m (%) | 3.8 | 6.8 | 7.7 | 9.7 | 11.5 |
| Dry density | $\rho_b/(1+m/100)$ | $\rho_d$ (Mg/m$^3$) | 1.90 | 1.98 | 1.98 | 1.95 | 1.90 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc: | 1.98 |
| Optimum moisture content, % | 7.7 |
| Material retained on 20mm,% | 0 |
| Sample used: | Single |
| Size of mould: | 1000cm$^3$ |
| Weight of rammer: | 2.6 kg |




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**Comments:**

*Information provided by client

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Kozhikode, Kerala, 673025

TC-14746

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/R-01866/2
Issue No : 1
Report Date:16/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

**Sample Details**

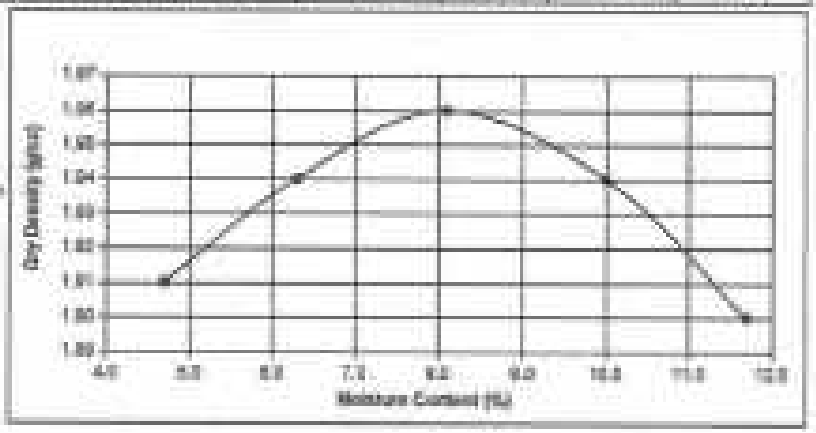
| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*): | Soil (UDS-4), BH 01, Depth 11.00m |
| Work Order ID: | ML23/W-01866 | Sample Submitted By.*: | Geotechnical Division |
| Sample ID: | ML23/W-01866/B6 | Source*): | BH 01, Depth 11.00m |
| Date Sampled: | 28/05/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | 6 Approx |
| Sample Location*): | Kalamassery, Ernakulam | Date Tested : | 13/06/2023 - 14/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-4), BH 01, Depth 11.00m |
| Tested By: | DK | Client Sample Desc.: | Soil (UDS-4), BH 01, Depth 11.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ (cm$^3$) | 998 | | | | |
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4083 | | | | |
| Mass of mould + compacted sample | | W (g) | 6059 | 6119 | 6179 | 6189 | 6179 |
| Mass of sample | | | 1976 | 2036 | 2116 | 2126 | 2116 |
| Wet density | $(W-W_m)/V_m$ | $\rho_b$ (Mg/m$^3$) | 1.98 | 2.04 | 2.12 | 2.13 | 2.12 |
| Mass of wet sample | | $W_w$ (g) | 489.1 | 491.7 | 509.7 | 505.8 | 502.9 |
| Mass of dry sample | | $W_d$ (g) | 467.1 | 453.8 | 471.8 | 459.8 | 450.2 |
| Moisture content | $[(W_w-W_d)/W_d]\times100$ | m (%) | 4.7 | 8.3 | 8.1 | 10.0 | 11.7 |
| Dry density | $\rho_b/(1+m/100)$ | $\rho_d$ (Mg/m$^3$) | 1.91 | 1.94 | 1.96 | 1.94 | 1.90 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc | 1.96 |
| Optimum moisture content, % | 8.1 |
| Material retained on 20mm,% | 0 |
| Sample used: | Single |
| Size of mould: | 1000cm$^3$ |
| Weight of rammer: | 2.6 kg |




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**Comments:**

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Tests results relate only to the samples tested.



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Kozhikode, Kerala, 673029.

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: MLB2/R-01566/W
Issue No : 1
Report Date: 16/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveeth Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

IR-TC12No230000041221F

**Sample Details**

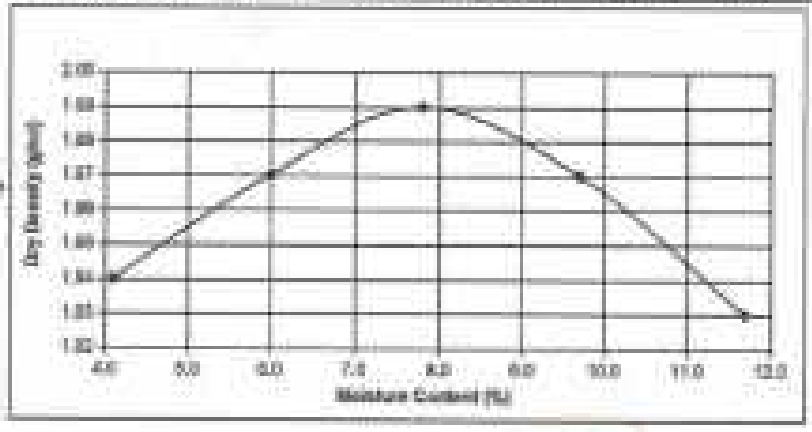
| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*): | Soil (UDS-6), BH 01, Depth 12.00m |
| Work Order ID: | MLB2/W-01566 | Sample Submitted By.*): | Geotechnical Division |
| Sample ID: | MLB2/W-01566/07 | Source*): | BH 01, Depth 12.00m |
| Date Sampled: | 26/05/2023 | Sampled By*): | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | 8 Approx |
| Sample Location*): | Kalamassery, Ernakulam | Date Tested : | 13/06/2023 - 14/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.) | Soil (UDS-6), BH 01, Depth 12.00m |
| Tested By: | DK | Client Sample Desc.) | Soil (UDS-6), BH 01, Depth 12.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ (cm³) | 1000 | | | | |
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4083 | | | | |
| Mass of mould + compacted sample | | W (g) | 6079 | 6149 | 6204 | 6218 | 6219 |
| Mass of sample | | | 2016 | 2066 | 2141 | 2156 | 2156 |
| Wet density | $(W-W_m)/V_m$ | $\rho_w$ (Mg/m³) | 2.02 | 2.09 | 2.15 | 2.16 | 2.16 |
| Mass of wet sample | | $W_{ws}$ (g) | 484.4 | 478.1 | 517.8 | 449.6 | 462.2 |
| Mass of dry sample | | $W_{ds}$ (g) | 474.9 | 451.0 | 490.1 | 450.8 | 473.8 |
| Moisture content | $((W_{ws}-W_{ds})/W_{ds})\times100$ | m (%) | 4.1 | 6.0 | 7.8 | 9.7 | 11.7 |
| Dry density | $\rho_w/(1+m/100)$ | $\rho_d$ (Mg/m³) | 1.94 | 1.97 | 1.99 | 1.97 | 1.93 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc | 1.99 |
| Optimum moisture content, % | 7.8 |
| Material retained on 20mm,% | 0 |
| Sample used | Single |
| Size of mould | 1000cm³ |
| Weight of rammer | 2.6 kg |




For and on behalf of MatterLab

**Comments:**

*Information provided by client

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Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-01956/R
Issue No : 1
Report Date: 19/06/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavenatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 626000 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kalamassery, Ernakulam |
| **Tel / Email:** | - |

## Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 09/06/2023 | **Client Sample Ref.*:** | Soil, BH 01, Depth 10.00m |
| **Work Order ID:** | ML23/W-01956 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-01956/04 | **Source*:** | BH 01, Depth 10.00m |
| **Date Sampled:** | 28/05/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2131 - 1981 | **Sample Size(kg):** | 5 Approx |
| **Sample Location*:** | Kalamassery, Ernakulam | **Date Tested :** | 14/06/2023 - 16/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil, BH 01, Depth 10.00m |
| **Tested By:** | SR/VY | **Client Sample Desc*.:** | Soil, BH 01, Depth 10.00m |
| **Condition of Soil:** | Natural | **Period of Soaking:** | 24 Hrs |
| **Test Location:** | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3: Mechanical Method | Liquid Limit,% | 105 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 56 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 49 | - |

For and on behalf of MatterLab

## Comments

* Information provided by client

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These results relate only to the samples tested.



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Kozhikode, Kerala, 673028.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-01958/E
Issue No : 1
Report Date: 16/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

IEA-TC/SPec 2 3 8 0 8 8 4 5 2 3 F

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 11.50m |
| Work Order ID: | ML23/W-01958 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01958/S6 | Source*: | BH 01, Depth 11.50m |
| Date Sampled: | 25/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested : | 14/06/2023 – 16/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 11.50m |
| Tested By: | AAVY | Client Sample Desc*.: | Soil, BH 01, Depth 11.50m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3: Mechanical Method | Liquid Limit,% | 33 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 16 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 17 | - |

For and on behalf of MatterLab

**Comments**

* Information provided by client

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# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23R-015567
Issue No : 1
Report Date:19/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveriatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala -682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*): | Soil (UDS-1), BH 01, Depth 9.00m |
| Work Order ID: | ML23W-01958 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-01958/02 | Source*): | BH 01, Depth 9.00m |
| Date Sampled: | 26/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location: | Kalamassery, Ernakulam | Date Tested : | 11/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 9.00m |
| Tested By: | GK | Client Sample Desc.*): | Soil (UDS-1), BH 01, Depth 9.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2) 1990 | Bulk Density of Soil, g/ml | 2.24 | - |

For and on behalf of MatterLab

**Comments**
*Information provided by client

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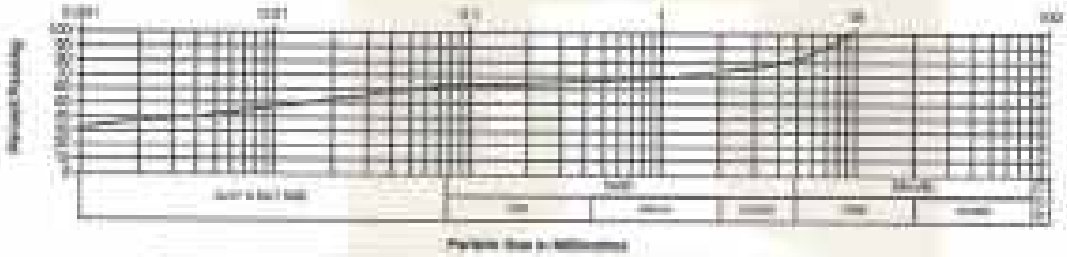
# Hydrometer Analysis Test Report

| | | | |
|---|---|---|---|
| Client: | PE Global | Consultant: | - |
| Address: | Kavanah Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 626000 | Owner: | KSWAP |
| Contact: | Mr. Ranabir Dey | Contractor: | - |
| Project No: | - | Project Location: | Kalamassery, Ernakulam |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam | Tel./ Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 26/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 10.00m |
| Work Order ID: | ML23/W-01998 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01998/S4 | Source*: | BH 01, Depth 10.00m |
| Date Sampled: | 26/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Shape: | S Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested : | 12/06/2023 - 14/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lab No / Lot: Box: | - | Lab Sample Desc.: | Soil, BH 01, Depth 10.00m |
| Tested By: | RH | Client Sample Desc.*: | Soil, BH 01, Depth 10.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Particle Size Distribution** (Method: IS: 2720 (Part 4): 1985, Cl.9.5)



| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 91 |
| 2.000 | 78 |
| 0.850 | 68 |
| 0.600 | 67 |
| 0.425 | 66 |
| 0.300 | 65 |
| 0.150 | 63 |
| 0.075 | 62 |
| 0.052 | 59 |
| 0.037 | 57 |
| 0.026 | 54 |
| 0.019 | 52 |
| 0.014 | 49 |
| 0.010 | 47 |
| 0.007 | 44 |
| 0.005 | 42 |
| 0.004 | 39 |
| 0.002 | 37 |
| 0.001 | 32 |

| | |
|---|---|
| Gravel % | 19 |
| Sand % | 19 |
| Silt % | 25 |
| Clay % | 37 |

For and on behalf of MatterLab

**Comments**

*Information provided by client



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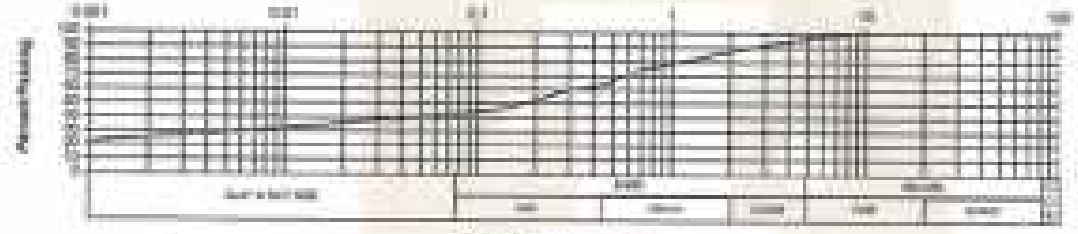
# Hydrometer Analysis Test Report

| | | | |
|---|---|---|---|
| Client: | PE Group | Consultant: | - |
| Address: | Kavanat Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 682030 | Owner: | KSWAP |
| Contact: | Mr. Renatio Dey | Contractor: | - |
| Project No: | - | Project Location: | Kalamassery, Ernakulam |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam | Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 11.50m |
| Work Order ID: | ML23/IN/01888 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/IN/01888/588 | Source*: | BH 01, Depth 11.50m |
| Date Sampled: | 09/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size/Kgs: | 5 Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested: | 10/08/2023 - 14/08/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 11.50m |
| Tested By: | RH | Client Sample Desc.*: | Soil, BH 01, Depth 11.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4)-1985, Cl.9.3



Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 96 |
| 2.000 | 87 |
| 0.850 | 78 |
| 0.600 | 71 |
| 0.425 | 63 |
| 0.300 | 54 |
| 0.150 | 47 |
| 0.075 | 42 |
| 0.053 | 40 |
| 0.037 | 36 |
| 0.026 | 27 |
| 0.019 | 25 |
| 0.014 | 23 |
| 0.010 | 22 |
| 0.007 | 20 |
| 0.005 | 19 |
| 0.004 | 17 |
| 0.002 | 15 |
| 0.001 | 13 |

| | |
|---|---|
| Gravel,% | 4 |
| Sand,% | 54 |
| Silt,% | 17 |
| Clay,% | 25 |

For and on behalf of MatterLab

**Comments**

*Information provided by client

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# SHEAR STRENGTH TEST REPORT

Report No: ML23/R-010892/D
Issue No: 1
Report Date: 19/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Karumadi Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Renatte Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 09/09/2023 | Client Sample Ref.*: | Soil (UDS-2), BH 01, Depth 9.50m |
| Work Order ID: | ML23/W-010892 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-010892/03 | Source:* | BH 01, Depth 9.50m |
| Date Sampled: | 28/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location:* | Kalamassery, Ernakulam | Date Tested: | 14/09/2023 - 15/09/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab - Kozhikode | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 9.50m |
| Tested By: | DK | Client Sample Desc.: | Soil (UDS-2), BH 01, Depth 9.50m |

## Test Results

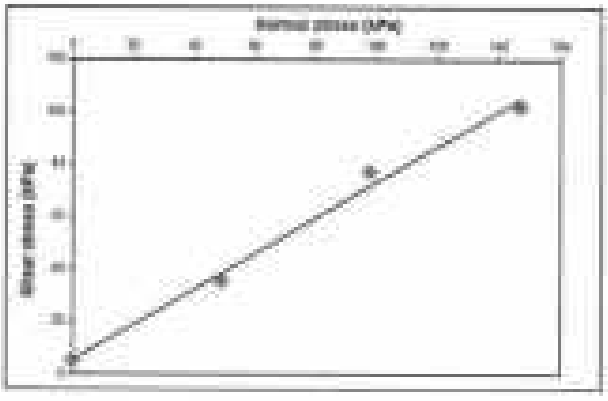
Method: IS 2720 (Part 13): 1986

| | |
|---|---|
| Area of specimen (cm²) | 36 |
| Height of specimen (mm) | 20 |
| Rate of strain (mm/min) | 1.25 |
| Test Condition | Unconsolidated Drained |
| Bulk Density (Mg/m³) | 2.00 |
| Moisture content (%) | 7.7 |
| Dry Density (Mg/m³) | 1.86 |

| Load Increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Stress (mm) |
|---|---|---|---|
| 1 | 49 | 39.4 | 2.0 |
| 2 | 98 | 77.1 | 2.6 |
| 3 | 147 | 101.0 | 3.0 |

Cohesion Intercept (C'), kPa: 0

Angle of Internal Friction (Φ'): 34°




For and on behalf of MatterLab

## Comments

*Information provided by client

Material tested was passing 4.75 mm test sieve, reconsolidated at maximum achievable density and moisture content

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## SHEAR STRENGTH TEST REPORT

Report No: ML23/R/[illegible]
Issue No : 1
Report Date: 16/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | Soil (UDS-4), BH 01, Depth 11.00m |
| Work Order ID: | ML23W-01986 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-01986/S5 | Source:* | BH 01, Depth 11.00m |
| Date Sampled: | 28/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location:* | Kalamassery, Ernakulam | Date Tested : | 14/06/2023 - 15/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | Matterlab - Kozhikode | Lab Sample Desc.: | Soil (UDS-4), BH 01, Depth 11.00m |
| Tested By: | DK | Client Sample Desc.: | Soil (UDS-4), BH 01, Depth 11.00m |

### Test Results

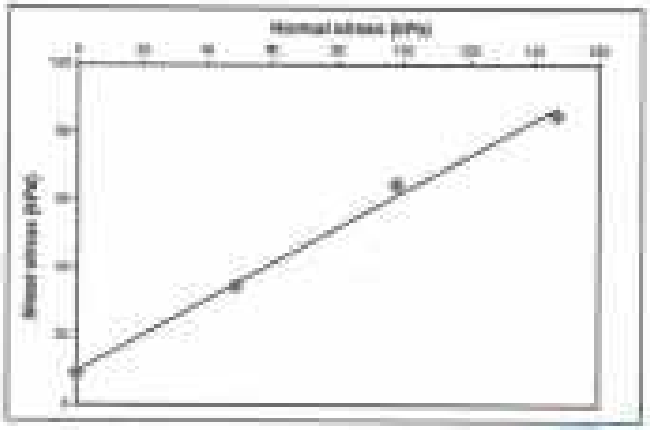
Method: IS 2720 (Part 13)-1986

| | | |
|---|---|---|
| Area of specimen (cm²) | : | 36 |
| Height of specimen (mm) | : | 25 |
| Rate of strain (mm/min) | : | 1.25 |
| Test Condition | : | Unconsolidated Drained |
| Bulk Density (Mg/m³) | : | 1.87 |
| Moisture content (%) | : | 8.1 |
| Dry Density (Mg/m³) | : | 1.54 |

| Load Increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Stress (mm) |
|---|---|---|---|
| 1 | 49 | 34.8 | 2.0 |
| 2 | 98 | 64.8 | 2.4 |
| 3 | 147 | 85.2 | 2.8 |

Cohesion Intercept (C') kPa : 9

Angle of Internal friction (ϕ') : 29°




For and on behalf of MatterLab

### Comments

*Information provided by client

Material tested was passing 4.75 mm test sieve, reconstacted at maximum achievable density and moisture content

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Thiruvannur, Kozhikode, Kerala, 673029

# SHEAR STRENGTH TEST REPORT

Report No: ML23/R-01000/12
Issue No : 1
Report Date:16/06/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kaveriatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| **Contact:** | Mr. Ratnabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical investigation at Duripalla in Kalamassery, Ernakulam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kalamassery, Ernakulam |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 09/05/2023 | **Client Sample Ref.*:** | Soil (UDS-6), BH 01, Depth 12.50m |
| **Work Order ID:** | ML23/W-01998 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-01998/08 | **Source:*** | BH 01, Depth 12.50m |
| **Date Sampled:** | 28/04/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method:** | IS: 2131 - 1981 | **Sample Strength:** | 5 Approx |
| **Sample Location:*** | Kalamassery, Ernakulam | **Date Tested :** | 14/06/2023 - 15/06/2023 |
| **Sample Cont. No:** | - | **Test Method Variation:** | None |
| **Test Location:** | Matterlab - Kozhikode | **Lab Sample Desc.:** | Soil (UDS-6), BH 01, Depth 12.50m |
| **Tested By:** | DK | **Client Sample Desc.:** | Soil (UDS-6), BH 01, Depth 12.50m |

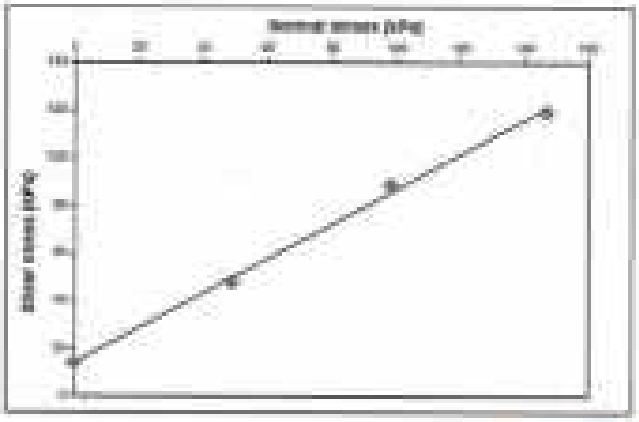
**Test Results** — Method: IS 2720 (Part 13)-1986

| | |
|---|---|
| Area of specimen ($cm^2$) | 36 |
| Height of specimen (mm) | 25 |
| Rate of strain (mm/min) | 1.25 |
| Test Condition | Unconsolidated Drained |
| Bulk Density ($Mg/m^3$) | 1.80 |
| Moisture content (%) | 7.8 |
| Dry Density ($Mg/m^3$) | 1.67 |

| Load Increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Stress (mm) |
|---|---|---|---|
| 1 | 49 | 47.8 | 2.4 |
| 2 | 98 | 88.5 | 2.8 |
| 3 | 147 | 119.1 | 3.2 |

Cohesion Intercept (C'), kPa: 14

Angle of internal friction (ϕ'): 36°




For and on behalf of Matterlab

**Comments**

*Information provided by client

Material tested was passing 4.75 mm test sieve, recompacted at maximum achievable density and moisture content

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Thiruvannur, Kozhikode, Kerala, 673009

# Permeability of Soil Test Report

Report No: ML23/R-01956/12
Issue No.: 1
Report Date: 19/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 626030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Work Order ID: | ML23/W-01956 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01956/S2 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 26/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 6 Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested : | 14/06/2023 - 15/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 6.00m |
| Tested By: | DH/GK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 1.08 E-03 | - |

SREELESH T.V
Head-Civil Laboratory

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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# Permeability of Soil Test Report

Report No: ML23/K-01958/S4
Issue No : 1
Report Date: 16/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveriat Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ronald Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | Soil (UDS-4), BH-01, Depth 11.00m |
| Work Order ID: | ML23/W-01958 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01958/S6 | Source*: | BH 01, Depth 11.00m |
| Date Sampled: | 28/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested : | 16/06/2023 - 16/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-4), BH 01, Depth 11.00m |
| Tested By: | DK/GK | Client Sample Desc.*: | Soil (UDS-4), BH 01, Depth 11.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 1.11 E-03 | - |

VINEELESH T.V

For and on behalf of Matter Lab

Comments
*Information provided by client

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# Permeability of Soil Test Report

Report No: ML23/W-01995/R
Issue No : 1
Report Date: 19/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | Soil (UDS-5), BH 01, Depth 12.00m |
| Work Order ID: | ML23/W-01995 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01995/07 | Source*: | BH 01, Depth 12.00m |
| Date Sampled: | 29/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested : | 16/06/2023 - 18/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-5), BH 01, Depth 12.00m |
| Tested By: | DK/GK | Client Sample Desc.*: | Soil (UDS-5), BH 01, Depth 12.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 1.16 E-03 | - |

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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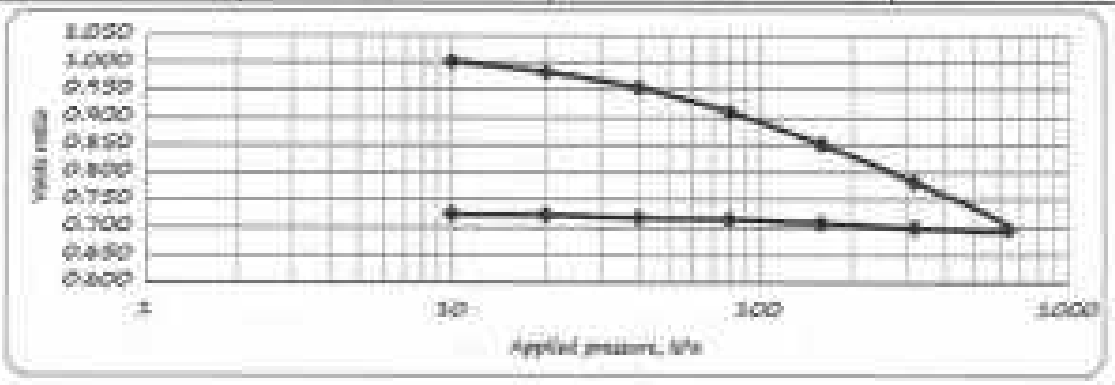
# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | | | |
|---|---|---|---|
| Date Received | 09/06/2023 | Report No. | ML23/R-01956/18 |
| Date Reported | 04/07/2023 | Client Ref. | Soil (UDS-3), BH 01, Depth 9.50m |

| | | | |
|---|---|---|---|
| Client | SPE Global | | |
| Adress | Kavarati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628000 | | |
| Contact | Mr. Ranabir Dey | | |
| Project Number | - | | |
| Project Name | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam | | |
| Consultant | - | | |
| Owner | KSWMP | | |
| Source* | BH 01, Depth 9.50m | Client Sample Ref*. | Soil (UDS-3), BH 01, Depth 9.50m |
| Sampled by | Geotechnical Division | Date Tested | 12/06/2023 - 21/06/2023 |
| Test Method | IS : 2720 ( Part 15 ) - 1986 | Test Location | MatterLab - Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | ML23/W-01956/S3 | Initial diameter (mm) | 60 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Kalamassery, Ernakulam |
| Initial voids ratio | 1.019 | Dry Density (Mg/m$^3$) | 1.340 |
| Moisture content (%) | 33.2 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 10 | 1.002 | 63.67 | 0.700 |
| 20 | 0.981 | 50.40 | 1.007 |
| 40 | 0.953 | 31.24 | 0.712 |
| 80 | 0.909 | 16.84 | 0.888 |
| 160 | 0.850 | 15.24 | 0.383 |
| 320 | 0.782 | 13.60 | 0.331 |
| 640 | 0.696 | 13.03 | 0.192 |




Preconsolidation Pressure: 70 kPa
Compression Index, $C_c$: 0.21
Recompression Index, $C_r$: 0.02

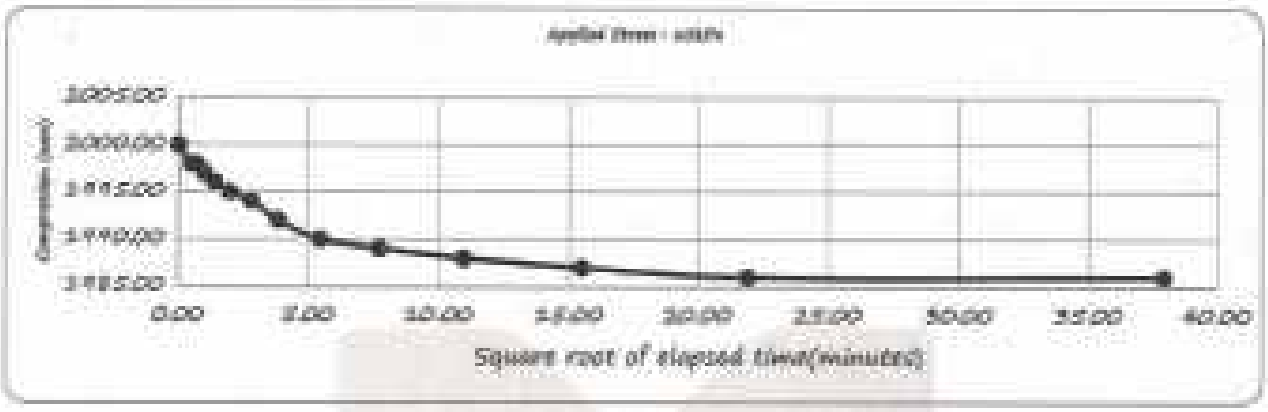
Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 2 of 3 & 3 of 3)
*Information provided by client

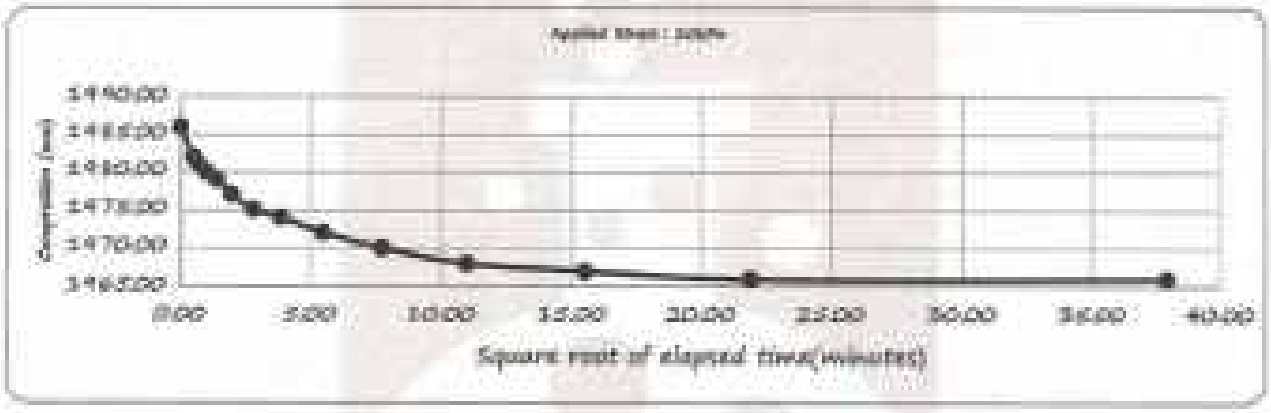


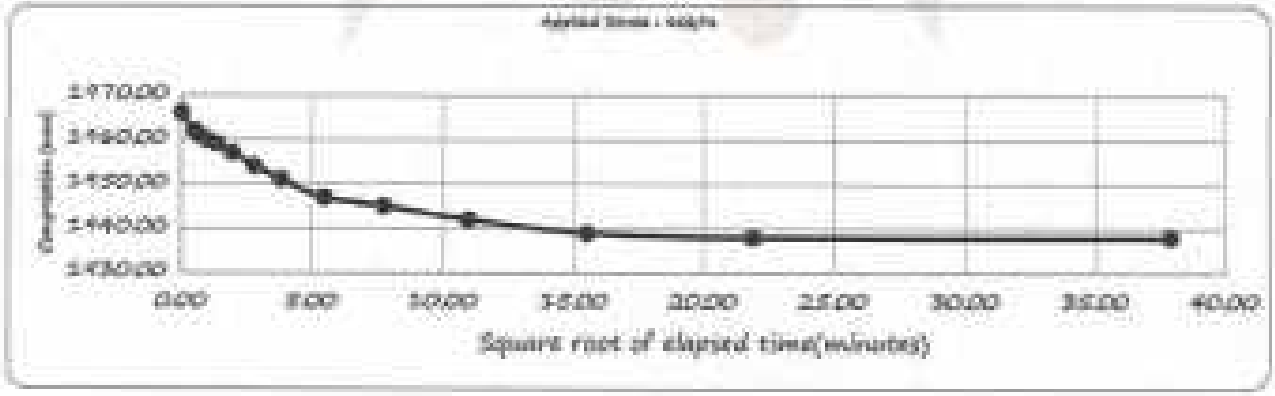
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Compression Vs square root of time curves



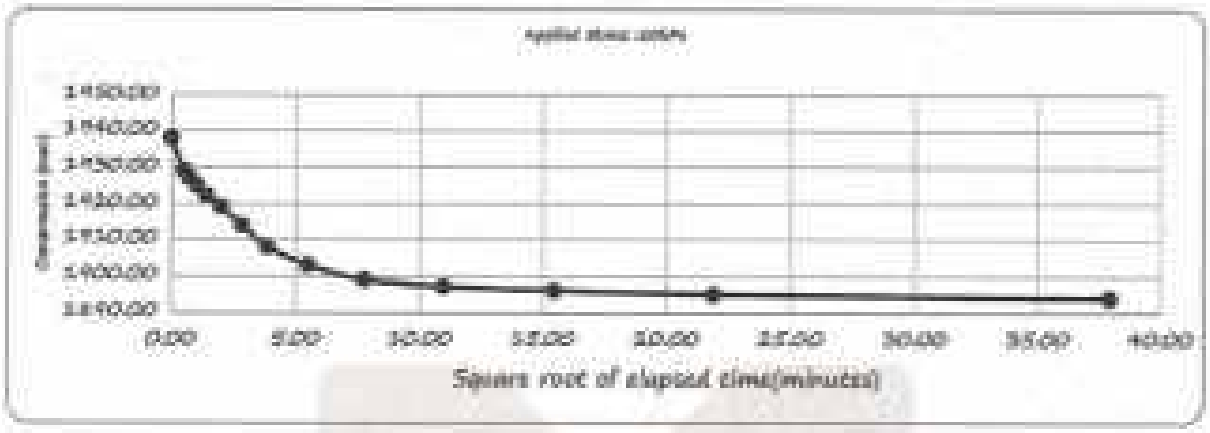



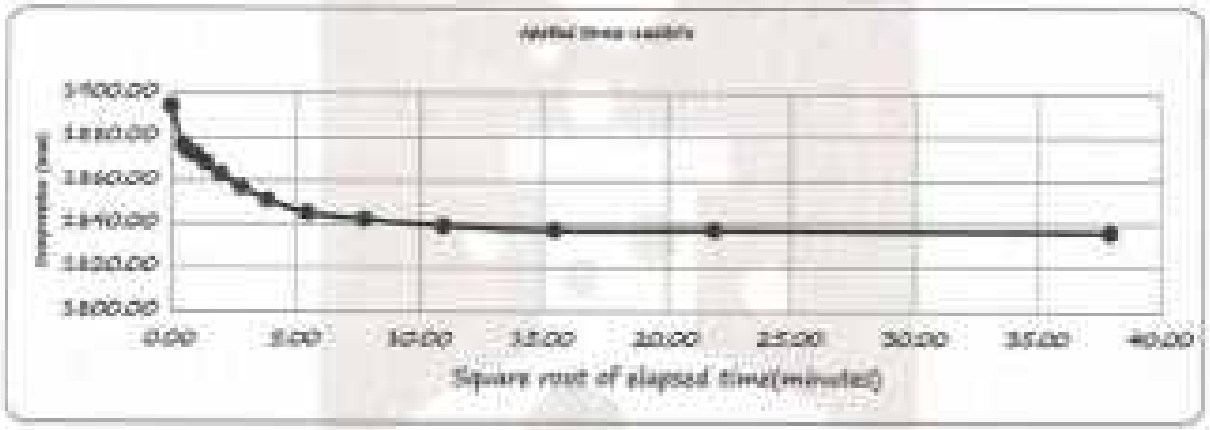



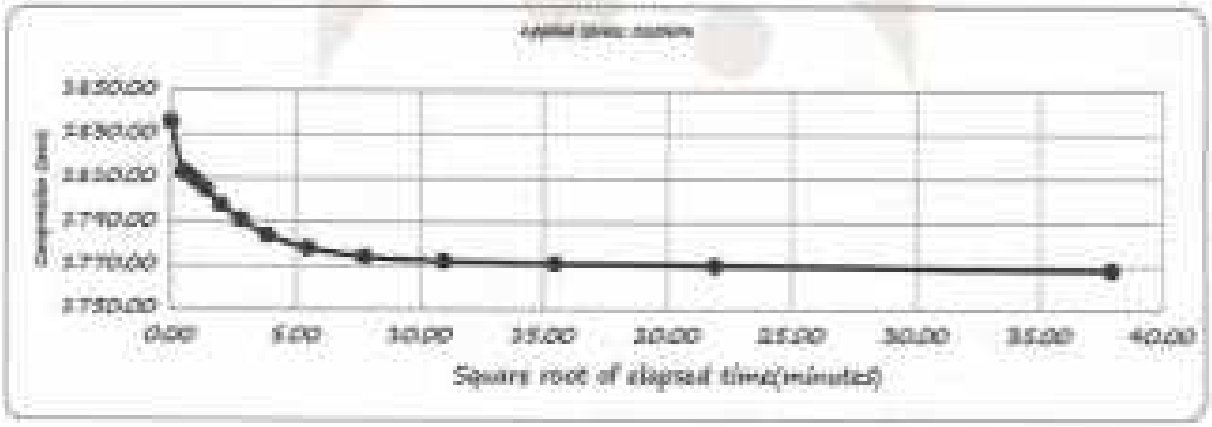
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Compression Vs square root of time curves



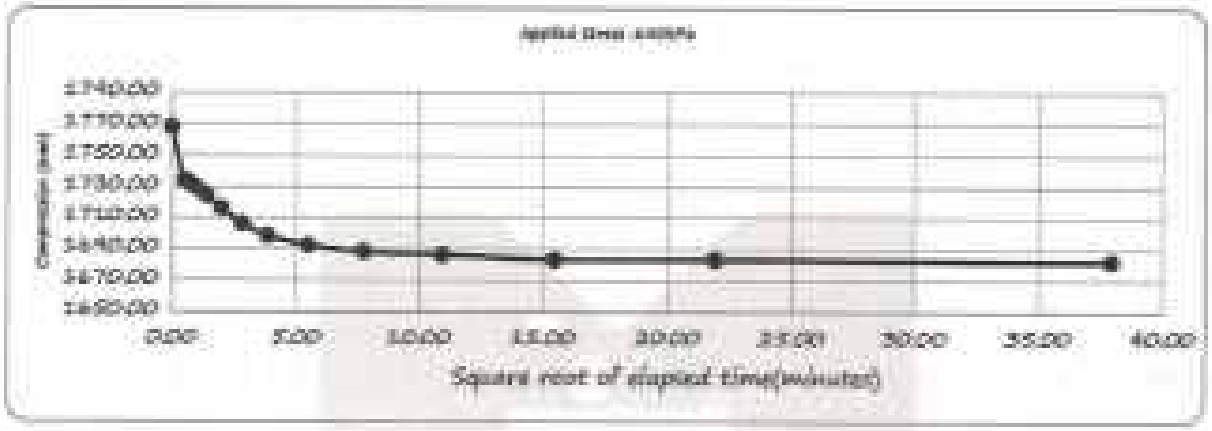



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**Compression Vs square root of time curves**




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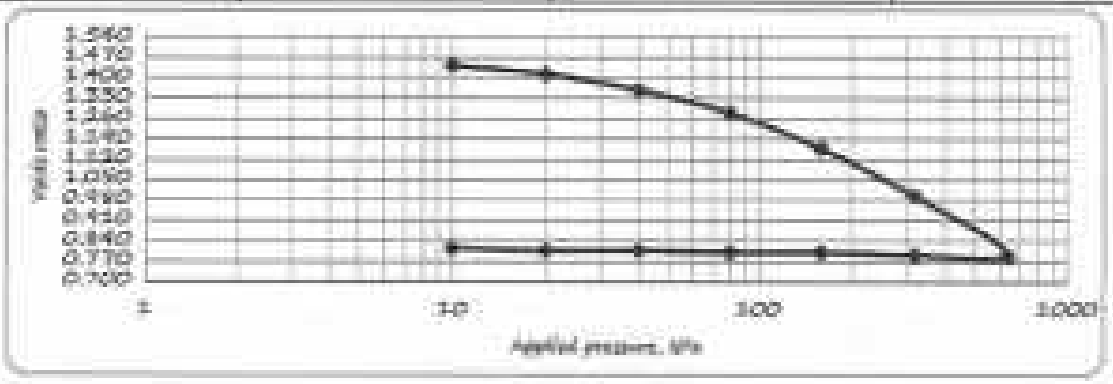
# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | | | |
|---|---|---|---|
| Date Received | 09/06/2023 | Report No. | ML23/R/01666/17 |
| Date Reported | 04/07/2023 | Client Ref. | Soil (UDS-4), BH 01, Depth 11.00m |

| | | | |
|---|---|---|---|
| Client | SPE Global | | |
| Adress | Pavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 | | |
| Contact | Mr. Ranabir Dey | | |
| Project Number | - | | |
| Project Name | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam | | |
| Consultant | - | | |
| Owner | KSWMP | | |
| Source* | BH 01, Depth 11.00m | Client Sample Ref*. | Soil (UDS-4), BH 01, Depth 11.00m |
| Sampled by | Geotechnical Division | Date Tested | 12/06/2023 - 21/06/2023 |
| Test Method | IS : 2720 ( Part 15 ) - 1986 | Test Location | MatterLab - Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | ML23/W-01666/SS | Initial diameter (mm) | 60 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Kalamassery, Ernakulam |
| Initial voids ratio | 1.455 | Dry Density (Mg/m$^3$) | 1.071 |
| Moisture content (%) | 57.2 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 10 | 1.441 | 43.01 | 0.800 |
| 20 | 1.411 | 34.46 | 1.307 |
| 40 | 1.367 | 10.57 | 1.120 |
| 80 | 1.279 | 5.62 | 0.833 |
| 160 | 1.157 | 4.67 | 0.667 |
| 320 | 0.969 | 2.80 | 0.477 |
| 640 | 0.786 | 2.18 | 0.333 |




Preconsolidation Pressure: 109 kPa
Compression Index, $C_c$: 0.68
Recompression Index, $C_r$: 0.03



Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 2 of 3 & 3 of 3)
*Information provided by client

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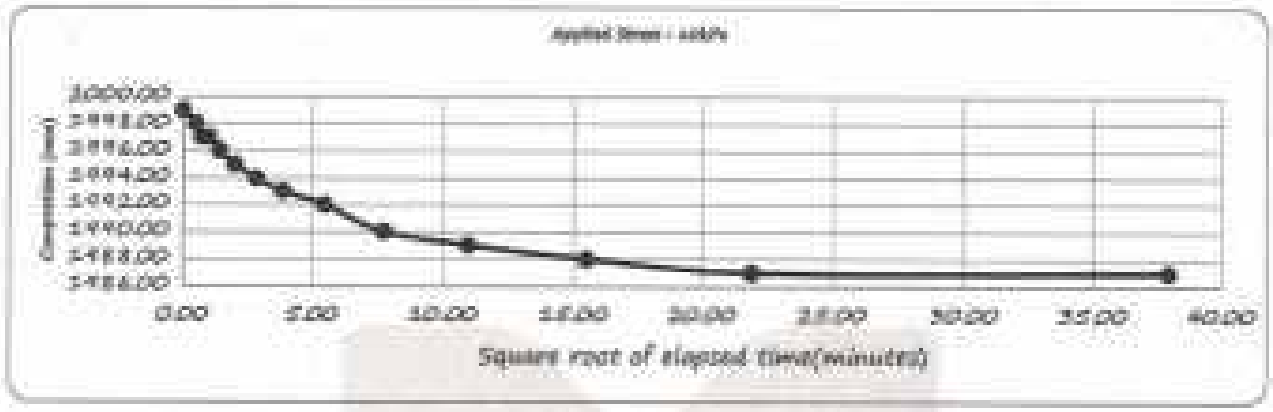
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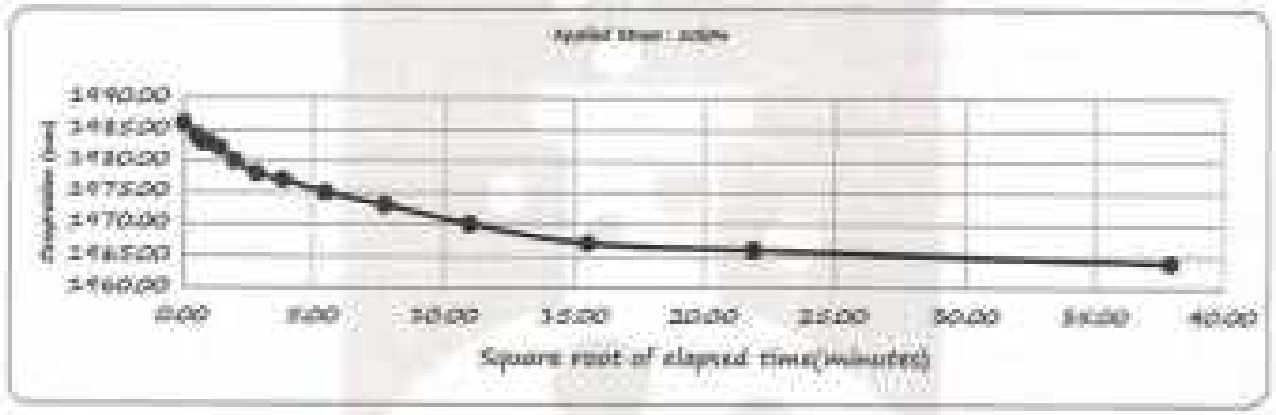
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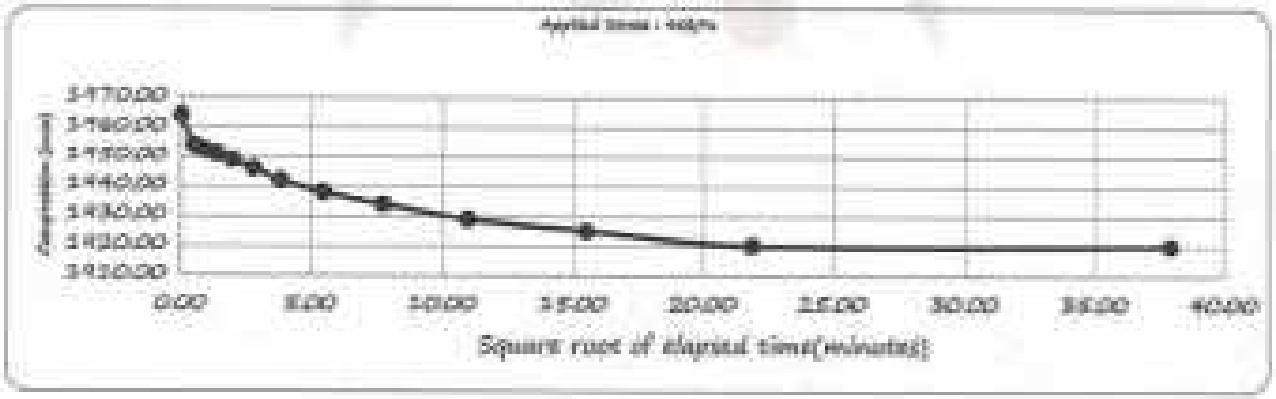
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Consolidation Vs square root of time curves



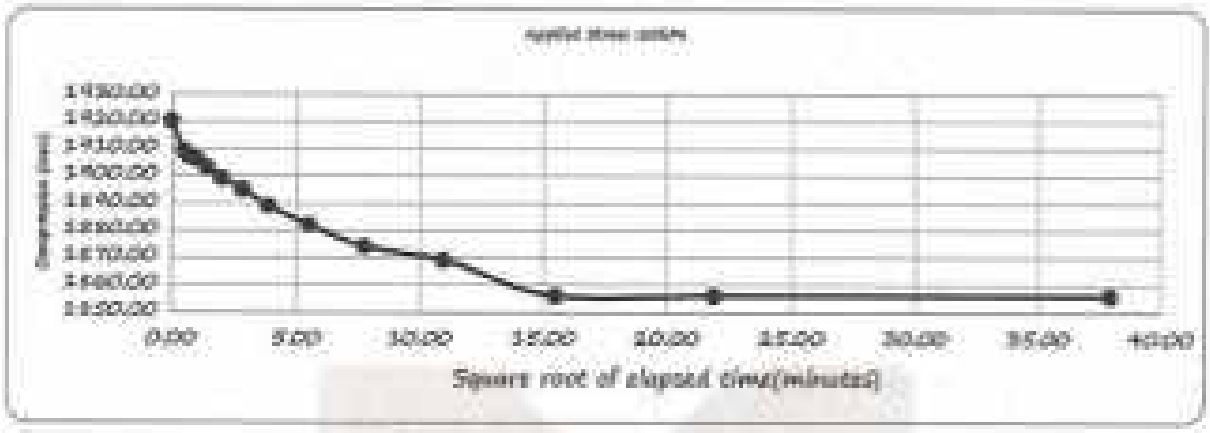


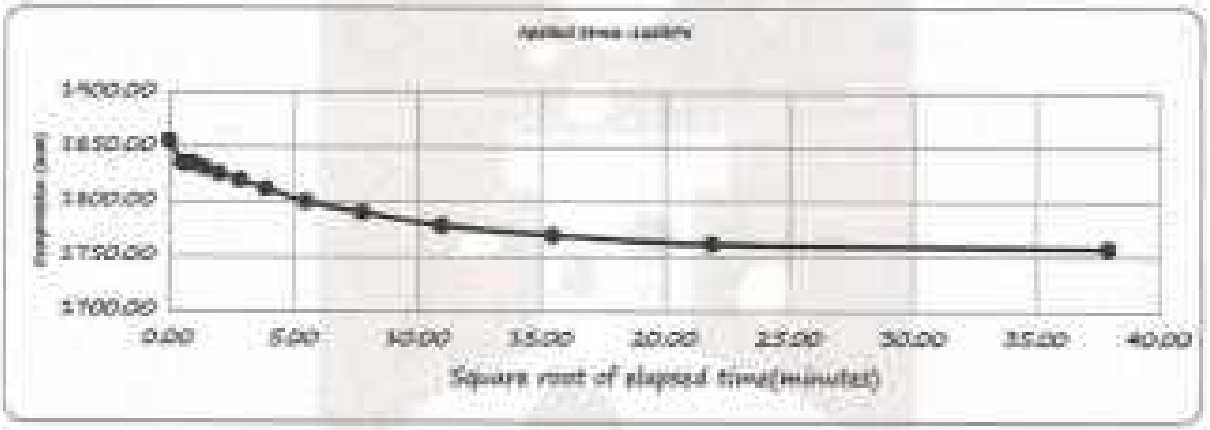

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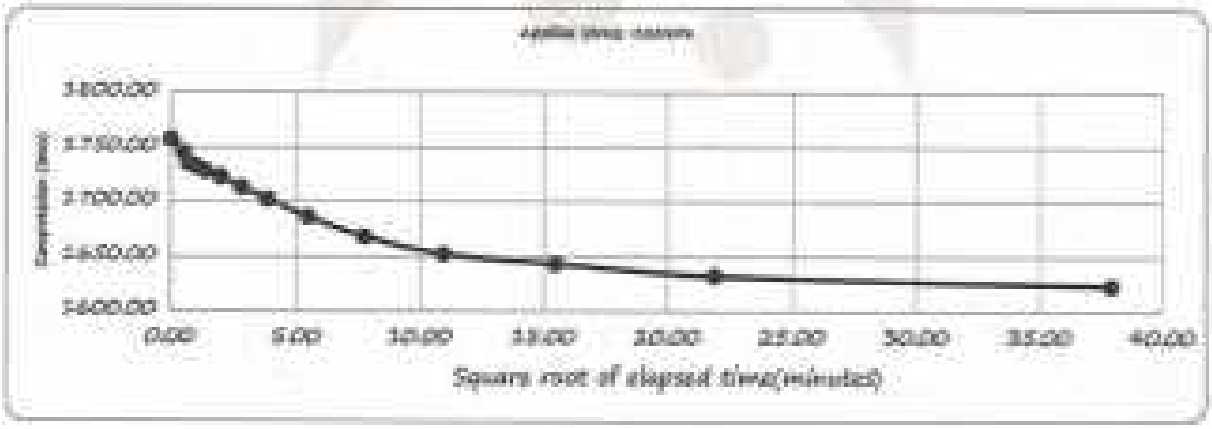
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Compression Vs square root of time curves



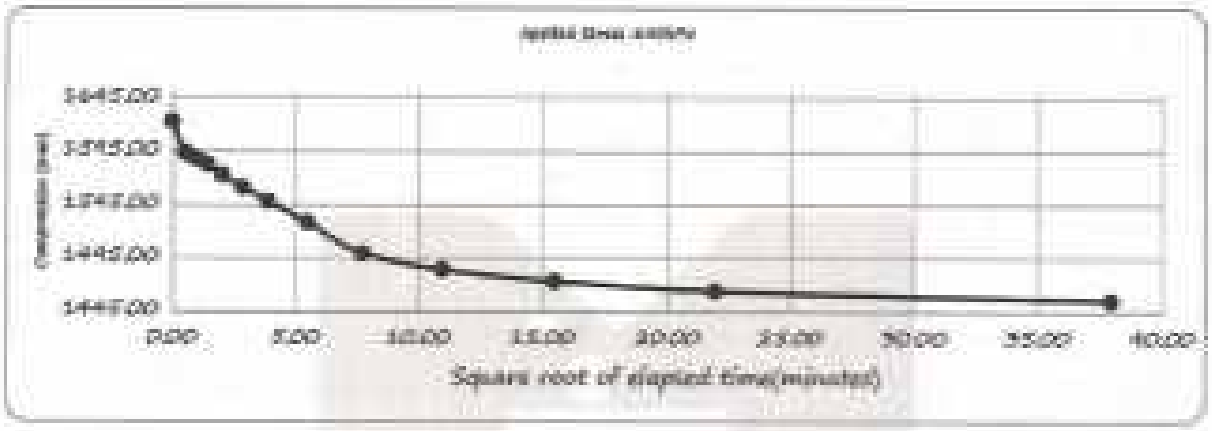



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Compression Vs square root of time curves




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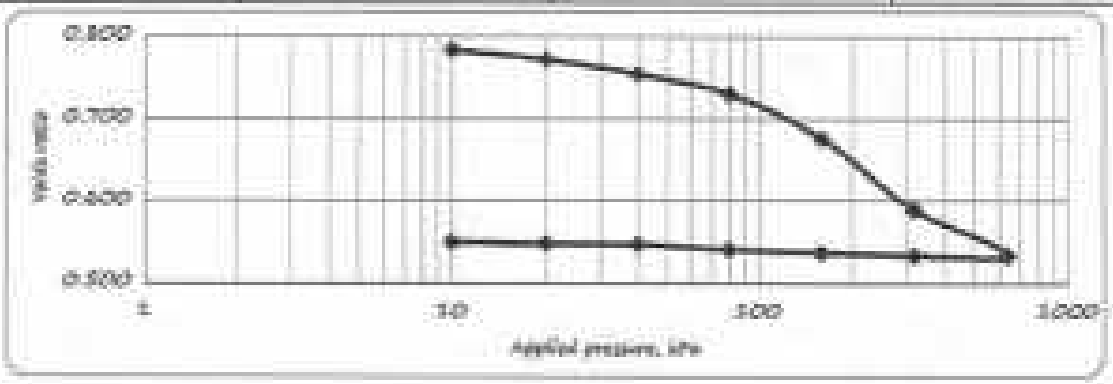
# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | | | |
|---|---|---|---|
| Date Received | 09/06/2023 | Report No. | ML23/R-01999/19 |
| Date Reported | 04/07/2023 | Client Ref. | Soil (UDS-8), BH 01, Depth 12.50m |

| | | | |
|---|---|---|---|
| Client | SPE Global | | |
| Adress | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 | | |
| Contact | Mr. Ranabir Dey | | |
| Project Number | - | | |
| Project Name | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam | | |
| Consultant | - | | |
| Owner | KSWMP | | |
| Source* | BH 01, Depth 12.50m | Client Sample Ref*. | Soil (UDS-8), BH 01, Depth 12.50m |
| Sampled by | Geotechnical Division | Date Tested | 12/06/2023 - 21/06/2023 |
| Test Method | IS : 2720 ( Part 15 ) - 1986 | Test Location | MatterLab - Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | ML23/W-01999/58 | Initial diameter (mm) | 60 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Kalamassery, Ernakulam |
| Initial voids ratio | 0.788 | Dry Density (Mg/m$^3$) | 1.460 |
| Moisture content (%) | 24.3 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 10 | 0.783 | 609.40 | 0.300 |
| 20 | 0.771 | 279.84 | 0.652 |
| 40 | 0.753 | 194.93 | 0.935 |
| 80 | 0.729 | 142.94 | 0.344 |
| 160 | 0.676 | 38.31 | 0.388 |
| 320 | 0.589 | 33.60 | 0.324 |
| 640 | 0.533 | 17.90 | 0.109 |




Preconsolidation Pressure: 97 kPa
Compression Index, $C_c$: 0.23
Recompression Index, $C_r$: 0.01

Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 2 of 3 & 3 of 3)
*Information provided by client

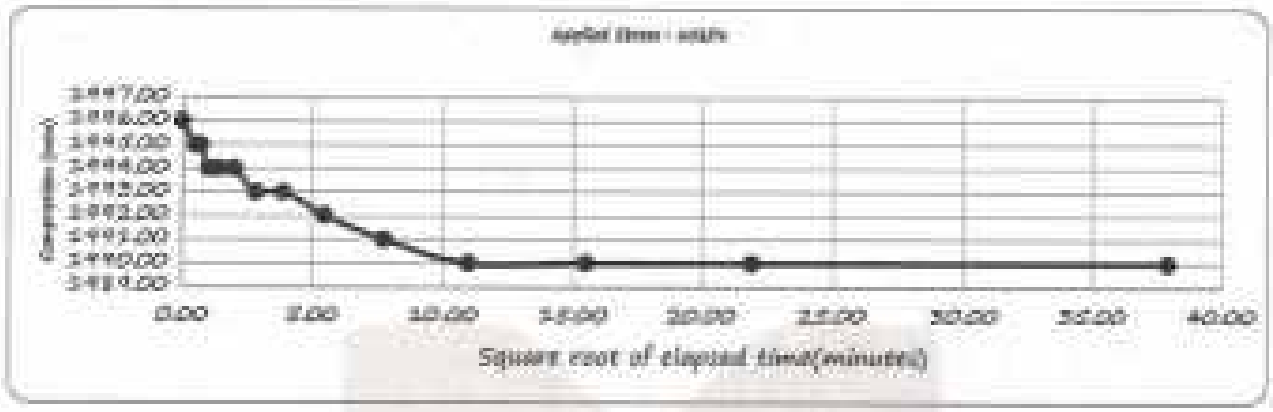


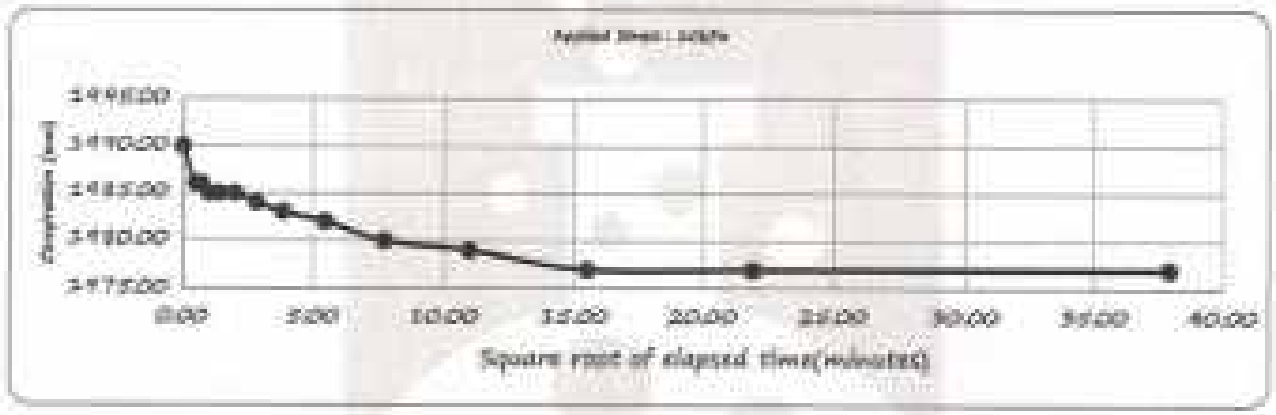
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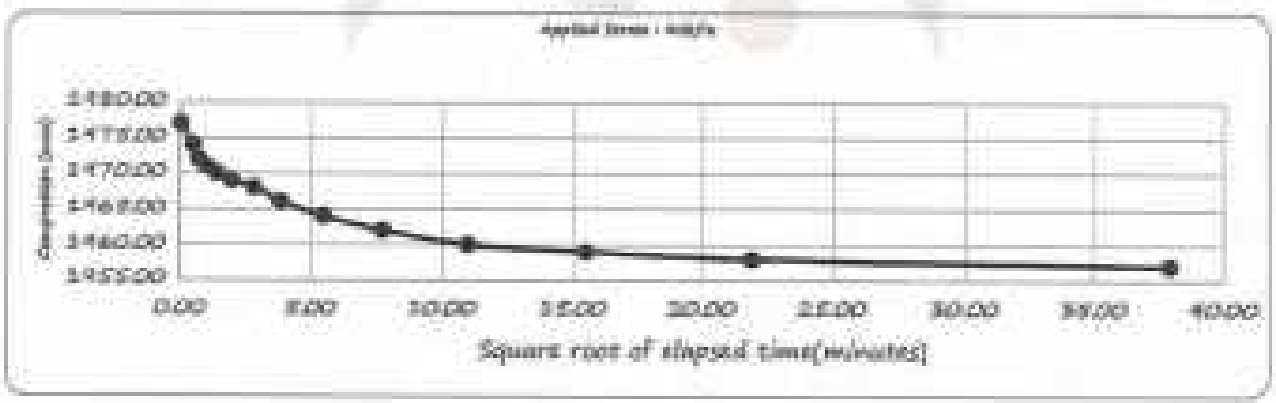
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Consolidation Vs square root of time curves



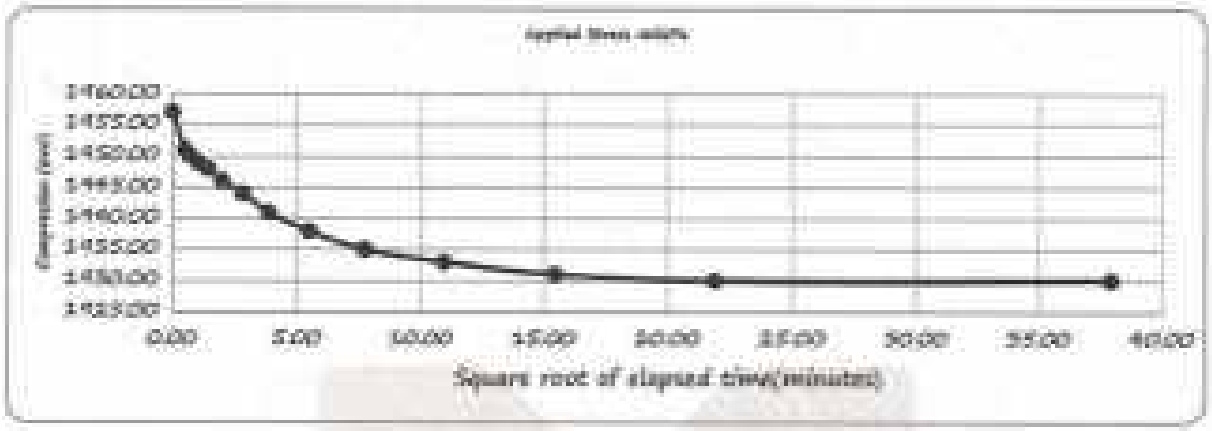


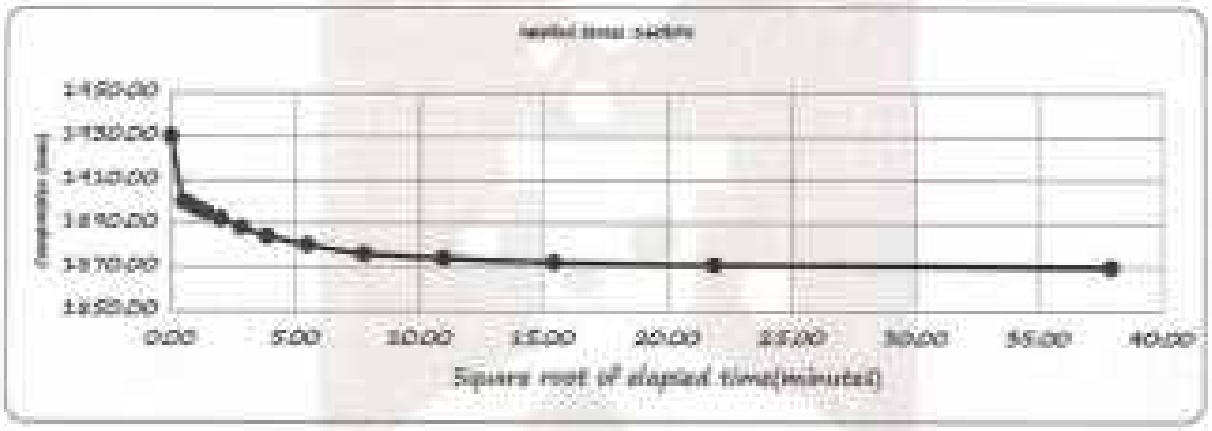

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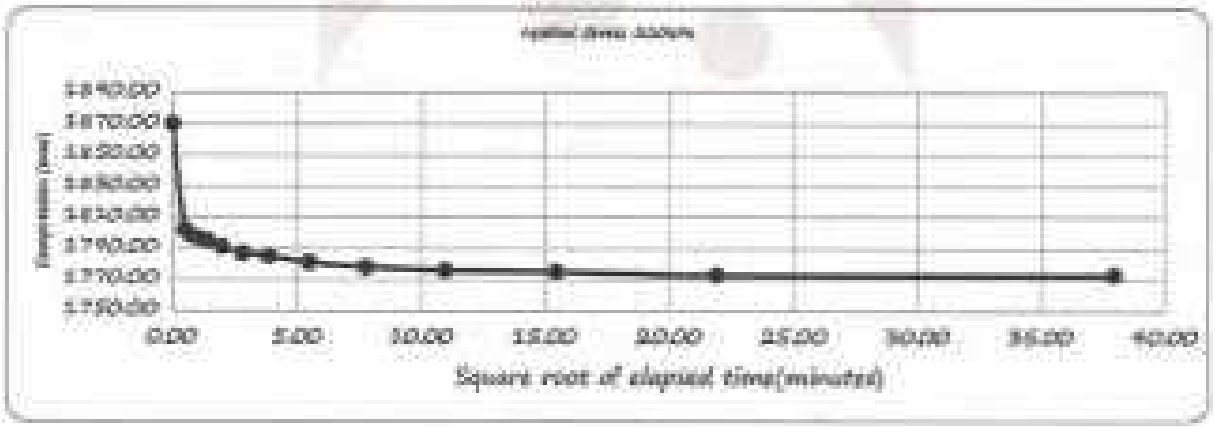
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Compression Vs square root of time curves



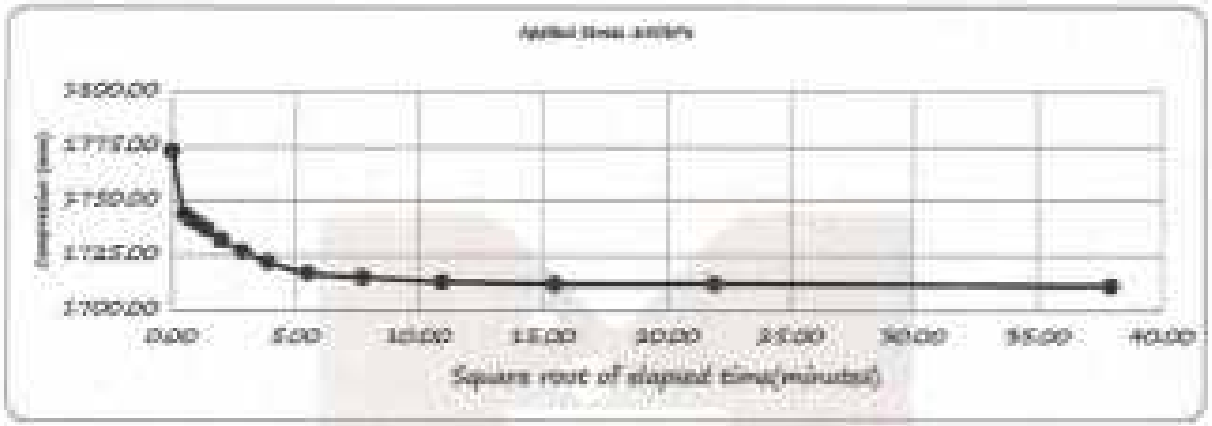



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TC-10743

# Water Content of Soil Test Report

Report No: ML23/R-01996/19
Issue No: 1
Report Date: 31/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

ULR-TC107423000000535F

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-02), BH 01, Depth 9.50m |
| Work Order ID: | ML23/W-01996 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01996/32 | Source*: | Soil, BH 01, Depth 9.50m |
| Date Sampled: | 25/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-02), BH 01, Depth 9.50m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-02), BH 01, Depth 9.50m |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 7.7 | - |

SREELESH T.V
Head-Chief Laboratory

For and on behalf of Matter Lab

**Comments**

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TC-10743

## Water Content of Soil Test Report

Report No: ML23/R-01868/23
Issue No: 1
Report Date: 31/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

ULR-TC10743231000005360F

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 28/07/2023 | Client Sample Ref.*: | Soil (UDS-04), BH 01, Depth 11.00m |
| Work Order ID: | ML23/W-01868 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01868/05 | Source*: | Soil, BH 01, Depth 11.00m |
| Date Sampled: | 28/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-04), BH 01, Depth 11.00m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-04), BH 01, Depth 11.00m |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (wt.)% | 9.1 | - |

SREELESH T.V
Head-Chief Laboratory

For and on behalf of Matter Lab

**Comments**

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Kozhikode, Kerala, 673020.

## Water Content of Soil Test Report

Report No: ML23/R-01888/21
Issue No: 1
Report Date: 31/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

ULR-TC107A02300859367F

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-06), BH 01, Depth 12.50m |
| Work Order ID: | ML23/W-01888 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01888/58 | Source*: | Soil, BH 01, Depth 12.50m |
| Date Sampled: | 25/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(Kg): | 5 Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-06), BH 01, Depth 12.50m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-06), BH 01, Depth 12.50m |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content, (w),% | 7.8 | - |

SREELESH T.V
Head-Civil Laboratory

For and on behalf of Matter Lab

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Thiruvannur, Kozhikode, Kerala, 673029

# TEST REPORT

Report No: ML23/R-01956/22
Issue No: 1
Report Date: 31/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-02), BH 01, Depth 9.50m |
| Work Order ID: | ML23/W-01956 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01956/02 | Source*: | Soil, BH 01, Depth 9.50m |
| Date Sampled: | 25/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location: | Kalamassery, Ernakulam | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cart. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-02), BH 01, Depth 9.50m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-02), BH 01, Depth 9.50m |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/cc | 2.00 | - |
| | Moisture Content,% | 7.7 | - |
| | Dry Density,g/cc | 1.86 | - |

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Head-Civil Laboratory

For and on behalf of MatterLab

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Thiruvannur, Kozhikode, Kerala, 673029

# TEST REPORT

Report No: ML23/P-01956/22
Issue No : 1
Report Date:31/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kaneyanoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kuttanadu, Mundakpuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-04), BH 01, Depth 11.00m |
| Work Order ID: | ML23/W-01956 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01956/02 | Source*: | Soil, BH 01, Depth 11.00m |
| Date Sampled: | 22/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx. |
| Sample Location: | Kalamassery, Ernakulam | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-04), BH 01, Depth 11.00m |
| Tested By: | OK | Client Sample Desc.*: | Soil (UDS-04), BH 01, Depth 11.00m |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS: 1377(Part 2):1990 | Bulk Density of Soil, g/cc | 1.67 | - |
| | Moisture Content,% | 8.1 | - |
| | Dry Density g/cc | 1.54 | - |

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Head Civil Laboratory

For and on behalf of MatterLab

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# TEST REPORT

Report No: ML23/S-01998/23
Issue No.: 1
Report Date: 31/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarath Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumarnala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-06), BH 01, Depth 12.50m |
| Work Order ID: | ML23/W-01998 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01998/S8 | Source*: | Soil, BH 01, Depth 12.50m |
| Date Sampled: | 25/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(Kg): | 5 Approx |
| Sample Location: | Kalamassery, Ernakulam | Date Tested : | 25/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-06), BH 01, Depth 12.50m |
| Tested By: | OK | Client Sample Desc.*: | Soil (UDS-06), BH 01, Depth 12.50m |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/cc | 1.80 | - |
| | Moisture Content,% | 7.8 | - |
| | Dry Density,g/cc | 1.67 | - |

SREELESH T.V
Head-Soil Laboratory

For and on behalf of MatterLab

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# Chemical Test Report of Soil

Report No: ML23/R-02959/1
Issue No : 1
Report Date:27/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanett Building,Kanayanoor Village,Kakkanad,Ernakulam,Kerala - 628030 |
| Contact: | Mr.Ranabir Dev |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery,Eranakulam |
| Owner: | KSWMP |
| Project Location: | Kalamassery,Eranakulam |
| Tel No: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 12/07/2023 | Client Sample ID:* | Soil and Rock |
| Work Order ID: | ML23/W-02959 | Source:* | Borehole - 1 (Depth 1.5m from orginal soil) |
| Sample ID: | ML23/W-02959/S1 | Sample Submitted By: | Geotechnical Division |
| Date Sampled: | 28/06/2023 | Sampled By: | Geotechnical Division |
| Sample Location: | Kalamassery,Eranakulam | Date Tested: | 13/07/23 - 20/07/23 |
| Tested By: | MLA | Test Method Variation: | None |

## CHEMICAL ANALYSIS

| Test/Parameter | Test Method | Unit | Result |
|---|---|---|---|
| Cation Exchange Capacity | USDA No.19 | (cmol/100gm) | 11.91 |

ANWAR. P
Lab Manager-Chemistry
For and on behalf of Matter Lab

## Comments

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Thiruvennur, Kozhikode, Kerala, 673020

# Chemical Test Report of Soil

Report No: ML23/E-02589/2
Issue No: 1
Report Date: 06/10/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building,Kaneyanoor Village,Kakkanad,Ernakulam,Kerala - 626030 |
| Contact: | Mr.Ranabir Dey |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery,Ernakulam |
| Owner: | KSWMP |
| Project Location: | Kalamassery,Ernakulam |
| Tel No: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 12/07/2023 | Client Sample ID:* | Soil and Rock |
| Work Order ID: | ML23/W-02589 | Source:* | Borehole - 1 (1.5 m from orginal ground level) |
| Sample ID: | ML23/W-02589/S1 | | |
| Date Sampled: | 28/06/2023 | Sampled By: | Geotechnical Division |
| Tested By: | MatterLab,Kozhikode | Date Tested: | 13/07/23 - 20/07/23 |
| Sample Location: | Kalamassery,Ernakulam | Test Method Variation: | None |

## CHEMICAL ANALYSIS - Test Method:IS 2204:2021 & CPHEEO Manual

| Test/Parameters | Units | Results |
|---|---|---|
| pH Value | - | 4.60 |
| Electrical Conductivity | mS/cm | 0.497 |
| Nitrogen (N) | % | 0.19 |
| Phosphorus (P) | % | 0.03 |
| Potassium (K) | % | 0.13 |
| Carbon | % | 1.62 |
| Carbon / Nitrogen Ratio | % | 8.53 |
| Biodegradable Factor | % | < 0.1 |

## HEAVY METALS - Test Method: EPA 3050 (ICP OES)

| | | |
|---|---|---|
| Arsenic (As) | mg/Kg | 3.0 |
| Cadmium (Cd) | mg/Kg | < 5.0 |
| Chromium (Cr) | mg/Kg | 157.4 |
| Copper (Cu) | mg/Kg | 120.0 |
| Lead (Pb) | mg/Kg | 83.6 |
| Nickel (Ni) | mg/Kg | 46.8 |
| Zinc (Zn) | mg/Kg | 3012.0 |
| Mercury (Hg) | mg/Kg | < 0.1 |

ANWAR. P
Lab Manager-Chemistry
For and on behalf of Matter Lab

Comments
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# APPENDIX-III

# LABORATORY TEST RESULTS OF WASTE

# SUMMARY OF LABORATORY TEST RESULTS (WASTE)

**Report Number : ML23/R01956 Report Date: 03/08/2023**

**Project : Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam**

| MatterLab ref. | Moisture content,% | Density of waste, kg/m$^3$ | Solid waste size analysis, m$^2$ | | | | | | | Percentage of waste composites, % | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Plastic waste | | Cloth waste | | Wood waste | | Glass waste | Plastic waste | Cloth waste | Wood waste | Glass waste |
| | | | min | max | min | max | min | max | | | | | |
| ML23/W01956/S9 | 73 | 835 | 0.003380 | 0.292592 | 0.008073 | 0.080863 | 0.000940 | 0.212639 | 0.076414 | 7.32 | 1.49 | 1.19 | 0.12 |

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# SOLID WASTE SIZE ANALYSIS TEST REPORT

Report No: ML23/R-01956/23
Issue No. : 1
Report Date:03/06/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 629000 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kalamassery, Ernakulam |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 09/05/2023 | **Client Sample Ref.*:** | Composite Waste |
| **Work Order ID:** | ML23/W-01956 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-01956/59 | **Source*:** | - |
| **Date Sampled:** | 25/05/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | - | **Sample Size(kg):** | 5 Approx |
| **Sample Location*:** | Kalamassery, Ernakulam | **Date Tested :** | 31/05/2023 - 03/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Composite Waste |
| **Tested By:** | DK | **Client Sample Desc.*:** | Composite Waste |
| **Test Location:** | MatterLab - Kozhikode | | |

**Test Results**

| Type of Waste Material | Maximum Size of a Single Waste Material, $m^3$ | Minimum Size of a Single Waste Material, $m^3$ |
|---|---|---|
| Plastic Waste | 0.282092 | 0.00338 |
| Cloth Waste | 0.080983 | 0.000973 |
| Wood Waste | 0.212639 | 0.000940 |
| Glass Waste | 0.078414** | |

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Head-Civil Laboratory

For and on behalf of Matter Lab

**Comments**

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** Only one piece of glass waste included in the waste composite

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# Moisture Content of Waste Test Report

Report No: ML23/R-01999/23
Issue No: 1
Report Date: 03/08/2023

| | |
|---|---|
| Client: | BPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 09/05/2023 | Client Sample Ref.*): | Composite Waste |
| Work Order ID: | ML23/W-01999 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01999/SS | Source*: | - |
| Date Sampled: | 28/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | - | Sample Size/kg): | 5 Approx |
| Sample Location*): | Kalamassery, Ernakulam | Date Tested : | 31/07/2023 - 02/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Composite Waste |
| Tested By: | DK | Client Sample Desc.*): | Composite Waste |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Moisture Content, % | 73 | - |

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Head-Civil Laboratory

For and on behalf of Matter Lab

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# Test Report

Report No: ML23R-01955/07
Issue No : 1
Report Date:03/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Ravanat Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628008 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | Composite Waste |
| Work Order ID: | ML23W-01956 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-01955/50 | Source*: | - |
| Date Sampled: | 29/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(Kg): | 5 Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested : | 31/07/2023 - 02/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Composite Waste |
| Tested By: | DK | Client Sample Desc.*: | Composite Waste |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Percentage of Plastic Waste, % | 7.32 | - |
| | Percentage of Glass Waste, % | 0.12 | - |
| | Percentage of Wood Waste, % | 1.19 | - |
| | Percentage of Cloth Waste, % | 1.49 | - |

SREELESH T.V
Head-Civil Laboratory

For and on behalf of Matter Lab

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Thiruvannur, Kozhikode, Kerala, 673029

# Density - Test Report

Report No: MLLAB-01966/23
Issue No : 1
Report Date:03/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarat Building, Kanayannor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalamassery, Ernakulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalamassery, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | Composite Waste |
| Work Order ID: | ML23/W-01966 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01966/S9 | Source*: | - |
| Date Sampled: | 26/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kalamassery, Ernakulam | Date Tested : | 31/07/2023 - 02/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Composite Waste |
| Tested By: | GK/DK | Client Sample Desc.*: | Composite Waste |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Density of Waste,kg/m$^3$ | 835 | - |

SREELESH T.V
Head-Civil Laboratory

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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*Those results shown only to the samples tested.



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# POLUCHEM LABORATORIES PVT LTD

CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

Phone : 0484-2544030, 8281982322, 9747400685 www.poluchem.com, poluchem@gmail.com

ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


## TEST REPORT



**RefNo: PL/RT/SW/6498/2023** **Date of Issue: 05/08/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavassat Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector

Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014

Sample Description : Water Sample

Date of Sample Collected : 05/08/2023

Date of receipt of sample : 05/08/2023

Date of analysis started : 05/08/2023

Date of completion of analysis : 05/08/2023

| Parameters tested | Test method | Results | | |
|---|---|---|---|---|
| | | Leachate near to surface water | Leachate Middle of Site | Surface water |
| pH | IS 3025 (P) 11 –1983RA2017 | 7.35 | 4.25 | 6.49 |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 910 mg/l | 5070 mg/l | 91 mg/l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

*End of the report*

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TC 4089

**ACCREDITED BY NABL - GOVT. OF INDIA AND KSPCB AS "A" GRADE LABORATORY**


## TEST REPORT



**Ref.No: PL/RT/SW/1092/2023**
(ULR NO:TC658923000000001092F)

**Date of Issue: 15/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- Upstream-Kalamassery
Sample Location : Gps Reading : N- 10 °03'58.958"
E -76°19'39.681"

Sample code : F/1092/2023
Date of Sample Collected : 30/05/2023
Date of receipt of sample : 31/05/2023
Date of analysis started : 31/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 –1983RA2017 | 6.49 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 –1983RA2017 | 7 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 4.1 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 70 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 45.5 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1 mg/l) | --- | -- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 20 mg/l | 200 mg/l | -- |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 14 mg/l | -- | -- |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 12.35 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 1.08 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 –1989RA2014 | 3.1 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.69 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.55 mg/l) | 1.5 mg/l | 1.5 mg/l |

Conti...

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

# POLUCHEM LABORATORIES PVT LTD

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

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Continuation of Test Certificate No: 1002/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 170 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | --- | --- |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

Microbiologist

*End of the report*

The above results are related only to the sample submitted for analysis. This test report shall not be reproduced except in full, without the written approval of the laboratory.

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ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


## TEST REPORT



**Ref.No: PL/RT/SW/5052/2023** **Date of Issue: 15/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- Upstream-Kalamassery
Sample Location : Gps Reading : N- 10 °03'58.958"
E -76°19'39.681"

Sample code : F/5052/2023
Date of Sample Collected : 30/05/2023
Date of receipt of sample : 30/05/2023
Date of analysis started : 30/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | --- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | --- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27$^0$ C ) | IS 3025 (P) 44 -1993RA2014 | 5.4 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 10 mg/l | --- | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 2.7 mg/l | --- | -- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

*End of the report*

The above results are related only to the sample submitted for analysis. This test report shall not be reproduced except in full, without the written approval of the laboratory.

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TC-6589

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## TEST REPORT



**Ref.No: PL/RT/SW/1091/2023** **Date of Issue: 15/06/2023**

(ULR NO:TC658923000000001091F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- Down stream-Kalamassery
Sample Location : Gps Reading : N- 10 °04'6.001"
E -76°19'48.938"

Sample code : F/1091/2023
Date of Sample Collected : 30/05/2023
Date of receipt of sample : 30/05/2023
Date of analysis started : 30/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 –1983RA2017 | 6.04 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 –1983RA2017 | 10 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 8.5 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 90 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 58.5 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1 mg/l) | --- | -- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 20 mg/l | 200 mg/l | -- |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 18 mg/l | -- | -- |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 15.20 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 2.04 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 –1989RA2014 | 2.9 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.76 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.80 mg/l | 1.5 mg/l | 1.5 mg/l |

Conti...

SREEJA RA[illegible]
QUALITY MANAGER
[illegible]OCHEM LABORATORIES PVT LTD

# POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 1091/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 220 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | — | — |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


## TEST REPORT



**Ref.No: PL/RT/SW/5053/2023** **Date of Issue: 15/06/2023**

Name & address of customer :M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- Down stream-Kalamassery
Sample Location : Gps Reading : N- 10 °04'6.001"
E -76°19'48.938"

Sample code : F/5053/2023
Date of Sample Collected : 30/05/2023
Date of receipt of sample : 30/05/2023
Date of analysis started : 30/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | --- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | --- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27° C ) | IS 3025 (P) 44 -1993RA2014 | 6.3 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 10 mg/l | --- | -- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 –1988 RA2014 | 2.6 mg/l | --- | -- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL-0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

*End of the report*

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ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


## TEST REPORT



| Client Name & Address | | |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Certificate No: | PL/RT/5078/2023 |
| | Date of issue: | 15/06/2023 |
| | Date of sample collection | 30/05/2023 |
| | Date of sample received: | 30/05/2023 |
| | Date of analysis | 31/05/2023 |
| | Sample Received From | Kalamassery |
| | Sample description | Waste Segregation |
| | Sample Location | Gps Reading : : N- 10 °03'54.403"<br>E -76°19'41.039" |

| PHYSICAL COMPOSITION | | | | |
|---|---|---|---|---|
| SL NO | Parameters | | Result | |
| | | | Weight | Percentage |
| 01 | BioEarth | (-4.75mm) | 7.4 | 29.6 |
| | | (+4.75 to 8 mm) | 4.1 | 16.4 |
| 02 | C&D | C&D (+8mm) | 1.5 | 6 |
| 03 | Plastics | Plastics | 8.5 | 34 |
| 04 | Paper | Paper/MLP/SUP | 1.6 | 6.4 |
| 05 | Cloths | Cloths/ Rags | 0.9 | 3.6 |
| 06 | Glass | Glass | 0.4 | 1.6 |
| 07 | Metals | Metals | 0.3 | 1.2 |
| 08 | Rubber | Rubber | 0.3 | 1.2 |
| 09 | E-Waste | E-waste | 0.002 | 0.008 |
| 10 | Leather | Leather | 0.001 | 0.004 |
| Total Weight Of sample -25 Kg | | | | |

* End of the Report*

The results are related only to the sample collected for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory

For and on behalf of
POLUCHEM LABORATORIES (P) LTD.

AUTHORIZED SIGNATORY

BREEJA RAMESH

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## TEST REPORT



| Client Name & Address | | |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Certificate No: | PL/RT/5079/2023 |
| | Date of issue: | 15/06/2023 |
| | Date of sample collection | 30/05/2023 |
| | Date of sample received: | 30/05/2023 |
| | Date of analysis | 31/05/2023 |
| | Sample Received From | Kalamassery |
| | Sample description | Waste Segregation |
| | Sample Location | Gps Reading : : N- 10 °03'54.403"<br>E -76°19'41.039" |

| PHYSICAL COMPOSITION | | | | |
|---|---|---|---|---|
| SL NO | Parameters | | Result | |
| | | | Weight | Percentage |
| 01 | BioEarth | (-4.75mm) | 6.6 | 26.4 |
| | | (+4.75 to 8 mm) | 4.9 | 19.6 |
| 02 | C&D | C&D (+8mm) | 1.3 | 5.2 |
| 03 | Plastics | Plastics | 9.2 | 36.8 |
| 04 | Paper | Paper/MLP/SUP | 1.7 | 6.8 |
| 05 | Cloths | Cloths/ Rags | 0.57 | 2.18 |
| 06 | Glass | Glass | 0.3 | 1.2 |
| 07 | Metals | Metals | 0.35 | 1.4 |
| 08 | Rubber | Rubber | 0.1 | 0.4 |
| 09 | E-Waste | E-waste | 0.005 | 0.02 |
| 10 | Leather | Leather | 0.005 | 0.02 |
| Total Weight Of sample -25 Kg | | | | |

* End of the Report*

The results are related only to the sample collected for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory

For and on behalf of
POLUCHEM LABORATORIES (P) LTD.

SREEJA RAMESH
AUTHORIZED SIGNATORY

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**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

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TC-8889

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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/SD/5061/2023(ULR NO:TC658923000000005061F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 15/06/2023 |
| | Date of monitoring | 30/05/2023 |
| | Monitoring Location | Kalamassery<br>GPS Reading : N- 10 °03'54.418"<br>E -76°19'41.7" |
| | Sample Description | Ambient Sound Level |

| HOURLY INTERVAL | | RESULT | HOURLY INTERVAL | RESULT |
|---|---|---|---|---|
| 30.05.2023 | 15.00 Hrs | 58.0 dB (A) | 08.00 Hrs | 64.9 dB (A) |
| 16.00 Hrs | | 57.8 dB (A) | 09.00 Hrs | 81.7 dB (A) |
| 17.00 Hrs | | 52.2 dB (A) | 10.00 Hrs | 67.8 dB (A) |
| 18.00 Hrs | | 51.7 dB (A) | 11.00 Hrs | 67.5 dB (A) |
| 19.00 Hrs | | 58.9 dB (A) | 12.00 Hrs | 63.7 dB (A) |
| 20.00 Hrs | | 53.0 dB (A) | 13.00 Hrs | 54.7 dB (A) |
| 21.00 Hrs | | 49.6 dB (A) | 14.00 Hrs | 63.9 dB (A) |
| 22.00 Hrs | | 49.6 dB (A) | | |
| 23.00 Hrs | | 50.8 dB (A) | | |
| 31.05.2023 | 00.00 Hrs | 49.6 dB (A) | | |
| 01.00 Hrs | | 49.4 dB (A) | | |
| 02.00 Hrs | | 47.7 dB (A) | | |
| 03.00 Hrs | | 48.2 dB (A) | | |
| 04.00 Hrs | | 48.4 dB (A) | | |
| 05.00 Hrs | | 49.3 dB (A) | | |
| 06.00 Hrs | | 51.0 dB (A) | LeqDay | 59.3 dB (A) |
| 07.00 Hrs | | 53.1 dB (A) | LeqNight | 49.0 dB (A) |

Limits: Industrial Area Day Time-75dB(A),Night Time- 70dB(A),Commercial area Day Time -65 dB(A),Night Time55dB(A),
Residential area Day Time -55 dB(A),Night Time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am

*End of the Report *

For Poluchem Laboratories (P) Ltd.

Authorised Signatory

SREEJA RAMESH

QUALITY MANAGER

# POLUCHEM LABORATORIES PVT LTD

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

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TC-6589

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/128/2023 (ULR NO:TC658923000000128F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 15/06/2023 |
| | Date of monitoring | 30/05/2023 |
| | Date of sample received | 31/05/2023 |
| | Date of analysis Started | 31/05/2023 |
| | Sample description | Ambient air -Kalamassery |
| | Sample Code | G/F/128/2023 |
| | Sample Location | GPS Reading : N- 10°03'53.611"<br>E -76°19'40.463" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 42.8µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 23.4µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 7.4 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 8.6 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 0.8 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
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SREEJA RAMESH
QUALITY MANAGER
FOR POLUCHEM LABORATORIES (P) LTD

# POLUCHEM LABORATORIES PVT LTD

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

Phone : 0484-2544030, 8281982322, 9747400085. www.poluchem.com, poluchem@gmail.com

ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5049/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 15/06/2023 |
| | Date of monitoring | 30/05/2023 |
| | Date of sample received | 31/05/2023 |
| | Date of analysis Started | 31/05/2023 |
| | Sample description | Ambient air -Kalamassery |
| | Sample Code | G/F/5049/2023 |
| | Sample Location | GPS Reading : N- 10 °03'53.611"<br>E -76°19'40.463" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 $\mu g/m^3$ | 400 $\mu g/m^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 $\mu g/m^3$ | 1 $\mu g/m^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 6 $ng/m^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 20 $ng/m^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 $\mu g/m^3$ | 180 $\mu g/m^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 $\mu g/m^3$ | 5 $\mu g/m^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 $ng/m^3$ | 1 $ng/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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TC-6589

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/127/2023 (ULR NO:TC658923000000000127F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 15/06/2023 |
| | Date of monitoring | 30/05/2023 |
| | Date of sample received | 31/05/2023 |
| | Date of analysis Started | 31/05/2023 |
| | Sample description | Ambient air -Kalamassery |
| | Sample Code | G/F/127/2023 |
| | Sample Location | GPS Reading : N- 10°03'54.71"<br>E -76°19'40.485" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 65.4 µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 36.4µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 20.1 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 24.7 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 1.6 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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QUALITY MANAGER
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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5048/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 15/06/2023 |
| | Date of monitoring | 30/05/2023 |
| | Date of sample received | 31/05/2023 |
| | Date of analysis Started | 31/05/2023 |
| | Sample description | Ambient air -Kalamassery |
| | Sample Code | G/F/5048/2023 |
| | Sample Location | GPS Reading : N- 10 °03'59.71"<br>E -76°19'40.485" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | 7.4 $\mu g/m^3$ | 400 $\mu g/m^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 $\mu g/m^3$ | 1 $\mu g/m^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 6 $ng/m^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 20 $ng/m^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 $\mu g/m^3$ | 180 $\mu g/m^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 $\mu g/m^3$ | 5 $\mu g/m^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 $ng/m^3$ | 1 $ng/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5055/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 15/06/2023 |
| | Date of monitoring | 30/05/2023 |
| | Date of sample received: | 30/05/2023 |
| | Date of analysis | 31/05/2023 |
| | Sample Description | Waste Analysis - Kalamassery |
| | Sample Location | Gps Reading : : N- 10 °03'54.403"<br>E -76°19'41.039" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 31.08 |
| 02 | Bulk Density | | | USEPA | $kg/m^3$ | 830 |
| 03 | Density | | | USEPA | $g/cm^3$ | 0.8024 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 895 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 4.75 | 4 + | | | 94.5 |
| | | 2.36 | 8 | | | 3.4 |
| | | 1.18 | 16 | | | 2.1 |

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5056/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 15/06/2023 |
| | Date of monitoring | 30/05/2023 |
| | Date of sample received: | 30/05/2023 |
| | Date of analysis | 31/05/2023 |
| | Sample Description | Waste Analysis - Kalamassery |
| | Sample Location | GPS Reading : N- 10°03'55.079"<br>E -76°19'40.758" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 36.5 |
| 02 | Bulk Density | | | USEPA | $kg/m^3$ | 827 |
| 03 | Density | | | USEPA | $g/cm^3$ | 0.8047 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 340 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 4.75 | 4 + | | | 63.3 |
| | | 2.36 | 8 | | | 8.6 |
| | | 1.18 | 16 | | | 17.4 |
| | | 0.6 | 30 | | | 6.8 |
| | | 0.3 | 50 | | | 3.9 |

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SREEJA RAMESH
QUALITY MANAGER
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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5050/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 15/06/2023 |
| | Date of monitoring | 30/05/2023 |
| | Date of sample received: | 30/05/2023 |
| | Date of analysis | 31/05/2023 |
| | Sample Description | Waste Analysis -Kalamassery |
| | Sample Location | Gps Reading : : N- 10°03'54.403"<br>E -76°19'41.039" |

**CHEMICAL PARAMETERS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 8.44 |
| 02 | Biodegradable Factor | USEPA | % | 6.3 |
| 03 | Total carbon | USEPA 9060A | % | 4.8 |
| 04 | Phosphorus(P) | USEPA | % | 0.027 |
| 05 | Nitrogen(N) | USEPA | % | 0.41 |
| 07 | Potassium(K) | USEPA | % | 0.051 |
| 08 | C/N Ratio | USEPA | .. | 11.7:1 |
| 09 | Calorific Value | ASTM D 5865 | K.cal/kg | 895 |

Conti.....

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5050/2023 |
|---|---|---|
| M/s. IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 15/06/2023 |
| | Date of monitoring | 30/05/2023 |
| | Date of sample received: | 30/05/2023 |
| | Date of analysis | 31/05/2023 |
| | Sample Description | Waste Analysis -Kalamassery |
| | Sample Location | Gps Reading : : N- 10 °03'54.403"<br>E -76°19'41.039" |

**TOXICITY ANALYSIS- HEAVY METALS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 10 | Iron (Fe) | USEPA 3050 | % | 3.6 |
| 11 | Arsenic(As) | USEPA 3050 | mg/kg | <0.1 |
| 12 | Selenium(Se) | USEPA 3050 | mg/kg | <0.1 |
| 13 | Nickel(Ni) | USEPA 3050 | mg/kg | <0.1 |
| 14 | Zinc (Zn) | USEPA 3050 | mg/kg | 80.2 |
| 15 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 |
| 16 | Copper (Cu) | USEPA 3050 | mg/kg | 33.12 |
| 17 | Chromium(Cr) | USEPA 3050 | mg/kg | 13.7 |
| 18 | Lead(Pb) | USEPA 3050 | mg/kg | 27.1 |
| 19 | Mercury(Hg) | USEPA 3050 | mg/kg | <0.1 |
| 20 | Manganese(Mn) | USEPA 3050 | mg/kg | 10.1 |

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POLUCHEM LABORATORIES (P) LTD.

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

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## TEST REPORT



**Ref.No: PL/RT/5054/2023**

**Date of Issue: 15/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Leachate- Kalamassery
Sample Location : Gps Reading : N-10 °03 56'.168"
E -76°19'40.702"

Sample code : F/5054/2023
Date of sample collected : 30/05/2023
Date of receipt of sample : 30/05/2023
Date of analysis started : 30/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Results |
|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 3.81 |
| Total Dissolved Solids(Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 23400 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 864 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 12535.12 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 88000 mg/l |
| B O D (3 days at 27° C) | IS 3025 (P) 44 – 1993RA 2014 | 20000 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 3987 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 2577 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 46.5 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) |
| Cyanide as $CN^-$ | IS 3025 (P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54 – 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | 1.3 mg/l |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 3.6 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 7.4 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

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TC-6889

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## TEST REPORT



**Ref.No: PL/RT/GW/1090/2023**
(ULR NO:TC658923000000 1090F)

**Date of Issue: 15/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Ground water
Sample Location :
Gps Reading : N- 10 °03'51.298"
E -76°19'38.641"

Sample code : F/1090/2023
Date of sample collected : 30/05/2023
Date of receipt of sample : 31/05/2023
Date of analysis started : 31/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.71 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 8 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 4.7 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 260 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 169 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 8 mg/l | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 76 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 28.85 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 22.8 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 8.5 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.64 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 3.2 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l). | 1.0 mg/l |

Conti…

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 1090/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 110 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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**TEST REPORT**

**ACCREDITED BY KSPCB AS "A" GRADE LABORATORY**



**Ref.No: PL/RT/GW/5214/2023** **Date of Issue: 15/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad -
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Kalamassery
Gps Reading : N- 10 °03'51.298"
E -76°19'38.641"

Sample code : F/5214/2023
Date of Sample Collected : 30/05/2023
Date of receipt of sample : 31/05/2023
Date of analysis started : 31/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P)54-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P)41-1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P)47-1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P)42-1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P)59-2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P)48-1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P)49-1994RA2014 | 0.23 mg/l | 5.0 mg/l |
| C O D | IS 3025(P)58-2006RA2017 | 10 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025(P) 34-1988RA2014 | BDL(MDL- 1mg/l) | --- |
| Total Chromium as Cr | IS 3025(P)52-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P)37-1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Conti..

# POLUCHEM LABORATORIES PVT LTD

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

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**ACCREDITED BY KSPCB AS "A" GRADE LABORATORY**




Continuation of Test Certificate No: 5214/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

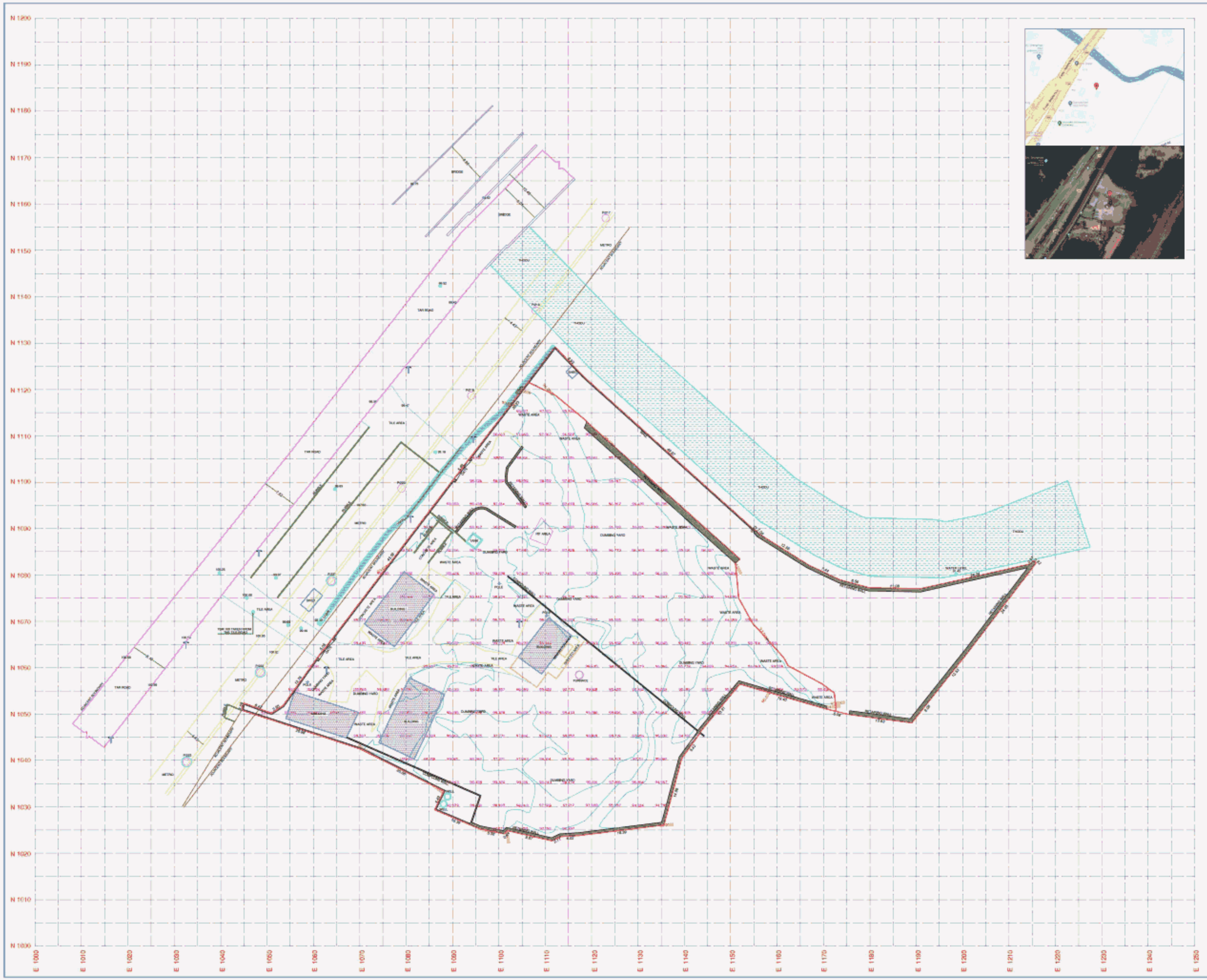
For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

*End of the report*

The above results are related only to the sample submitted for analysis. This test report shall not be reproduced except in full, without the written approval of the laboratory.




VERIFY NORTH AT SITE

SCALE : 1:100
PRINT SCALE : :

| | |
|---|---|
| DATE | 28/05/2025 |
| DRAWN | SINSHA |
| CHECKED | PRAKASH |

LEGENDS

LAMP POST

SPOT LEVELS

BOUNDARY

ROAD

BUILDING

WALL

RUBBLE

DRAIN

AREA

CONTOUR INTERVAL - 1 METRE
GRID INTERVAL - 5X5 M

**AREA - 1.95 ACRES**

ALL DIMENSIONS ARE IN METRE

CLIENT

KSWMP
KAKKANAD

ARCHITECTS

SURVEYED BY

NOEL
KIRAN
ALTHAF

TITLE

CONTOUR & TOPO SURVEY

DRAWING CODE

D.N. : 16789

SITE AT

KALAMASSERY
( 10.053588 ° North , 76.318980 17° East )
( N10.053581 , E76.318980 17 )

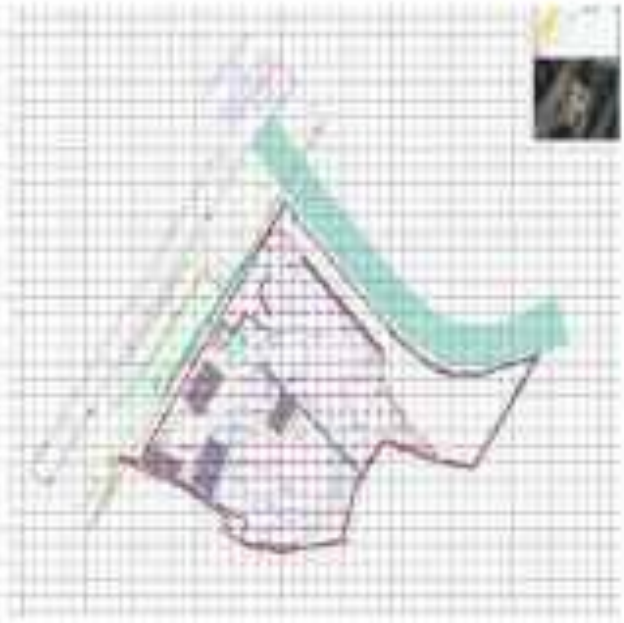
SURVEYED BY

Spreads SURVEY

G-171, NR.SHOPPING COMPLEX
PANAMPILLY NAGAR
COCHIN - 682 036
Ph:0484 2323446
Mob: 98954 48367

ROOM NO :49,50 , VYAPARABHAVAN,
BANK ROAD
CALICUT-1 PH:0495-4020204
Mob: 98954 48369

spreadssurvey@gmail.com





Land shall be reclaimed i.e. all the legacy waste will be removed till it reaches the surface of the earth/ soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the contractor to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to bi-weekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site.



# PART B
# SOCIAL IMPACT ASSESSMENT

**KALAMASSERY DUMPSITE**

**KALAMASSERY MUNICIPALITY**
**ERNAKULAM DISTRICT**

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## 1.INTRODUCTION

Social safeguard aspects during dump site remediation mainly focusing on meaningful stakeholder engagement, understanding stakeholder's risk perception and restoring them to a safe and environmentally sustainable state. It involves a series of systematic social actions which include social inclusion, effective labour management, prevention of gender violence during the process, successive rehabilitation of the affected people and reduction of health risk of the host community. The bio mining process of Kalamassery municipal dumpsite has been included in the World Bank supported KSWMP project. This chapter addresses the current situation of the dumpsite, potential possible social impacts due to the implementation of the project, recent fire incidents, remediation efforts, the quantity of legacy waste, the dumpsite's location within the solid waste management facility, and the complaints received from nearby communities.

## 2. KALAMASSERY MUNICIPALITY- BRIEF PROFILE

Kalamassery Municipality is in Ernakulum district in the state of Kerala. The Municipality is spread over an area of 27 sq. Km. The Municipality is divided into 42 wards. The dump site is situated in ward 6 which is located at Central part of the municipality and comprise a population of 1769 and 842 households (Source: Census handbook of Ernakulum 2011), which comprises 2.4% of the ULB population. Socio-Economic profile of Kalamassery is presented below in the Table.

| SOCIO ECONOMIC PROFILE DATA | |
|---|---|
| District Name | Ernakulum |
| Sub District Name | Kanayannur |
| Town Name | Kalamassery (m) |
| Total Households | 17844 |
| Total Population of Town | 71038 |
| Total Male Population of Town | 35331 |
| Total Female Population of Town | 35707 |
| Total Scheduled Castes Population of Town | 5630 |
| Total Scheduled Castes Male Population of Town | 2762 |
| Total Scheduled Castes Female Population of Town | 2868 |
| Total Scheduled Tribes Population of Town | 384 |
| Total Scheduled Tribes Male Population of Town | 190 |
| Total Scheduled Tribes Female Population of Town | 194 |

*(Based on Census Report -2011*

## 3.PROFILE OF KALAMASSERY DUMPSITE

The dumpsite is located near Kalamassery Apollo Tyres, specifically in Ward 6. of Kalamassery Municipality in Kanayannur taluk, Ernakulam district. The GPS coordinates of the site are 10°03'55.1"N 76°19'41.0"E. Total land owned by the Municipality is 1.95 Acres in which 1.25

Acres are covered by waste. This has been operational since 1990 and stopped in 2021 after deputing CKCL for forward linkage purposes. Estimated quantity of legacy waste to be removed is 3356 Cum based on the study conducted by the ULB. The dumpsite has road access through the National Highway (NH) on its west side.

## 4. SOCIO ECONOMIC BASELINE OF HOST COMMUNITY

It is identified that there are no households situated within the 200 meters from the dumpsite.

## 5. VULNERABILITY MAPPING OF HOST COMMUNITY

There is no vulnerable community identified in and around the dump site within 200m radius. There is no risk with respect to the social and economic conditions of the host communities except the street vendor who is running the Petty Shop near the site.

## 6.DATA COLLECTION TOOLS

### 6.1 SOCIAL SCREENING CHECK LIST

Social screening of the proposed site was conducted by a joint team of social and communication experts from KSWMP-DPMU and TSC following a screening checklist to identify the potential social risks anticipated during the dumpsite remediation. A screening report has been prepared based on the checklist.

### 6.2TRANSECT WALK

A transect walk was conducted in and around the dumpsite on 06/06/2023. The aim of transect walk was to identify the potential social impacts of the project, issues of land availability, any adverse impacts and elicit necessary community participation in the program. A team of experts from Technical Support Consultancy, District Project Management Consultancy, and the District Project Management Unit, along with representatives of ULB such as ward councillor and Health Supervisor participated in the transect walk.

The group exercise that entails walking between two points to intentionally cross or transect a community. The group explores environmental and social resources, conditions, and systems by observing, asking, listening, looking, and producing a transect diagram. Information collected can be used to reveal land use practices, hazards, and vulnerabilities to inform disaster mitigation and water management.

### 6.3 FOCUSSED GROUP DISCUSSION

A preliminary discussion was conducted on 31$^{st}$ July 2023 in the Municipal Hall with the ULB council and officials of health section about the remediation process. During the meeting discussion have been held about various process, risks and benefits associated with the dump site remediation process.

## 6.4 SITE SPECIFIC OBSERVATIONS FROM TRANSECT WALK AND SOCIAL SCREENING

- Dumpsite is located more than 200 meters from the habitation/settlements
- The dumpsite is located within the existing common solid waste management facility of the Kalamassery Municipality. The facility includes a Transfer Station, Material Collection Facility (MCF), and a Resource Recovery Facility (RRF).
- 20 migrant labourers including 5 women, deployed by the CKCL are working there and 5 sanitation workers of the ULB are also engaged in the waste management process at the site.
- 1 HKS member is deployed in Dump site for monitoring of the waste segregation and transportation activities related to the functioning of MCF and RRF.
- Municipal Crematorium and Cemetery of St Marys Jacobite Church, Kalamassery are located very close to the site. A good number of people used to gather in these areas
- HKS member and contract workers involved in waste management were unaware of the dumpsite remediation process going to be executed.
- During the transect walk, it was observed that there are no rag pickers associated with the dumpsite. Therefore, there are no livelihood risks for rag pickers in this context.
- No toilet facility is available in the premises of the site. The workers are using the toilets in the side of the crematorium which is not having adequate hygiene and lighting facilities and is at least 70 meters from the site
- The total scheduled tribal population in the ULB is 104, but there are no scheduled tribes staying near the dumpsite, and no impact on their land, customary rights, or livelihoods of tribes is observed.
- There is one street vendor along with his wife runs a petty shop near to the Dumpsite. The proposed activity will not have much impact on his livelihood. Temporarily relocation may be considered based on the site conditions during the remediation.
- There are no households affected by the proposed project activity, including non-titleholders or squatters. Most of the people in the ward 6 are currently using the public crematorium.
- There is no requirement for government, forest, or private land acquisition for the dumpsite remediation project. The currently designated plot has space for the transportation or mobilization of construction materials.

## 7. STAKEHOLDER ANALYSIS

The remediation process requires collaboration of the following stakeholders.

| SL No | Stakeholders | Roles of the stakeholders associated with the remediation process |
|---|---|---|
| **Service Providers** | | |
| 1 | ULB Council | Tendering, finalization and deputing contractor/agency for remediation |
| 2 | Govt institutions like PCB, KSEB, KWA, Fire Station, Police Station, Thaluk Hospital etc | To deliver necessary approvals and provide necessary services in emergency situations during remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | KSWMP-DPMU | Monitoring and Evaluation |
| 5 | TSC and DPMC Unit | Technical support and supervising |
| 6 | Contractor | Execution of the Remediation process |
| 7 | Haritha Karma Sena workers | Proper collection and waste segregation to prevent further dumping after remediation |
| 8 | Rag Pickers | Participation in informal collection to strengthen the collection process to prevent further dumping |
| 9 | Scrap dealers | Informal participation in NBD waste management to prevent further dumping after remediation |
| 10 | End recyclers | Process the inert and legacy waste safely after remediation |
| **Affected Community** | | |
| 1 | Workers in Crematorium and cemetery functioning in the same compound | Support and cooperation for the remediation process |
| 2 | Public coming to the crematorium and cemetery | Support and cooperation for the remediation process |
| 3 | HKS and CKCL workers in MCF and RRF | Attending in orientation programs about the remediation process, comply with health and safety measures and |

| | | |
|---|---|---|
| | | deliver support and cooperation to the remediation process |
| 4 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |
| 13 | Street vendor running petty shop near the site | Cooperating with the remediation process and relocating the shop with the support of ULB if required |

## 8. POSITIVE SOCIAL IMPACTS AFTER REMEDIATION.

### 8.1 ENHANCED QUALITY OF LIFE

The remediation can restore the aesthetics of the area, reducing visual blights, foul odour and improving air and water quality. According to the opinion of people residing in ward 6, the project can contribute to an improved sense of well-being. Also, it results to a clean and hygienic work environment for the workers engaged in MCF and RRF.

### 8.2 LIVELIHOOD AND EMPLOYMENT OF VULNERABLE COMMUNITY

It is identified that no rag pickers are currently engaged in collecting waste from the dumpsite or making a living from it. Therefore, the proposed dumpsite rehabilitation project will have no impact on housing or livelihood of any rag pickers.

### 8.3 ECONOMIC OPPORTUNITIES

After remediating the site, the Municipality is planning to enhance the capacity of the MCF and RRF to process more non-biodegradable waste and to set up a centralized waste management unit to process the bio degradable waste. These projects will create more job opportunities to the people who are looking for employment in waste management sector.

### 8.4 ACCESS TO SERVICE

It is observed that the project will not affect access to any facilities, services, or natural resources as there is enough space/land available in the exiting site.

### 8.5 LAND AVAILABILITY

2.5 acres of land is available in the in the existing dumpsite, which is owned by the Kalamassery Municipality, so there is no need of land acquisition/transfer or purchase. Dumpsite remediation will create acres of vacant land which can be effectively useful for other purposes of ULB especially for the waste management. Recovered land can be converted to Transfer Station for the temporary storage of the inert waste. The cleaned-up land can potentially be used for new construction, commercial development, or recreational activities. The property value after the remediation will be very high.

## 9.EXPECTED SITE-SPECIFIC SOCIAL IMPACTS/RISKS

- Since there is not enough space for vehicle movements and machinery installation during remediation process, it may be required to shift the MCF and RRF to another space.
- livelihood issue of 20 migrant labourers of CKCL currently employed in the MCF and RRF functioning at the site.
- Health and safety issues of the labours at site during remediation period
- Health and safety issues of the public coming to Crematorium and Cemetery.

## 10. SUGGESTIONS/RECOMMENDATIONS

- A temporary parallel facility /spaces should be provided by ULB to continue the same process currently going on in the dumpsite. So the waste management activities will run accordingly and it may not affect the livelihood and income of the waste workers and HKS.
- Proper gender friendly toilet facility should be provided in the dumpsite for the labours as well as for the workers engaged in MCF and RRF.
- The public access towards the dumpsite should be restricted during the execution of the project.
- Adequate health and safety measures to be provided to the contractor to his labours during the process.
- Site specific action plans to be formulated and followed during the remediation process.
- Female Workers may be included in the dumpsite remediation project works. Gender friendly washrooms and dressing rooms should be provided
- A project-level grievance redressal mechanism will be instituted to receive and facilitate the resolution of stakeholders' concerns and grievances. Awareness campaigns about the Grievance Redressal Mechanism (GRM) will be conducted through Information, Education, and Communication (IEC) activities for the community and Urban Local Body (ULB) functionaries
- Proper capacity building is essential for municipal councilors, health wing officials, SWM workers of the Urban Local Body (ULB), and other functionaries involved in the operation and management of this project.

- It is recommended to install essential facilities such as water supply and separate toilet facilities at the dumpsite.

## 11. SCOPING OF SOCIAL IMPACT ASSESSMENT AND REQUIRED ACTION PLANS

All the social risks were identified through the social screening and Transect walk conducted at site. Considering the social impact assessment, certain action plans have been formulated to be followed at site

- **Labour Management Plan**

Maximum of 15 labours are expected to be engaged in remediation process at a time. A detailed labour Management plan has been prepared and attached as Annexure.

- **Labour Influx Management Plan**

No family is residing near the site. So there will not be any impact to the community due to the labour influx. But considering the workers in Crematorium and Cemetery near the site, a Labour Influx Management plan has been prepared and attached as Annexure.

- **Preventive GBV Action plan**

Considering the labours at site during the work a detailed GBV action plan has been prepared and attached as Annexure.

- **Citizen Engagement Plan**

A detailed citizen engagement plan has been prepared considering the workers employed in Crematorium and Cemetery near the site and the same is attached as Annexure.

As per the detailed assessment of potential social risk during the remediation process, the identification from social screening with screening checklist, transect walk and focus group discussion indicates that there will be a chance of temporary loss of livelihood of SWM workers in the existing MCF and RRF located in the same site. A detailed impact assessment shall be conducted by the TSC, and Livelihood Action Plan will be prepared, if required

It is identified that land acquisition is not required as sufficient land is available.

## 12. CONCLUSION.

During the screening, it has been observed that the only anticipated risk is associated with labour, with no other adverse social impacts on dwellings, land, livelihood, or community resources for the execution of the proposed remediation process. The dumpsite has enough road access through the National Highway (NH) on its west side, thus there will not be any disruption to the public properties and commercial establishments nearby the site. There are no scheduled tribes, rag pickers and other vulnerable communities near to the dumpsite. Since there is not much risk with respect to the social and economic conditions of the host communities, the dumpsite can be categorized into “Moderate Risk” and dumpsite remediation will create a positive impact on environmental and social aspects.

# Annexure I: Citizen Engagement Plan

## 1. Brief introduction about the project

Project for the remediation of Dumpsite at Kalamassery, in ward no 6 of Kalamassery Municipality.

## 2. Stakeholder identification

As part of social safeguard initiatives for the Bioremediation of dumpsite at Kalamassery, the social experts of TSC, DPMC and DPMU conducted brainstorming exercises with locals, functionaries of Kalamassery Municipality, Suchithwa Mission. A detailed list of primary and secondary stakeholders is prepared based on these exercises.

### 2.1 Waste Generators

Kalamassery dumpsite is currently functioning as a transfer station of NBDW from the nearby primary stakeholders. WM facilities like MCF and RRF are also functioning inside the compound. The identified waste generators are as follows.

| Sl.No | Waste Generators |
|---|---|
| 1 | **General Households** |
| 2 | **Shops** |
| 3 | **Institutions** |
| 4 | **Commercial establishments** |

### 2.2 Service Providers

The identified service providers of the dumpsite are as follows:

| Sl.No | Primary Service Providers | Male | Female |
|---|---|---|---|
| 1 | Migrant labors of CKCL | 15 | 5 |
| 2 | Sanitation workers of ULB | 5 | Nil |
| 3 | HKS | Nil | 1 |
| 4 | Drivers | | |
| | Staff-CKCL | 1 | Nil |

| Sl.No | Secondary Service Providers |
|---|---|
| 1 | ULB Health staff |
| 2 | Elected representatives of ULB |
| 3 | CKCL |
| 4 | Suchithwa Mission |
| 5 | PCB |
| 6 | Police |
| 7 | KSWMP |
| 8 | Taluk Hospital |
| 9 | Contractor |
| 10 | Recyclers |
| 11 | Labors engaged in remediation |

## 3. Need of the plan

Citizen engagement as part of the proposed bioremediation of dumpsite in Kalamassery municipality aims to facilitate two-way communication between the project and its stakeholders to make better informed decisions. Such an engagement will certainly pave the way for better implementation of the project, and it will ensure public participation in trouble shooting at all the stages of the implementation of the project.

## 4. Objective of the plan

The citizen engagement plan for the proposed dump site remediation is prepared with following objectives.

- To create a conducive environment for the smooth implementation of the proposed bioremediation of the dumpsite by promoting constructive dialogues between the project and its stakeholders.
- To ensure stakeholder participation in the planning, implementation, and monitoring of the sub-project.
- To suggest appropriate activities with a monitoring plan and an expected budget for engaging the stakeholders with the motive of enhancing their ownership in the project through increased participation.

## 5. Stakeholder concern

### 5.1 Waste Generators

- The waste collection may get delayed/stopped due the remediation process.

### 5.2 Service Providers

- Livelihood of SWM workers currently working in the dumpsite and nearby vendor may get affected
- The entire waste management system of the ULB may get disturbed because of remediation process

## 6. Community/citizen Awareness

- Conducting Sensitization programs to care takers of municipal crematorium and authorities concerned of nearby st.marys Jacobite church.
- Detailed awareness shall be given to the street vendor functioning near to dumpsite.

## 7. Awareness to Service providers

- Awareness regarding the dumpsite remediation and its procedures shall be given to the ULB council/Staff and CKCL.
- Sensitization programs shall be provided to Fire Force, Police and PCB regarding dumpsite remediation.
- The SWM workers currently working in the site, drivers and related workers should be oriented regarding the dumpsite remediation process and its benefits.

## 8. Citizen Engagement Plan Matrix

| S. No | Engagement Challenge | Impacts on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| 1 | Lack of Awareness on Project activities | Non-co-operation from Community/stakeholders | Awareness campaigns / sensitization programs to the stakeholders | Contractor/TSC |
| 2 | Delay in decision making and timely support from the ULB | To establish transparency and building confidence in the project commitments to ULB elected members and officials | Sensitization on bio remediation activities for the Kalamassery Municipality council and staffs before the commencement of the remediation | Contractor/TSC |

| | | | | |
|---|---|---|---|---|
| 3 | GRM committee | Delay in the execution of remediation work | Constitution of a project level GRM Committee to take-up any social issues raised at site level | Contractor/TSC |
| 4 | To understand the actual operational plans (Time of operations ,Machineries involved, number of workers, actions to be initiated for dust /odor/and sound pollution, vehicle movements) | To inform actual plan of operation to the host community and prevent any social & environmental issues and plan mitigation measures | Meeting with the contractor to understand the plan of operation, number of labors going to involve, duration of the work | TSC |

**9. Budget**

| S. No | Activity | Specification | Quantity | Cost |
|---|---|---|---|---|
| 1 | Sensitization program | Physical meeting with identified staffs/caretakers of Municipal crematorium and St.marys church | Sensitization training- 1No's<br><br>Total expected members-10 | [redacted] |
| 2 | Awareness programs for ULB Council/staff and CKCL | Physical meeting at ULB council hall | Number of meetings -2<br><br>Total expected participants-60 | [redacted] |
| 3 | Sensitization programme to the concerned officials of Fire Force, Police and | Physical meeting with Officials | 1 No's of meeting with each department | [redacted] |

| | | | | |
|---|---|---|---|---|
| | PCB regarding dumpsite remediation. | | Total expected participants-20 | |
| **Total** | | | | [redacted] |

# Annexure II: Preventive GBV Action plan

## 1. Sub project information

Bioremediation of existing dumpsite in ward -6 of Kalamassery Municipality

### 1.1 Details of labors

The project is under pre planning stage. ULB must finalize contactor/Agency for Remediation. So the exact number of Labors are not available. But approximately we can expect maximum of 12 labors

| | |
|---|---|
| Total number of labors | : 12 (Approx.) |
| Category of labors (Age/sex/gender) | : Not available |
| Data of migrant labors, if any | : Not available |

## 2. GBV Issues likely to be identified at site

1. Issues against female workers at site
2. Lack of safe and Gender friendly toilets at work sites
3. Disparity in work and wages based on gender

## 3. Activities under GBV Action plan

1. **Formation of Internal Complaints Committee (ICC)**
   The committee should be Presided by a senior woman, and more than half of the total Committee members should be women. There should be an external member who has experience in dealing with issues related to women. Preferably a Social Worker /Advocate/NGO Representative.

2. **Placing of ICC informatory board at Work site**

| Insert Logos of KSWMP,WB,AIIB | | | |
|---|---|---|---|
| Project Name (KERALA SOLID WASTE MANAGEMENT PROJECT) | | | |
| Sub Project Name: | | | |
| Internal Complaints Committee | | | |
| Sl.No | Name | Designation | Contact Number |
| | | | |
| EMERGENCY CONTACT NUMBER | | | |

3. **Gender Sensitization trainings for Labors**

The Project expect around 12 labours will be employed in a day and women participation in the labor force is limited, even the project is taking precaution to protect and prevent any GBV incidence at the site. Taking into consideration all these aspects, the project plan to conduct a half day sensitization program in the following subjects, viz. the type of GBV, the action to be taken by the victim, the laws and the support organizations which extend support to the victim of GVB and the role of ICC and their contact details etc.

**Allocation of Gender friendly and safe toilet facilities for women**

Project has taken special care to arrange a separate toilet, wash and rest facility for female workers to protect their privacy and safety, and the same must be arranged by the contractor.

**Keeping of wage register at site to restrict wage disparity based on gender**

The project actively opposes gender-based wage disparity at any site funded under the KSWMP-supported SWM project. To ensure gender parity in various aspects such as wages, division of labor, and facilities, an appropriate monitoring mechanism, such as a wage register, should be maintained for the scrutiny of the project implementers.

**Details of GBV Service Providers identified**

The government of Kerala has constituted a help desk under Kudumbashree to support or to prevent and extend support to the GBV victims, and their details are given below.

**Kudumbashree Snehitha Gender Help Desk**
Contact Number – 0484-2428745
Toll free number - 180042555678

**Preventive GBV Implementation Plan Matrix**

| Sl No | Activity | Timeline | Primary Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 1 | Formation of Internal complaint committee | Pre-Construction Phase. | TSC/Contractor | DPMU |
| 2 | Placing of ICC informatory Board at worksite | Pre-Construction Phase. | Contractor | DPMU/TSC |
| 3 | Gender sensitization Training to labors | During Construction | Contractor/TSC | DPMU |
| 4 | Ensuring Gender friendly and safe toilet facilities | Construction stage | Contractor | DPMU |
| 5 | Keeping Wage Register at site | Construction stage | Contractor | DPMU |

**Budget**

| Sl No | Particulars | Cost |
|---|---|---|
| 1 | Placing of ICC Informatory board | [redacted] |
| 2 | Gender sensitization trainings to labor | [redacted] |
| 3 | FGD | [redacted] |
| | **Total Cost** | [redacted] |

**Monitoring plan**

| Activity | Monitoring Indicators | Means of Monitoring | Reporting Period | Responsibility |
|---|---|---|---|---|
| Formation of Internal complaint committee | Minutes of Meeting/Bye Law of Committee/Reports | Verification of Minutes of Meeting and Reports | 15 days after commencement of work | DPMU |
| Placing of ICC informatory board at worksite | Photos of Boards placed | Physical verification | 15 days after the commencement of work | DPMU |
| Gender sensitization Training to labors | Attendance and Photographs | Verification of Documents | 5 days after the commencement of work | DPMU |
| Ensuring Gender friendly and safe toilet facilities | Gender friendly signage's, Condition of latches, Floor Condition, Status of Flush | Physical verification | Before Commencement of work | DPMU |
| Keeping Wage Register at site | Photographs | Verification of Register | 5 days after the commencement of work | DPMU |

# Annexure III: Labour Management Plan

## 1. INTRODUCTION

### 1.1 Project Title

Project for the remediation of dumpsite at ward 6 owned by Kalamassery Municipality

### 1.2. Project Area

The Dumpsite of Kalamassery Municipality is situated in ward 6 of the municipality, covering an area of 2.5 acres.

## 2. SCOPE AND STRUCTURE OF THE LABOUR MANAGEMENT PLAN

The scope of the LMP shall be as outlined in the World Bank's ESMF. The engagement will be planned as an integral part of the project's social assessment and project design and implementation. This document has 10 chapters. This chapter viz., chapter 1 served as introduction. Scope and structure of LMP is provided in chapter 2. An overview of labour use in the project is presented in chapter 3. Key potential labour risks are listed in chapter 4. Legislative framework governing labour employment in India/Kerala is discussed in chapter 5. Implementation Arrangements, policies and procedures follow in the subsequent chapter. Grievance redressal mechanism, contractor management are presented in the last chapters.

## 3. OVERVIEW OF LABOUR USE ON THE PROJECT

### 3.1 Details of Labours

The proposed remediation process requires following category and number labors

| Sl.No | Equipment | Category of labors | Required No.of labors |
|---|---|---|---|
| 1 | One trommel | Labours for waste segregated purpose | 5 |
| 2 | One excavator | Operator | 1 |
| 3 | One JCB | Operator | 1 |
| 4 | Two small tippers | drivers | 2 |

| | | | |
|---|---|---|---|
| | | Helpers | 2 |
| 5 | | Supervisor | 1 |
| **Total Labours** | | | 12 |

## 4. ASSESSMENT OF KEY POTENTIAL LABOUR RISKS

### 4.1 Project Activities:

The bioremediation of the dumpsite includes the following activities;

- Mobilization of plant and machinery for bio-mining
- waste excavation and forming of windrow
- Spraying with inoculum and waste stabilization
- Waste segregation and refinement
- sorting materials into recyclable, RDF, compost and inert
- Transport to the authorized recyclers and end users

### 4.2 Key Labour Risks

It is assessed that key labour risks would be associated with health and safety risks related to the construction activities such as exposure to physical hazards during construction activities such as: use of heavy equipment, exposure to noise and dust, falling objects, exposure to hazardous materials and exposure to electrical hazards from the use of tools and machinery, lack of proper sanitation facilities, availability of separate toilet for women workers. As the construction activities will involve hazardous work, persons under the age of 18 will not be employed by the Project. Many workers will be exposed to occupational health and safety hazards, primarily including but not limited to:

- Injuries/accidents/ fatalities leading to even death, while at work.
- Inadequate accommodation facilities at work force camps, including inadequate sanitation and health facilities.
- Non-payment of wages by Employer.
- Non-payment of benefits (compensation, bonus, maternity benefits etc.) by Employer
- Discrimination in Employment (e.g., abrupt termination from employment, working conditions, wages or benefits etc.)
- Engagement of child labour.
- Sexual harassment at work sites.

- Forced labour or trafficking.
- Security of women workforce.
- Inadequate facilities for pregnant women and lactating mothers.
- Inadequate facilities for the children of the workforce at workforce camp sites
- Possibility of Gender based violence as the work is mostly carried out within the premises of the existing facilities like MCFs/ RRFs etc where female SWM workers are engaged.
- Absence or inadequate or in accessible emergency response system for rescue of labour/workforce.
- Health risks of labour relating to HIV/AIDS and other sexually transmitted diseases.
- Unclear terms and conditions of employment.
- Discrimination and denial of equal opportunity in hiring and promotions/incentives/training opportunities.
- Denial for workers' rights to form worker's organizations, etc.
- Absence of a grievance redressal mechanism for labour to seek redressal of their grievances/issues.

## 5. BRIEF OVERVIEW OF LABOUR LEGISLATION: TERMS AND CONDITIONS

| Sl No | Applicable Acts | Details |
|---|---|---|
| 1. | Employees Compensation Act 1923: | The Act provides for compensation in case of injury, disease or death arising out of and during employment |
| 2. | Contract Labour (Regulation & Abolition) Act 1970 | The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. |
| 3. | Minimum Wages Act 1948: | The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. |

| | | |
|---|---|---|
| 4. | Payment of Wages Act 1936: | It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the workers. |
| 5. | Equal Remuneration Act 1976: | The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training, and promotions etc. |
| 6. | Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: | The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc. |
| 7. | Child Labour (Prohibition & Regulation) Act 1986: | The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in the Building and Construction Industry. |
| 8. | Employees State Insurance Act 1948: | The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the Central Government. The Act also provides for benefits to dependents of insured persons in case of death because of an employment injury. |
| 9. | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: | This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee |

| | | |
|---|---|---|
| 10. | Industrial Disputes Act 1947: | the Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing the establishment. |
| 11. | Trade Unions Act 1926: | The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. |

## 6. RESPONSIBILITY MAPPING

The ULB (Urban Local Body) will award the proposed work to the contractor through competitive bids. The contractor will be responsible for hiring labourers for both civil and skilled work. In the recruitment process, the contractor is obligated to provide opportunities to members of the host community who possess the necessary skills and willingness to engage in the activities available at the dumpsite for remediation.

The contractor is required to adhere to existing labour laws in the state of Kerala while employing labourers, ensuring compliance with all applicable welfare measures mandated by the relevant labour legislation and rules. Additionally, the contractor is responsible for implementing measures to protect and assist vulnerable groups of workers, including individuals with disabilities, migrant workers, and women workers. These protective measures should be explicitly outlined in the work agreement.

Furthermore, the contractor must prioritize occupational health and safety measures for the labourers. The ULB will actively monitor the contractor's compliance with legal and welfare requirements. The ULB will also organize training sessions for the workers and establish a forum at the ULB level to address any grievances raised by the workers.

It is a prerequisite for the contractor to possess a valid Labor License, and all laborers working on the site must be registered with the appropriate authorities. This comprehensive approach ensures the well-being and fair treatment of workers throughout the remediation project.

## 7. CODE OF CONDUCT

A code of conduct needs to be incorporated with the contract under the project. The contractor should conduct continuous awareness generation and training activities to ensure that the workers abide by the code of conduct. While preparing the code of conduct, following aspects should be ensured;

- Compliance with applicable laws, rules, and regulations of the jurisdiction
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment (PPE), preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment)
- The use of illegal substances

- Non-Discrimination (for example based on family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction)
- Interactions with community members (for example to convey an attitude of respect and non-discrimination)
- Sexual harassment (for example to prohibit use of language or behavior, towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate)
- Violence or exploitation (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favors or other forms of humiliating, degrading or exploitative behavior)
- Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behavior with children, limiting interactions with children, and ensuring their safety in project areas)
- Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by their employer and not open areas)
- Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favors, are not provided to any person with whom there is a financial, family, or personal connection)
- Respecting reasonable work instructions (including regarding environmental and social norms)
- Protection and proper use of property (for example, to prohibit theft, carelessness, or waste)
- Duty to report violations of this Code
- No retaliation against workers who report violations of the Code, if that report is made in good faith.

## 8. SYSTEMATIZING THE CODE OF CONDUCT

Awareness raising: The Contractor is required to conduct ongoing awareness-raising and training activities to ensure that workers consistently adhere to the Code of Conduct. Additionally, the Contractor must take measures to ensure that local communities are well-informed about the Code of Conduct, enabling them to report any concerns or instances of non-compliance. This proactive approach aims to foster a shared understanding of ethical standards and accountability within both the workforce and the surrounding communities.

## 9. TRANSPARENCY IN CONTRACT SPECIFIC TERMS AND CONDITIONS

All contracts must contain

- Wages: Specific wages and payment modality, timeline
- Working Hours: hours of work, maximum number of hours that can be worked on the project, overtime, compensation
- Leaves: rest per week, annual leave, maternity leave, sick leave

- Benefits: medical treatments in case of accidents or otherwise
- Notice of termination of employment and details of severance payments in a timely manner
- Collective agreements that apply to the project, other specific terms, and conditions
- Details of the grievance redressal mechanism

## LABOUR MANAGEMENT PLAN INDEX

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To complete the registration by the Principal Employer, the ULB, as per the provisions of the Contract Labour (Regulation & Abolition) Act 1970 (CL Act), Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979 (ISML Act) and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 (BOCW Act) and procure certificate to that effect. | 3 Registration Certificates to be procured by the ULB under CL Act, ISML Act and BOCW Act respectively. | Before Awarding works | Registration Certificate issued by District Labour Officer under CL Act, ISML Act and BOCW Act | PIU |
| To Procure license under CL Act, ISML Act and registration under BOCW Act by the contractor | 2 Licenses and One registration under CL Act, ISML Act and BOCW Act respectively. | Before commencing the work at site | License and registration certificate issued by the competent Authority. | Contractor |
| To procure Workmen Compensation insurance policy proportionate to the number of labour force deployed. (By the Contractor) | One insurance policy. | Before commencing work at site | Copy of insurance policy | Contractor |
| To display a copy of the certificate of registration at the conspicuous place at the premises where the building and other construction work is being carried on.To establish a labour information signboard at camp site by including following details like, date of payment of wages, working hours, holidays, wages rates for different | One notice board | As soon as the work is started. | Photographs of the notice board where the license is displayed. | Contractor |

| | | | | |
|---|---|---|---|---|
| categories of labours and name and contact details of local labour inspector and his/ her office and emergency contact numbers. | One notice board | Do | do | |
| To conduct pre- employment medical examination (as per the provisions of BOCW Act)- to ensure medical fitness of the employee. | All workers must be examined | No of workers employed by the contractor | Pre-Medical Examination certificate issues as per Rule 223(C) of BOCW Act (Form No. IX) by the Registered Medical Practitioner. | Contractor |
| To conduct Periodical Medical Check-ups (once in every six months) | All workers must be examined. | No of workers employed by the contractor | Medical Examination certificate issued by a registered medical practitioner. | Contractor |
| To provide safe drinking water- the contractor must provide safe drinking water at worksite as well as camp site* (Guideline is provided along with this document) | As per requirement | During the entire contact period | Photographs of supply of potable water, Bill of water purchase. | Contractor |
| To arrange first Aid facility at work site as well as camp site (Specifications and items to be maintained in the box is mentioned in this document) | As per requirement | During the entire contract period | First Aid Register, Bill of purchase, photographs of First Aid kit | Contractor |
| To arrange separate First Aid room at work site | Allot one specified room | To be made available during the construction period | Photographs of the facility | Contractor |

| | | | | |
|---|---|---|---|---|
| To provide first Aid training to selected labourers or staff members through an authorized agency. | One training with authorized agency | Within one month of commencement of the work | Training records & Photographs | Contractor |
| To establish linkage with local hospitals/ health care institutions for emergency medical assistance | Tie up with at least one hospital | Within one month of the commencement of the work | Letters issued by the hospital or correspondence and agreement with the hospital. | Contractor |
| To establish rest room at work site or camp site | | Before the commencement of the work | Photographs of the rest room | Contractor |
| To establish Canteen facility for labours if the contractor engages more than 250 labours | | Before the commencement of the work | Photographs of the facility, canteen register etc | Contractor |
| To maintain essential registers and records like Form A (Registration of employees), Attendance Register, Wages Register, and other registers like incidents registers including Accident register, Harassment complaints, recovery register, Maternity leave, Termination etc | | As and when the work starts | Copy of registers. | Contractor |
| Constitute GRC for labours (maximum members to be six. Number of members from employer and employee to be equal. Female members should be minimum 50%. ) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |

| | | | | |
|---|---|---|---|---|
| Constitution of ICC (minimum members to be four. The presiding member should be a senior female employee) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| To publish the abstract of labour laws within the premises of the labour camp.<br>1. The Payment of Wages Act<br>2. The Employee Compensation Act<br>3. The Building and Other Construction Workers (RECS) Act<br>4. The Contract Labour (A&R) Act<br>5. The Child and Adolescent Labour (P&R) Act<br>6. The Maternity Benefit Act | Abstract of Six acts | As and when the camp is established | Photos of the notices published. | Contractor |
| To establish code of conduct and provide induction trainings | | As and when new employees are joined | Training reports and other documents | Contractor |
| Conduct HIV/AIDS awareness programs | As per requirement | Once in six months | Reports, photographs etc | Contractor |
| All the Drivers should possess effective and valid Driving License | Drivers should be selected after verification of DL | As and when drivers are appointed | Photocopy of license ids to be collected | PIU |
| All the vehicles involved in the project shall be insured to cover the third-party risk | Vehicle must be allowed to be plied in the project only | As and when vehicles are plied in the project | Photocopy of insurance is to be collected | PIU |

| | | | | |
|---|---|---|---|---|
| | after procurement of third-party insurance to the vehicle | | | |

**Budget for LMP**

| S.No | Item | Cost |
|---|---|---|
| 1 | Labour compliance as per LMP | [redacted] |

## ANNEXURE IV: LABOUR INFLUX MANAGEMENT PLAN

| RISK | MITIGATION MEASURES | IMPLEMENTATION RESPONSIBILITY | MONITORING INDICATORS | MONITORING RESPONSIBILITY |
|---|---|---|---|---|
| Social and Community wellbeing | 1. Joint Meeting with the community by ULB officials and Elected members | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Economic and Livelihood Issues | 1. Skilled /Unskilled jobs for the Community members in the sub-project | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Accommodation /labour camp | 1. Ensure basic amenities are provided to the labourers( Toiltes,Water ,Kitchen facilities etc)<br>2. Daily briefing to the labourers | Contractor | • Risk identification report<br>• Proposed action/mitigation plan<br>• List of facilities in labour camp<br>• Details of labours | TSC/DPMU |

| | | | | |
|---|---|---|---|---|
| Communicable Diseases | 1. Access to Medical Check-up<br>2.Aaresness to the laboures | Contractor | • SOP for prevention of communicable disease and health wellbeing on worksite and labour camp<br>• Report on medical check-up | TSC/DPMU |
| Crimes | 1. Intimation to the Local police about the camp | Contractor | Work site complaint register<br>Number of cases reported, and action taken | TSC/DPMU |
| Child Labour | 1. Ensure Adhar card of all labourers at the site<br>2. | Contractor & TSC | • Number of child labour issues reported<br>• Data of labours | ULB/DPMU |
| Gender-based violence, including sexual harassment child abuse and exploitation | 1.Gender sensitization briefing to the labourers | Contractor/TSC | • Number of cases reported<br>• Action taken report<br>• Number of cases resolved<br>• Time taken for resolving complaints | ULB/DPMU |
| Laour licenses | To be ensured by the contractor | Contractor/PIU | Number of labours having license | DPMU |

Summary of SMP budget

| S.No | SMP Activity | Cost |
|---|---|---|
| 1 | Labour Management Plan | [redacted] |
| 2 | Labour Influx Management Plan | - |
| 3 | Preventive GBV action plan | [redacted] |
| 4 | Citizen Engagement Plan | [redacted] |
| **Total** | | [redacted] |

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR DUMPSITE BIOMINING AND BIOREMEDIATION, ADLAID, KALPETTA MUNICIPALITY



Submitted by

**Kerala Solid Waste Management Project**

# Part A

# Environmental Impact Assessment

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## Summary

### Introduction

The Kalpetta municipality is an Urban Local Body (ULB) of the Wayanad district of Kerala, covering an area of 40.74 square kilometers and divided into 28 administrative wards. This municipality generates 13.82 tons per day (TPD) of solid waste. However, Kalpetta ULB do not possess adequate solid waste treatment and disposal facilities as mandated by the Solid Waste Management (SWM) rules, 2016. Consequently, unsegregated waste was disposed of in an unscientific manner; essentially dumped at the ULBs trenching ground (where feces/night soil used to be dumped from pit latrines) at Adlaid in ward 23. In order to promote a healthy and sustainable environment, it is imperative to undertake the remediation of the existing dumpsite

### Subproject Description

The Bio-mining and Bioremediation at the Kalpetta ULB dumpsite are proposed as part of the Kerala Solid Waste Management Project (KSWMP) with support from the World Bank and the Asian Infrastructure Investment Bank. The dumpsite situated in Ward 23, Adlaid, covers a total area of 3.65 acres and contains a legacy waste quantity of 7640 tons. The waste at the site is approximately 40 years old, with dumping activities started in 1970 and stopped in 2010. Initially, the dumpsite served as a trenching ground for the disposal of sewage from pit latrines. The total volume of waste accumulated is approximately 9485.37 cubic meters, and the dumpsite spans across an area of 1.12 acres.

### Status of Subproject Development at the time of EIA

Currently, the dumpsite has stopped at site and solid waste of the ULB is treated and disposed at multiple decentralized facilities across the city. The entry to the dumpsite is facilitated by a 3.5-meter-wide approach road in good condition, located in Kalpetta –Adlaid and there is existing MCF (Material Collection Facility).

### Technical Aspects

Following a comprehensive evaluation, the method or technique of Bio-mining with a goal of achieving 100% land reclamation and recovery is found to be the most suitable remediation approach, ensuring long-term sustainability and environmentally responsible treatment of legacy waste, leading to the complete remediation of the dumpsite. Based on the Feasibility and site conditions, Mobile trommel machinery would be the most suitable option for the small site at Adlaid, Kalpetta. The optimal time frame for conducting the Biomining Process would be from December to April Months, a period characterized by lower rainfall levels as per climate data.

**Application of Regulatory and Guidance Framework**

In accordance with the SWM Rules of 2016, the selection of an appropriate method or technique for remediating a dumpsite should be determined through a feasibility study that consider technical, financial and Environmental aspects complying with regulatory requirements (CPCB, KSPCB and NGT). The formulation of the subproject adhered to the State/National and World Bank ESMF/ safeguards policies, both in its planning phase and will continue to do so during the implementation and monitoring stages. This commitment to compliance will be upheld by the ULB during the project period.

**Baseline Environmental Scenario**

A detailed environmental baseline study was conducted for analyzing quality of air, groundwater, surface water, noise levels, and leachate characteristics. The preliminary Environmental Screening [Annexure -1] and the detailed assessment showed that this sub project falls under "E2" category. (Please note that suggestive environmental categorization of dumpsite biomining / bioremediation as per EMF for KSWMP is E1. However, considering the very small extent of the dumpsite, absence of any sensitive environmental feature in or around the site, short biomining period, and the overall positive impacts of the proposed development post mitigation measures; this is categorized as E2. At this stage, locations for disposal of biomined wastes is unknown, the sub project would be recategorized if the locations are near any sensitive areas. In case the biomining is clubbed with other multiple sites also, the overall categorization would be reconsidered)

An analysis has been conducted at the site to review and comprehend the physiography, climate, soil, cultural heritage, ecology, and biodiversity of the dumpsite. This assessment aims to identify potential impacts on the environment, human health, and biodiversity. Additionally, a traffic assessment has been performed to analyze traffic patterns and movements during the project's implementation phase.

**Terrestrial Ecology:**

The nearest Forest/Protected Area, known as Meppadi Forest, is located approximately 6 kilometers away from the site. Various indigenous flora and fauna species commonly inhabit the vicinity of the site, which generally include Some common tree species seen here include rose-wood, anjili *(Artocarpus),* mullumurikku *(Erythrina),* several species of cassia and many other non-descript varieties. variety of large wild animals such as gaur, Indian elephant, deer and Bengal tiger are found there. *Ailanthus sp. (*Tree), *Areca catechu (Tree), Cyathula prostrate (Herb) and Aporosa cardiosperma (Shrub).* The species listed were not classified as Critically Endangered by International Union for Conservation of Nature (IUCN).

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**Air Quality:**

Air monitoring was conducted continuously for a 24-hour duration at all sites, and the obtained results were meticulously analyzed against the National Ambient Air Quality Standards (NAAQS) of 2009. It is noteworthy that all measured pollutants' concentrations were found to be well within the permissible limits. Furthermore, no presence of hazardous or toxic gases was detected during the monitoring process.

**Water Quality:**

The monitoring of water quality was carried out at 3 locations for Ground water & 1 Location for Surface Water.

Groundwater samples were collected from three distinct locations, each within a radius of 200 meters from residences. The analysis of these samples revealed that all parameters examined fall within acceptable limits, with the exception of pH levels.

Surface water assessment indicates that the Kabini River is located approximately 3 kilometers aerial distance from the site. A Surface water sample was obtained from a specific location very near to the dumpsite, which is at an aerial distance of 90 meters from the site. Upon analysis, it was determined that all examined parameters are within acceptable limits, with the exception of Biological Oxygen Demand (BoD).

**Noise Level**

Sample for noise level monitoring were collected within the dumpsite to assess the current ambient noise levels. The results indicate that the noise levels observed are comfortably within the permissible limits. However, it shall be noted that there is no activity currently on site. And noise levels are expected to increase with biomining activity.

**Assessment of Risks/Impacts and Proposed Mitigation measures and Monitoring**

The anticipated impacts of the interventions proposed have been analyzed in detail and mitigation measures proposed. The Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) documents, which assess the potential environmental and social impacts of the proposed subproject, serve to identify potential risks, formulate mitigation measures and ensure compliance with environmental and social standards regulations. This dumpsite remediation project comprises an overview of the current environmental conditions within the project area. Furthermore, the report delineates the environmental baseline data, Disaster Management Plan, identification of sensitive receptors and a Fire Risk Assessment. Another significant concern is the accessibility of the dumpsite, which may not be sufficient for a fire rescue vehicle. In such a scenario, it is imperative to establish comprehensive fire and safety precautions at the site. Key environmental risks include leachate and storm water from the site impacting the nearby areas, odour (including gas), visual blight, flies & pests, storage and disposal of retrieved materials, fire, accidents & other

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disasters, and health and safety of workers. Possible future dumping of wastes after biomining is also a concern. Mitigation and management measures for these in line with mitigation hierarchy are included in the EMP.

Proposed mitigation measures are designed to address environmental and social impacts effectively, with the goal of minimizing negative consequences while maximizing positive outcomes. Additionally, this report encompasses an Environmental Management Plan (EMP) and scope of Social Management Plan (SMP), providing detailed strategies for the management of the project's environmental and social facets.
In addition, a detailed Environment Monitoring Plan and Social Monitoring Plan will outline the monitoring procedures to assess the efficiency of mitigation measures and guarantee adherence to environmental and social standards. To ensure seamless and timely execution, the dumpsite remediation subproject report also includes an Environmental and Social Budget. This ensures a sustainable and responsible bio-mining process that prioritizes the protection of the environment and the well-being of nearby communities throughout the waste remediation process.

**Implementation Mechanism & Budget**

The Bio-mining project, with the objective of achieving 100% land recovery, will be carried out exclusively through an outsourcing model. If the land is found to be contaminated with hazardous wastes, the subproject shall be excluded. For solid waste/leachate contamination on site proper remedial measures will be followed before utilizing for future facilities. Retrieved materials and recyclables may be handed over to the authorized recyclers and the usage of these retrieved fractions is unknown today as it would be as per the Contractors proposal/plan. However, such reuse/recycling/disposal would be in line with National/State regulations which are stringent. . The land will be restored to its pre-waste dumping condition, necessitating the complete removal of all legacy waste until it reaches the original land surface. Following the completion of the bio-mining process, the machinery and vehicles belonging to the implementing agency must be vacated within 7 days. No waste material shall remain on site after contract period. The reclaimed land, free of any encumbrances, will then be transferred to the Urban Local Body (ULB).

The total budget proposed for Environmental Management & monitoring budget is [redacted] /- and including social budget of [redacted] /-.

**Consultation &Disclosure**

A transect walk was also carried out to assess the socio-environmental characteristics in the vicinity of the dumpsite. To understand the social dynamics, demographic profile, livelihood patterns, social dynamics of the community and to understand the needs, concerns, and aspirations of the community, a transect walk was carried out on 01.06.2023, which was

[redacted]

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crucial for developing effective dumpsite remediation strategies that align with their priorities. The findings and recommendation of the transect walk is shown in the following table.

| S.No | Social risks | Findings and Recommendations |
|---|---|---|
| 1 | Labours working in the MCF | The MCF facility is located in 35m way from the dumpsite. The bio mining process may affect the smooth functioning of MCF. |
| 2 | Lanour influx | The bio mining process requires 30-40 labours in a day. The contractor has to arrange the facilities for the labours include accommodation, food, compliances of labours laws etc |
| 3 | Gender Based Violences (Prevention) Action Plan | Different gender groups will be engaged in the bio-mining process. It is the responsibility of the contractor to take necessary pre cautions to prevent atrocities. Also ensure the compliances of relevant Acts |

***Note: All the references to Social Impact Assessment and Social Management Plan may be referred to Part B- Social Impact Assessment which is a separate document attached along with this document.***

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# 1. INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-Financing Framework agreement and as agreed Project Co-lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake biomining of multiple Legacy Waste Dumpsites in various districts. As per the Feasibility Study and methodology statement for implementing the subproject, proposed dumpsites for biomining are grouped into a single cluster of 12 dumpsites. It is expected that one single contractor bids for one Cluster. However, bidding modality is yet to be finalized- whether as a single site, or as a clusters.

## 1.2 The rationale for the Proposed Sub-Project

Adlaid dumpsite in Kalpetta ULB at ward no.23 has a total waste quantity of 7640 Tons, spreading over 1.12 acres. The site is located between Lat- 11°35'25.8"N and Long - 76°03'19.2"E and has an elevation of MSL +790 (m), with a gentle slope towards the south-eastern part. During monsoon season, due to geography of the site waste water flows downhill towards residential areas located at southern side of the site. Kalpetta ULB proposes biomining and bioremediation of the Adlaid legacy waste dumpsite under KSWMP supported by the World Bank and Feasibility Report has been prepared for this subproject. Considering the environmental and social impacts associated with legacy dumpsite biomining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

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### 1.3 Objectives and scope of Environmental & Social Impact Assessment

***Environmental Categorisation and Assessment:***

As per indicative categorization for dumpsite biomining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (3.65 acres) and waste spread (1.12acres) and absence of environmentally sensitive features around, this subproject is individually considered as E2, and EIA is prepared accordingly. Required monitoring and analysis are carried out considering the possible impacts.

***Social Impact Assessment***

The site is situated in an isolated area. No households, public facilities/ utilities etc are not found. Since the site is located in an isolated area, it comes under moderate risk category. Under this category social impact assessment is also a key factor to be considered. Accordingly, detailed assessment of the environmental and social impacts was carried out.

### 1.4 Proposed sub project details

*Table 1 Proposed sub project details*

| Description | Details |
|---|---|
| Name of ULB | Kalpetta |
| District | Wayanad |
| Taluk | Vythiri |
| Total present population in the ULB | 41,797 |
| Name of the sub-project | Dumpsite Remediation at Adlaid |
| Location of the sub-project | Adlaid at ward no 23 |
| Total dumpsite area (in acres) | 3.65 |
| Total waste accumulated area (in acres) | 1.12 |
| GPS Co-ordinate of the Site | Latitude: 11°35'26.2"N,<br>Longitude 76°03'21.1"E |
| Legacy waste quantity | 7,640 tons |


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*Figure 1 Legacy Waste Dumpsite at Adlayed*




The technology proposed is Bio mining and bioremediation in line with CPCB's Legacy Waste Biomining Guidelines, 2019. The various phases in the biomining process (as per Legacy Waste biomining Guidelines of CPCB) are shown below.

Table 2 Phases of Biomining

| Phases of Bio-mining | |
|---|---|
| **Phase 1: Stabilization** | The legacy waste is formed into equal-sized windrows and which are turned frequently, bio-culture is added and de-odourizer (an odour-controlling agent) sprayed. This phase removes stench, reduces moisture and eliminates pathogens. |
| **Phase 2: Sorting & Segregation** | In this phase, stabilized legacy waste is sorted/segregated into bio earth, recyclables, refused derived fuel (RDF) and C&D through series of various sizes of Trommels /circular rotatory sieves and manpower. |


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| | |
|---|---|
| **Phase 3: Disposal & Utilization** | In this phase, the non-combustible fractions such as soil and stones are disposed of for further processing into finer aggregates or for earth filling. The combustible fractions are called refuse-derived fuel (RDF) are sent for co-processing in cement industries. |

### 1.5 Site management plan

The plan aims to minimize potential adverse impacts on sensitive receptors while maximizing the recovery of valuable resources and promoting site restoration.

Mobile machineries will be used for biomining of the small Kalpetta dumpsite and they do not require a separate area for erection. The waste will be excavated and directly fed into mobile screeners for processing. This approach minimizes the need for additional infrastructure and optimises the efficiency for the biomining process. The proposed plan is as follows


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*Figure 2 Site Management Plan (Drawing attached as Annexure - E)*

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## 1.6 Structure of the report

*Table 3 Structure of the report*

| Chapter | Structure |
|---|---|
| 1 | Introduction |
| 2 | Policy and Regulatory Framework |
| 3 | Environment and Social baseline |
| 4 | Analysis of Alternatives |
| 5 | Assessment of Environmental and Social Risks and Impacts |
| 6 | Environmental and Social Management and Monitoring Plan |
| 7 | Institutional Arrangements |
| 8 | Public consultation and Information Disclosure |


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## 2. POLICY AND REGULATORY FRAMEWORK

### 2.1 National, State Legislations and Technical Guidelines related to environmental and social aspects of dumpsite remediation

*Table 4 Applicable rules and regulations for Kalpetta dumpsite Biomining and Bioremediation*

| S. No | Rules and Regulations | Relevance |
|---|---|---|
| 1 | The Motor Vehicle Act. 1988 | All vehicles used for installation and operation will need to comply with the provisions of this act and should have valid Pollution Under Control Certificate. |
| 2 | Authorization from PCB for storing Hazardous material like diesel for DG sets as per Hazardous and Other Wastes (Management & Trans boundary Movement) Rules, 2016 | Hazardous waste (used oil from DG Sets) is likely to be generated during the erection and operation stage. Hence, authorization under the purview of the rule shall be requiring. |
| 3 | Labour Act. | Occupational safety and health administration. |
| 4 | Solid Waste Management Rules, 2016 (MSW Rules) | To operate the mobile Bio mining plant, it is necessary to follow the existing MSW rules. |
| 5 | The Water (Prevention and Control of Pollution) Act, 1974 | Consent to Establish and Consent to Operate to be obtained during the construction phase and operation of waste recycling/disposal facilities |
| 6 | The Air (Prevention and Control of Pollution) Act. 1981 | Consent to Establish and Consent to Operate to be obtained during the construction phase and operation of waste recycling/disposal facilities |
| 7 | safety of the workers as per the ILO Convention No. 62 | Safety aspects |
| 8 | NOC from fire department | Safety aspects. |
| 9 | Tree felling permission:<br>If felling of trees as defined in Kerala Preservation of Trees Act, 1986 | If any tree needs to be cut or replanted concerned permission is required from Forest |


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| S. No | Rules and Regulations | Relevance |
|---|---|---|
| | | Dept. Government of Kerala. The ULB will take the necessary permission. |
| 10 | NGT guidelines upto date | Relevant to the subproject to be considered for the successful implementation of the project. |
| 11 | Building and Other Construction Workers (Welfare Cess Act) 1996, | Discusses Health and Safety and environmental aspects associated with construction and allied works |
| **Other Applicable Rules** | | |
| 12 | Solid Waste Management Rules, 2016 (SWM Rules) | |
| 13 | Biomedical Waste Management Rules, 2016 (BMWM Rules, 2016) | |
| 14 | Plastic waste Management Rules, 2016 | |
| 15 | Construction & Demolition, Waste Management Rules, 2016 | |
| 16 | Batteries (Management and Handling) Rules, 2001 | |
| 17 | E-Waste (Management) Rules, 2016 | |
| 18 | SBM-Urban Advisory on Landfill Reclamation, CPHEEO, June 2020. | |
| 19 | Kerala Municipality Act, 1994 & Rules | |
| 20 | Hazardous & Other Wastes (Management And Trans boundary Movement) Rules, 2016 | |
| 21 | The Operational Policies (Safeguards) of the World Bank and the Environmental and Social Management Framework and the World Bank EHS Guidelines | |


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## 2.2 The World Bank Safeguards Policies

*Table 5 World Bank Safeguard Policies*

| S.No. | WB Policy | Safeguard policy applicable | Description |
|---|---|---|---|
| 1 | Environmental Assessment (OP/BP 4.01) | Yes | The project has potential impacts and pose risks to various environmental factors during the implementation phase. Consequently, this policy is triggered, necessitating assessment and management of E&S risks and impacts, and ensuring a structured approach to safeguard management for risk mitigation including (health & safety risks, risks and impacts due to linked activities) in alignment with regulatory requirements, and Environmental and Social Management Framework (ESMF). |
| 2. | Natural Habitats (OP/BP 4.04) | Yes | Though the project will not support any activities that involve conversion or degradation of natural habitats. However, impacts on any flora/fauna on site during the proposed activity is important. |
| 3 | Pest Management (OP 4.09) | Yes | Considering the possible pest related issues as the project deals with wastes and improvements to dump sites, OP 4.09 Pest Management is triggered. As per this policy the banned pesticides/insecticides listed by the Nation / State and the World Health Organization (WHO) other national/state bodies should not be used in the project, and as much as possible Integrated Pest Management Options shall be followed |
| 4 | Physical Cultural Resources [PCR] (OP 4.11) | Yes | The proposed project will not support any activities that could potentially harm nearby cultural heritage, archaeological sites and physical resources valuable to the community |


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## 3. BASELINE ENVIRONMENTAL SCENARIO

### 3.1 Project location of the site

Adlaid dumpsite in Kalpetta ULB at ward No.23 is non-operational and dumping of waste stopped due to public protests during the year 2010. In accordance with the implementation of the Biomining Project, the disposal of street sweeping waste was subsequently discontinued. The location detailed are described in the previous section of 1.1 and 1.4.

*Table 6 Sensitive receptor around the Dumpsite*

| S.No | Sensitive Receptors | Distance |
|---|---|---|
| 1 | Residential buildings | No households are located within 200 m radius of the dumpsite |
| 2 | Educational institutions such as Govt. Sanskrit HSS | 500 m |
| 3 | Kabini river | 3.00 Km |
| 4 | Nearest Pond | 1.34 Km |

### 3.2 Methodology for Environmental Baseline studies

Baseline Study in EIA process usually includes data collection and analysis of various aspects in the project area, such as: Physical Environment (e.g., topography, geology, soil, water, air quality, and climate) and Biological Environment (e.g., flora and fauna, Land/Soil, habitat, biodiversity, and ecological processes). The overall methodology of EIA

1) Scoping, Environmental Screening, Exclusion and Categorization
2) Environmental Baseline study like analysis of Air, Water, Soil and Noise/Vibration and impacts on biodiversity, workers and people around
3) Environmental Impact Assessment
4) Avoidance of adverse impacts, minimization, mitigation and management measures
5) Environmental Management Plan (EMP)
6) Environmental Monitoring Plan (EMoP)
7) Budget for implementation of EMP and EMoP

The below table indicates the environmental attributes and frequency of monitoring


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*Table 7 Environmental Attributes*

| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| 1 | Meteorology | Temperature humidity and rainfall | - | Study area | Data collected from IMD |
| 2 | Ambient air quality | $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$, VOCs | A1 - N- 11° 35'24.276", E -76° 03'19.277" A2 - N- 11° 35'25.777", E -76° 03'19.007" | 2 | 24 hourly samples |
| 3 | Noise levels | Noise levels in dB(A) Leq | N1 - N- 11° 35'25.308", E -75 °03'20.171 | 1 | Once |
| 4 | Surface water quality | Physical, chemical and biological parameters including pH, temperature, turbidity, magnesium hardness, total alkalinity, chlorides, sulphates, fluoride, Copper, DO, BOD, COD, salinity, Zinc, Lead, Arsenic. | S1- N- 11 °35'25.876", E -76 °03'16.589" | 1 | Once |
| 5 | Groundwater quality | Physical, chemical and bacteriological parameters including pH, | G1- N- 11 °35'28.428", E -75° 03'18.347 G2- | 3 | Once |


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| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| | | temperature, turbidity, magnesium hardness, total alkalinity, chlorides, sulphates, fluoride, Copper, DO, BOD, COD, salinity, Zinc, Lead, Arsenic. | N- 11°35'33.228", E-76°03'29.7"<br><br>G-3<br>N- 11°35'38.31", E-76°03'32.099" | | |
| 6 | Biological environment | Existing flora and fauna | - | Study Area | Through field visits and substantiated through secondary data sources. |
| 7 | Soil characteristics | Physical, chemical and biological parameters including pH, Total Hardness, Nitrites, Phosphates, Organic matter, Fluorides, Total Iron, Nickel, Copper and Lead, TOC, Permeability. | - | - | Once |
| 8 | Land use/land cover | Land use for different land use Classifications. | - | Study Area | Land use / Land Cover Analysis using satellite imaging and GIS Technique |
| 9 | Leachate | pH, BoD, CoD, TSS, TDS, Fluoride, | L<br>N-11°35'23.91"<br>E-76°03'19.098" | 3 | Once |


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| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| | | Cyanide, Nickel, Cadmium, Lead, Copper, Mercury, Zinc | | | |

### 3.3 Existing Facilities on site and its Environmental Audit

There is no proper compound wall all around the dumpsite, and there is an MCF facility present adjacent to the site. However, we can ensure that the biomining process will not hinder the functioning of the existing MCF.

*Table 8 Existing Facilities on Site*

| S. No | Aspects | Remarks |
|---|---|---|
| 1 | Structural Characteristics | MCF/RRF/Windrow Compost facility situated near by the Dumpsite.<br>Buffer/setback around the MCF – 2 ft<br>Distance from waste pile of dumpsite- 40 m.<br>Roof: (GI Sheet Roof, Good condition)<br>Floor (Cement Floor, Good Condition)<br>Walls: (Concrete, Good Condition)<br>Doors & windows: Steel gate and Windows with mesh.<br>dust emission and odor can impact the MCF/RRF facility. |
| 2 | Functional Characteristics | Activities in the MCF: Waste Segregation, Windrow composting<br>Materials and condition of stacking: Segregated and Stacked in RRF area<br>Activities spilling out onto the dumpsite: NIL<br>Access to the MCF (Common access for MCF & Dumpsite. Both are in the same premises. But proposed separate entry for dumpsite while biomining)<br>No. of workers :12 to 14 HKS workers |
| 3 | Facilities | Parking area-Available<br>Loading/unloading area-NIL<br>Storage room & area: Available in the Same facility around 304 sq.m<br>Worker snack/rest areas: Available<br>Worker / other washrooms & sewerage: Available<br>Water supply for Cleaning, Washroom: Available within the premise<br>Greenbelt: Available. |


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**NOTE:** As the site access road measures below 3 meters in numerous areas, making it unpassable for many heavy vehicles, including firefighting vehicles, a suggested solution to address potential future fire issues involves constructing a 25,000-liter water tank with firefighting capabilities.

### 3.4 Analysis of Environmental Baseline

*Table 9 Environmental Baseline*

<table>
<tr><th>S No</th><th>Environmental Aspect</th><th>Discussion on Baseline Scenario</th><th>Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject</th></tr>
<tr><td>1</td><td>Topography</td><td>The elevation of the Kalpetta site is MSL +790 m, gentle slope towards the western section from the site. The land area in dumpsite is high land. Soil is predominantly Hard Laterite in nature. Kalpetta site falls within the tropical to sub- tropical climatic region.</td><td>During the rainy season, there is a chance that leachate from the dumpsite could drain towards the North, following the natural slope of the hilly terrain and potentially reaching a swampy area.</td></tr>
<tr><td>2</td><td>Climate</td><td>Kalpetta, the maximum temperature in the region varies almost between 24.4°C to 30.4°C and minimum temperature ranges from 16.7°C to 20.8°C.</td><td>Rains are heavy, and the site is at an elevated draining out of stored waste and leachate during dumpsite biomining & bioremediation works.<br><br>The biomining project has been scheduled during the off-season for rainfall in anticipation of reduced precipitation.</td></tr>
<tr><td>3</td><td>Hydrology/Hydrogeology& Soil</td><td><table><tr><th>Pre-monsoon (m) *</th><th>Post-monsoon (m) *</th><th>Avg. Fluctuation (m)</th></tr><tr><td>7.68</td><td>6.31</td><td>1.37</td></tr></table>*Groundwater level</td><td>Lateritic soil is porous and may lead to contamination of nearby wells. Hence, any waste below ground need to be remediated; and adequate measures are necessary to collect and</td></tr>
</table>


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<table>
<tr><th>S No</th><th>Environmental Aspect</th><th>Discusssion on Baseline Scenario</th><th>Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject</th></tr>
<tr><td></td><td></td><td>Kabini river is at a distance of 3.00 Km from the site.<br>Soil is predominantly laterite in nature<br>The land was historically used as a trenching ground.</td><td>manage leachate during all times</td></tr>
<tr><td>4</td><td>Forests and Ecology</td><td>Site is not located in forest area. Some of the common flora and fauna found near the site.
<table>
<tr><th>Sno</th><th>Scientific name</th><th>Common Name</th><th>Type</th></tr>
<tr><td>1</td><td>Artocarpus</td><td>Anjili</td><td>Flora [Tree]</td></tr>
<tr><td>2</td><td>Syzygium</td><td>nadiamarikkin</td><td>Flora [Tree]</td></tr>
<tr><td>3</td><td>Pycnonotus cafer</td><td>Red vented Bulbul</td><td>Fauna [Bird]</td></tr>
<tr><td>4</td><td>Acridotheres tristis</td><td>Common Myna</td><td>Fauna [Bird]</td></tr>
<tr><td>5</td><td>Aquila nipalensis</td><td>Black Eagle</td><td>Fauna [Bird]</td></tr>
<tr><td>Sl. No</td><td>Species</td><td>Family</td><td>Type</td></tr>
<tr><td>1</td><td>Alstonia sp.</td><td>Sinaroubaceae</td><td></td></tr>
<tr><td>2</td><td>Anona curicha</td><td>Annonaceae</td><td>Flora [Tree]</td></tr>
<tr><td>3</td><td>Artocarpus heterophyllus</td><td>Moraceae</td><td>Flora [Tree]</td></tr>
<tr><td>4</td><td>Cynthus prostrate</td><td>Amaranthaceae</td><td>Flora [Herb]</td></tr>
<tr><td>5</td><td>Alpinia calcaparata</td><td>Euphorbiaceae</td><td>Flora [Shrub]</td></tr>
</table></td><td>The species listed were not classified as Critically Endangered by the IUCN. (INTERNATIONAL UNION FOR CONSERVATION OF NATURE)</td></tr>
<tr><td>5</td><td>Socio Economic Aspects</td><td>Transect walk and Key Informant's Interview conducted near the Kalpetta dumpsite area.</td><td></td></tr>
<tr><td>6</td><td>Land use, Development Pattern and Key Projects</td><td>The predominant land use in the area is residential. Nearly 3.65 acres is used for dumping the waste and adjacent area there is an existing MCF and RRF</td><td>Measures have to be taken not to affect the functioning of existing MCF & RRF</td></tr>
<tr><td>7</td><td colspan="2">Infrastructure and Services</td><td></td></tr>
</table>


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| S No | Environmental Aspect | Discusssion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| 7.1 | Traffic and Transportation | A detailed incremental load by vehicles during the operation phase is assessed and given under the traffic assessment reported. Through assessment it is identified additional 3 trucks/day will be the traffic load due to the activity. | The implementing agency shall ensure staggering of the traffic movements from site considering peak hours/school timings. Also, night time vehicular movements can be implemented. More accurate information shall be available once Contractor is being on boarded. EIA to be updated by the contractor based on his work plan. |
| 7.2 | Water Supply<br>a) Surface water<br>b) Ground Water | A) Surface water collected from 1 site and results found – all parameters are well within limits except BoD, slightly exceeding.<br>B)Ground Water collected from 3 different location and results found – all parameters are well within limits except for pH. | Site Drainage & leachate Impacts due to biomining activity (esp during any seasonal rain) is important as far as the nearby soil & water environment are concerned. |
| 7.3 | Drainage, Sewerage and Sanitation | Region has an unplanned network of drains eventually leading to Kabani- River. The nearest swamp area is 90 m distance from the site. Site drains into this swamp which may not be accessible.<br>Kalpetta is mainly served with septic tanks for individual premises.<br>Leachate samples collected at site, showed BOD value exceeding the limit and all other parameters were within limit | |
| 7.4 | Air Quality | Air Samples collected from 2 locations within the dumpsite and results found to be well within the permissible Limits. | |


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| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| 7.5 | Noise Level | Noise Level monitoring samples collected within the dumpsite in order to identify the present noise level and results found well within permissible limit | Proper remedial measures for increased noise level shall be ensured by the contractor while bio mining activity. |

### 3.5 Description of Environmental Parameters

Under this baseline environmental attributes are arrived at after analysis of samples taken from the dumpsite and surroundings viz ground water, surface water, Noise level and air. The map showing sampling locations and the analysis with observations are given below:


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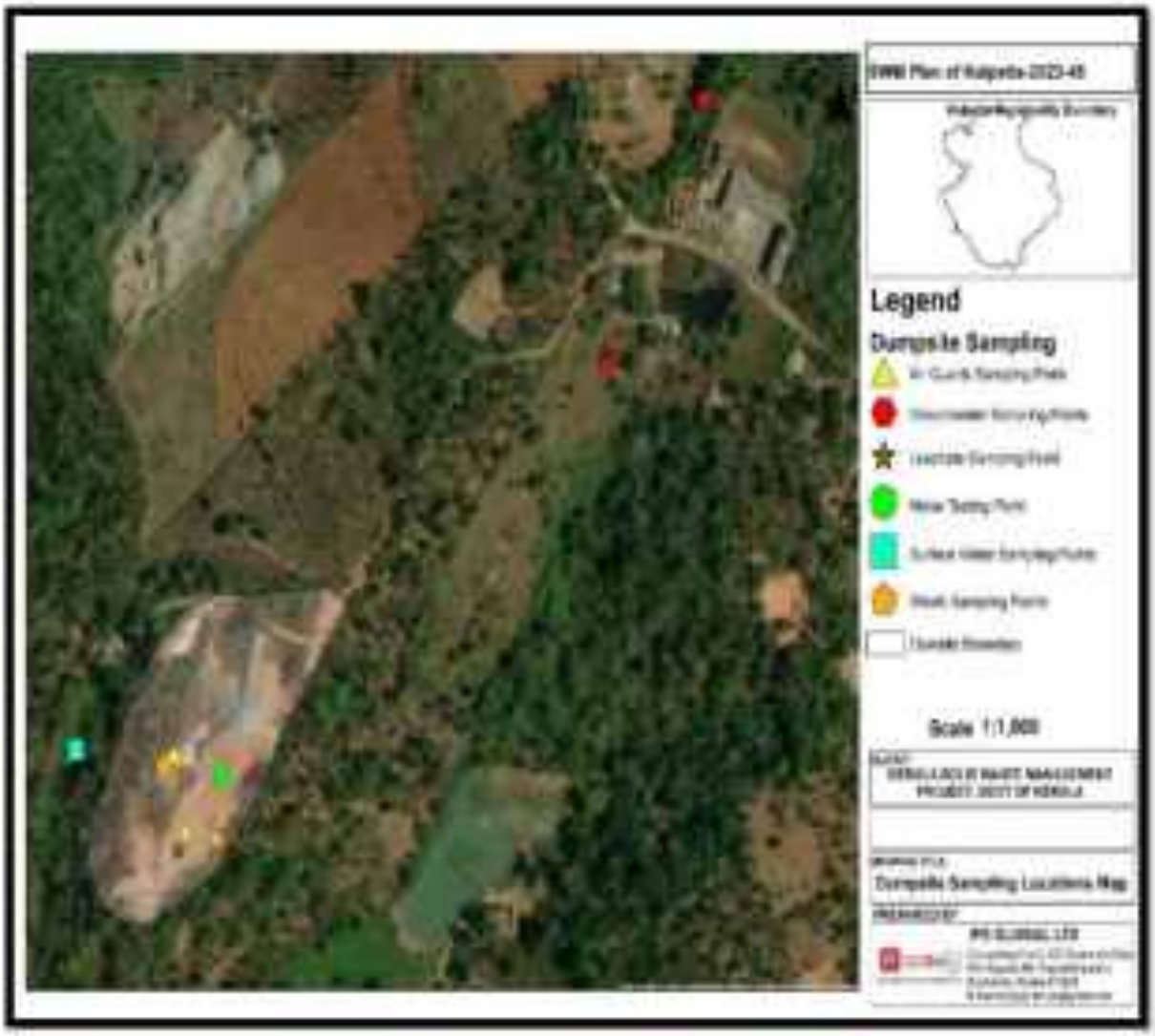



*Figure 3 Sampling Location Near Dumpsite*

*Table 10 Distance & Direction of Sampling locations*

| S.No. | Description | Direction | From Boundary of the dumpsite (m) |
|---|---|---|---|
| 1 | Surface Water | North | 55 |
| 2 | Ground water-1 | East | 300 |
| 3 | Ground water-2 | North | 40 |
| 4 | Ground water-3 | East | 460 |


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### 3.6 Identification of sampling location:

*Table 11 Identification of sampling location*

| S.No | Description | Place identified | Justification |
|---|---|---|---|
| 1 | Air sampling (2 Locations) | Inside the dumpsite | As per the wind rose diagram, the direction and speed of the wind are determined and based on the existing windrose data the air sampling location fixed at two locations |
| 2 | Noise (1 Location) | Inside the dumpsite | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. The adjacent MCF is operational. To mitigate any potential disruption to the workforce in close proximity to the MCF/RRF facility, a dedicated access point has been established for entry to the biomining worksite. |
| 3 | Surface water (1 Location) | Surface water near to the dumpsite [stream] | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope. This steep slope on North direction possesses a potential risk of leachate runoff, which could result in the contamination of surface water on that particular side of the site. So, the location of surface water is taken on the North direction. |
| 4 | Ground water (3 Locations) | 3 wells identified near the dumpsite area | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope (North). The infiltration of leachate which could result in the contamination of ground water.<br><br>Based on the possible infiltration and slope direction the ground water samples are collected in the North and East direction outside of the dumpsite. |


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### 3.7 Sampling Methodology

*Table 12 Sampling Methodology*

| S.No | Description | Method |
|---|---|---|
| 1 | Air sampling | Calibrated High Volume Sampler, Calibrated rotameter & calibrated Dry gas maters and sampling locations selected based on wind rose and impacts on surrounding land uses. |
| 2 | Noise | Calibrated sound level meter and sampling locations selected based on highest noise level on site and impacts on surroundings |
| 3 | Ground water | Water collected in polyethylene and sampling locations selected based on leachate and run off flow and impacts on surroundings |
| 4 | Surface water | Water collected in polyethylene bottles and sampling locations selected based on leachate and run off flow and impacts on surrounding surface water bodies and drains (line sources of pollution) used be communities |
| NOTE: Sampling Photographs added as Annexure-C in the FR Report. | | |

### 3.8 Site Connectivity

The access road leading to the dumpsite, known as Puzhamudy-Adlaid road, measures 5 meters in width. The link from the Puzhamudy-Adlaid Road to the dumpsite is crucial, but it presents a significant challenge as it is quite narrow, with widths dropping below 3 meters in certain sections. This limited width poses a concern for fire rescue vehicles, and it also makes it impractical for larger vehicles such as the Mobile trommel and other heavy vehicles to reach the dumpsite via this narrow road.

NH 766 is only about 1.5 kilometers away. It provides access to other major cities in Kerala, such as Kannur and Kozhikode. This highway provides access to other parts of Wayanad city. To mitigate any potential disruption to the workforce in close proximity to the MCF/RRF facility, a dedicated access point has been established for entry to the biomining worksite.

### 3.9 Traffic Assessment

Traffic assessment refers to the process of evaluating and analyzing the flow of vehicles, pedestrians, and other modes of transportation on roadways, intersections, or specific areas. This assessment helps in understanding current traffic conditions, identifying potential issues, and developing appropriate strategies to improve traffic flow, safety, and efficiency.


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**Traffic load:**

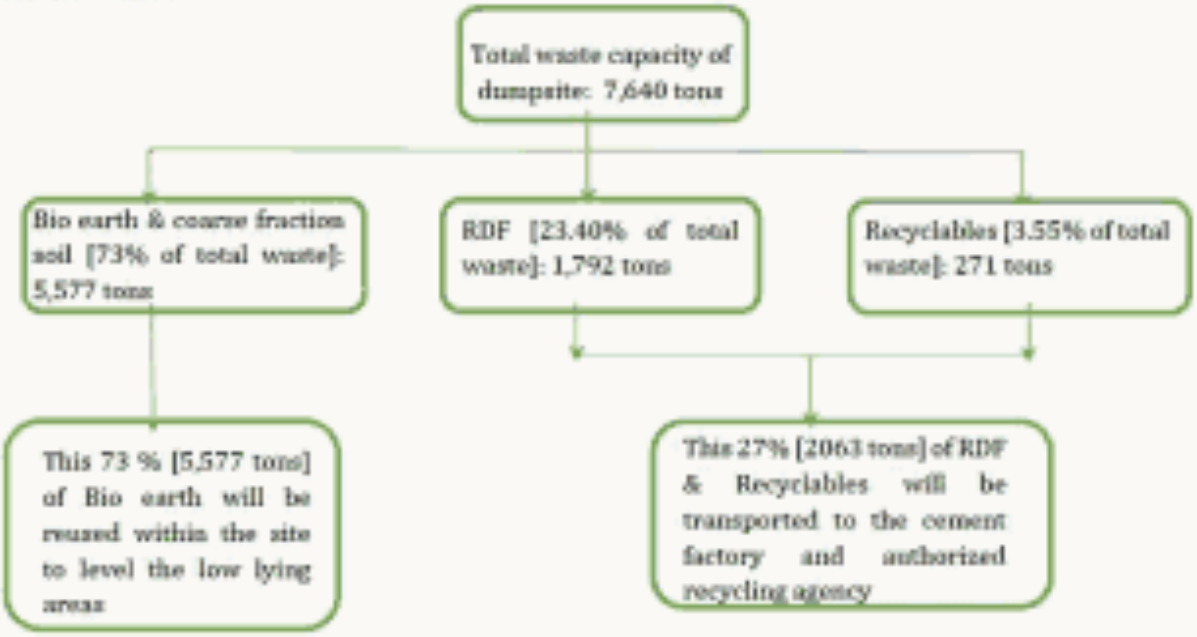



*Figure 4 Traffic Incremental load due to Project*

The dumpsite access road is 5m width and connecting with Puzhamudy - Adlaid road. Considering 90 days of operation phase the trips are planned and the inward & outward of the vehicle to be made during off peak hours.

To promote safety and avoid traffic congestion, it is recommended to impose restrictions on the movement of vehicles used for the Biomining process. These restrictions should be applied one hour before the start of school timings and one hour after school closing time.

*Table 13 Required* Truck capacity & trips for transporting By-Products

| S.No | Materials | % of Materials | Weight of each materials(t) | Vehicle Type | Max Capacity of load carrying Truck (t) | No. of Trips |
|---|---|---|---|---|---|---|
| 1 | RDF | 23.5 | 1792 | 12 Wheeler Dumper | 18 | 100 |
| 2 | Glass | 1.6 | 122 | 12 Wheeler Dumper | 25 | 5 |
| 3 | Metals | 1.95 | 149 | Goods Truck | 2 | 75 |


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| Total Weight | 2063 | Total No. of Trips | 180 |
|---|---|---|---|

*Table 14 Total Trips planned per day*

| S.No. | Materials | Total Trip | Total Days for Disposal | Trip/Day | Remarks |
|---|---|---|---|---|---|
| 1 | RDF | 100 | 90 | 1 | One Trip per day |
| 2 | GLASS | 5 | 90 | 0.1 | Ten days once one trip |
| 3 | Metals | 75 | 90 | 1 | One Trip Per day |


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## 4. ANALYSIS OF ALTERNATIVES

### 4.1 Alternative 1: No project (without project scenario)

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevent further contamination of the site.

If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows.

1. Foul Odor Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.

2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.

3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.

4. Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the surrounding environment, disrupting natural habitats and causing long-term ecological imbalances.

5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

### 4.2 Alternative 2: Mode of execution / Management Alternative

Regarding the execution strategy, the outcomes of a Transect walk have substantiated the impracticality of waste transfer between ULBs. As a result, the imperative is for the waste remediation procedure to take place on the premises, allowing only the byproducts to be considered for potential transfer.

The logistical aspects of arranging machinery and designating storage space for these byproducts will hinge upon the extent of land available. At the outset, the existing underutilized, partially constructed Material Collection Facility (MCF) will be employed to cater to the initial storage requirements.

### 4.3 Technology Alternative

The selection of the appropriate method or technique for remediation is determined by considering several parameters. These include the significant aspects and suitability of remediation types such as

[redacted]

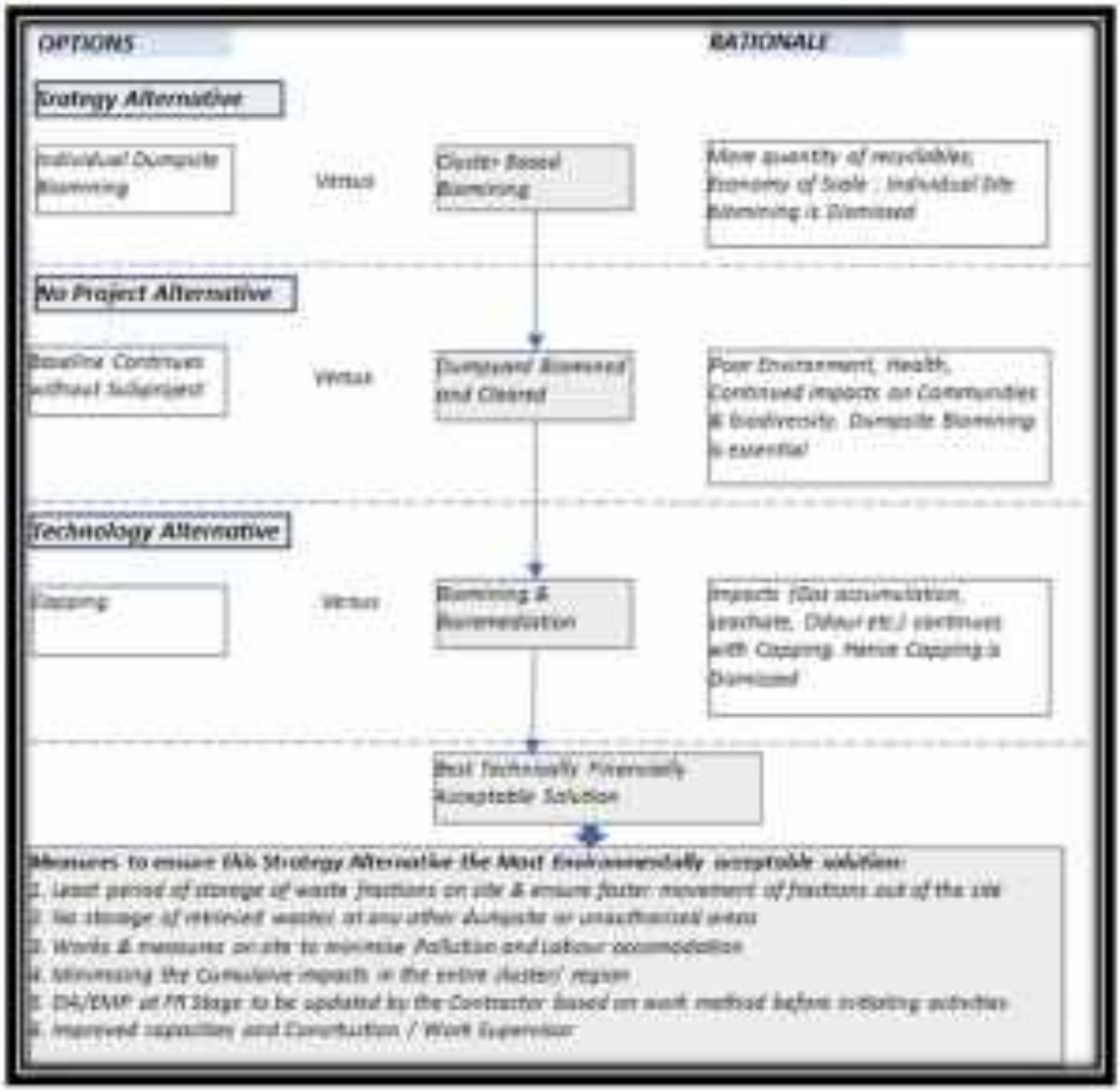
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1. Capping without land recovery,
2. Bio-mining – reclamation/recovery of 100% land
3. Capping with partial land recovery.

Additionally, factors like available resources such as manpower, machinery, finances, and physical site conditions, including the quantity and characteristics of legacy waste, Environmental baseline, social concerns, regulatory compliance (KSPCB/NGT), the need for complete land recovery, and opportunities for utilization of processed aggregates/by-products are taken into account.

After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

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## 5. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISK IMPACTS

Biomining and bioremediation of existing legacy dumpsites brings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more man-days at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, biomining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration) are important in this case. In addition, cumulative impacts of simultaneous biomining of multiple such legacy waste sites on the environment is important. Especially with respect to

(i) Drainage and leachate flow into regional water bodies (& esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies,

(ii) Pollution on land/soil, dust and odour nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks,

(iii) Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and

(iv) Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at this stage, while some would be known only based on the project details that would be known from the work plan of the contactor once on board.

### 5.1 Impacts on Assessment Methodology

Impacts are assessed based on Magnitude, Duration, and Significance of the impacts and sensitivity of the receptors present within the 500 m aerial distance of Kalpetta dumpsite.

#### 5.1.1 Magnitude and Duration of Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Biomining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;
- The spatial extent of the potential impact;

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- Reversibility of the Impact;
- Legal standards and established criteria.
- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table 15 - Aspects for Determining the Magnitude of Impacts. Magnitude is assessed as medium, considering shorter duration of the activity However, magnitude of cumulative impacts of various dumpsite remediations might be High.

*Table 15 Aspects for Determining the Magnitude of Impacts*

| Aspects | Large | Medium | Small | Negligible |
|---|---|---|---|---|
| **Duration of the potential impact** | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or Less than the lifespan of the program | Temporary with no detectable potential impact |
| **Spatial extent of the potential impact** | Regional – much beyond project boundaries | Beyond immediate Program components, site boundaries or local area | Within program boundary (but cumulative impact of various dumpsite biomining activities will be on larger extent) | A specific location within program component or site boundaries with no detectable potential impact |
| **Reversibility of potential impacts** | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months | Baseline remains constant |
| **Legal standards and** | Against national/approved | Complies with limits | Meets minimum | Not applicable |


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| Aspects | Large | Medium | Small | Negligible |
|---|---|---|---|---|
| **established professional criteria** | standards and or international guidelines/obligations | given in national standards but not confirming to international lender guidelines in one or more parameters | national standard limits or international guidelines | |
| **Likelihood of potential impacts occurring** | Commonly occurs under typical operating or construction conditions (Certain) | Usually seen occurring under most situations (Likely) | Occurs under abnormal, exceptional or emergency conditions (Occasional) | Unlikely to occur |

**NOTE: Anticipated Project Duration - 5 to 6 months**

### 5.1.2 Sensitivity of Receptor

The dumpsite is surrounded by majority plantation and other establishments such as Fecal Sludge Treatment plant, Batching Plant, during the time of site assessment the experts observed, some sensitive receptors within 500m from the site. Namely some schools, religious places and households. The sensitivity of these receptors is High due to the transport of wastes and byproducts from the project.

### 5.1.3 Significance of the impact

- Significance if the impact is high as it would even result in community resistance to biomining and bioremediation.

Since the project operational time 5 to 6 months, then the magnitude of the negative impact can be considered as small and medium sensitivity. In other hand magnitude of the positive impact, after the biomining of the existing land can be used for the recreational park for the public use.


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### 5.2. Cumulative Impacts in The Region / Cluster

The impacts that may arise due to clustering of different dumpsites. The following impacts could result from the clustering while implementation, requiring thorough assessment.

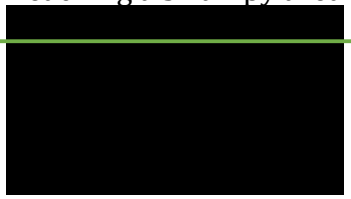
1. If a sensitive environmental component (River, mangrove, wetland, etc.) is served by the leachate/drainage from one or more nearby dumpsites, the impacts can be regional.
2. Presence of other projects outside KSWMP; existing or forthcoming landfills, transfer stations or those considered under Track one investments may together create a cumulative impact with this activity.
4. Impact of vehicular movement from various subprojects on biomining of dumpsites may have cumulative impacts on air, odour, traffic issues, and pollution incase of spills/accidents/emergencies due to this clustering approach.
5. Storage of materials if any at common sites, impacts during rains, floods/emergencies in multiple sites of same water/air shed.

However, such impacts will be known only based on final work plan, location and schedule for disposal of Legacy Waste once Contractor is on board. The need to update EIA/EMP based on this will be included in the Bid & Contract Documents.

**Source-Pathway-Receptor Analysis**

**A) Source**: The source of contamination is the legacy waste remaining and being deposited at the Kalpetta closed dumpsite, more specifically the landfill gas and leachate generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. In this case the waste is 50 years old, as dumping had started in year 1970and ceased 2010 due to public protest. Initially the dumpsite was acting as a trenching ground, depositing sewage (night soil) from pit latrines. The total waste volume is 9485.375 cu.m with the dumpsite spread over 1.12 acres and rises to a height of approximately 5m from the base. In addition to the landfill gas and leachate, material spill over from the existing MCF/RRF in the compound and windblown dust and litter are also considered as sources of contamination.

**B) Pathways**: The following pathways for migration of contaminants have been identified: Wind- The main pathway for litter and dust dispersion is the wind. As long as the waste is kept uncovered, the dust and litter will continue to be blown off the dumpsite to the surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. Rainwater runoff through the dumpsite acts as a pathway for transport of leachate to the soil and groundwater. The rainwater flowing off the dumpsite along the slope towards North direction acts as a pathway for the uncovered waste to flow into the natural slope to North side, there is a chance that leachate from the dumpsite could drain towards the North, following the natural slope of the hilly terrain and potentially reaching a swampy area.



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Lateritic Soil acts as a pathway for transport of leachate to the groundwater and for uptake of contaminated surface run-off.

The leachate flows with groundwater and acts as the pathway. Surface water Contaminants like run-off from the dumpsite, leachate and windblown dust and litter that reach nearby surface water bodies like canals, rivers and streams are further transported by surface waters and in this case the surface water acts as the pathway.

**Receptors:**

Receptors are air, surface water and ground water. For drinking purpose, they mainly use municipal water supply. (Within 200 m there is no residences and 1 school within 550 m), soil, flora, fauna and humans. In the case of remediated dumpsite, the most prominent group of receptors are the residences and institutions living nearby in adelayed ward. As the dump is not contaminated, remediation would improve the pollution scenario provided the bioearth used is pollution free and of good quality. However, other impacts are expected on the final destinations of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF/MRFs in the region. Depending on the locations of end use of fractions retrieved from biomining, the contractor shall assess the impacts on communities and workers on site & nearby; and near locations of end-use. Key impacts may result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after biomining activity, activities in biomined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post biomining activity.

### 5.3. Impacts on Air Environment

Key impacts on air include:

- Emission of Methane and other Greenhouse gases; and its impacts on scavengers, workers on site/other facilities on site (MCF in this case), nearby communities of Adlaid Ward.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odour, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.
- When the legacy site is opened, existing gases would get emitted. Further, any delay / unexpected stoppage of biomining activity, might further the process of gas formation depending on waste composition, odour and fire risks. In the case of Adalayed, since the analysis of wastes shows calorific value of 1305 combustibles

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with around 17 percent plastics, 2.5 % paper and 3.8 % cloth rags, it's well combustible; and the risk of fire is high during summers and incidents

### 5.4. Water Environment

Ground water

- Post and pre-monsoon water levels are 6.31 and 7.68mbgl. Borehole data indicates waste upto depth of 3 m with Light Brownish Red laterite strata after that. Hence it is expected that the ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. With the slope of the ground of the dumpsite, this tends to get accumulated at low-lying gradients and flows into slope up till9 0 m and terminates at swamp. High BOD levels of the drain and ground water wells around are indicative leachate and runoff pollution. Oozing & Pooling of leachate & it draining to nearby areas during rains would be an important aspect to be managed during biomining to prevent ground water contamination. Also, a separate out site drainage and leachate should be made.
- Leachate samples: BOD, COD, TDS, E.coli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution.
- Borehole data: Dump below water table; impacts on water resources, wells nearby
- Ground beneath the dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. There are no parameters exceeding the permissible limits for heavy metals.

Surface water

- The dumpsite experienced flooding during 2018 floods. The site is at a higher elevation, and hence no submergence was experienced at the site during the floods. The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas.
- There are no surface waterbodies near the site, except that swamp area at 90 m aerial distance.
- Predominant slope is in the North Direction. At North direction, (end direction) there are mixed vegetation are seen. The drainage and leachate from the site flows to nearby open drainage channel which flows through and ends at swamp area. It is important to contain and treat leachate from the proposed biomining activities on site. Treated leachate may be recirculated or used for other purposes.

### 5.5 Impacts on Land/Soil

- Historic land use assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it

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shall be excluded from the site as biomining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.

- Spillover of activities to nearby road, and land would result in pollution of all types on these areas. Hence it is important to restrict all activities to the site for legacy waste biomining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.
- Ground beneath dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. In Adlaid, all heavy- metals are falling within the limit as per Fertilizers Control Order. (2009). Adlaid does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste (including legacy asbestos), e-waste or biomedical waste is found while biomining, same shall be retrieved, transported, treated and disposed as per specific waste guideline of the Central Pollution Control Board, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste),Feb 2019) and World Bank EHS Guidelines. A plan shall be auditing of all wastes, management, eliminating pollution & OHS risks; and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.
- Wherever fuel, combustibles and retrieved waste is stored, it shall be on impervious surface, at appropriate elevation, protection against rains, flooding (such as cut off drains, berms etc.), wind and fly / pest menace (screens, green cover etc), watch and ward, lighting, remote monitoring measures etc). Risk of fire, dust and leachate contamination shall be well assessed by the contractor. Emergency Action Plan shall be prepared and mitigation measures shall be updated based on work plan/DPR, and implemented. Communities shall be made aware of works and advice to follow measures such as use of fly/dust covers/nets on wells etc.
- Of the waste samples analysed, 50 percent comprises of Bio earth; 33 % being <4.75mm size; C/N ratio (12:14) indicating slight unpleasant odour (high Nitrogen; releasing ammonia) less than that suitable for good compost.

### 5.6 Impacts due to Noise and Vibration

- Various machines vehicles and activities contribute to noise and vibration on and off site. This includes vehicles carrying recyclables, operation of JCB, and other machines, diesel generator sets, motors on site, etc. In addition, activities on the site and in

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relation to the existing MCFs such as vehicles transporting the dry waste from households to MCF, loading / unloading of collected waste materials, and workers activities on site would add to noise and vibration. Impacts include disturbance to fauna flora on site, health impacts on communities around due to exposure to large volume of sound.

### 5.7 Other impacts on Biodiversity - Fauna/Flora

- There is Malabar wildlife sanctuary areas within 10km of the site. There will be no direct impact due to the project. However, since the project involves transport of wastes, it is important to consider the impact beyond the project boundaries. Within 20 km from the site there are many tourist places like Wayanad Tea Museum, Meppadi Range Forest. Depending on the contractors plan for disposal of retrieved waste fractions, EIA shall be updated for biodiversity impacts.
- Fauna: impacted by direct consumption of the solid wastes, sharps, entanglement, or by consumption of plants and/or animals contaminated by wastes, or as a result of leachate effects on groundwater and surface water.
- Flora Plants near open dumpsites can be impacted directly by the waste, dust or smoke from burning. Disturbance to vegetation due to machinery, trampling by foot, vehicle or animals, or contamination by waste or leachate, the migration of landfill gas, or as a result of burning or smoke effects
- Disturbance to other fauna and flora on site: SWM activities onsite including those related to MCF may also impact fauna/flora through high noise levels of pre-construction / construction activities.
- Biodiversity of existing site: Available Biodiversity of existing site is mentioned in the Environmental Baseline session and there is no key species listed by IUCN.

### 5.8. Other impacts on Workers and Communities

- Contaminants in soil and water: Direct or indirect contact with polluted soil or water by neighboring water users. Additionally, because of their locations, recovered lands are subsequently used as parks, or for SWM facilities or office spaces etc. This may pose risk of bioaccumulation of metals which can constitute a health risk. Also impacts on buildings due to gaseous emissions, risk of fire etc if used after clearing.
- Health Risks: One of the primary health risks of dumps is the spreading of diseases - diarrhea, hepatitis etc. The ways such infection can be spread are numerous but are often related to direct contact with the waste (e.g., clinical waste, fecal matter) by scavengers and other unauthorized persons being on the site. The other main pathway is by vectors such as, foraging animals, rats, birds, flies and mosquitoes etc. - Flies, mosquitoes, rodents, crows, pigeons, pest menace on site, for workers & communities & their assets (such as wells) due to exposure of putrefied wastes

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- Impacts if separate common site/s or a site among these dumpsites is chosen to store wastes from other dumps till it is disposed, or as transfer stations or for common processing of certain fractions: Such activities would result in Air, odor, dust, noise, water, vibration, flora, fauna, communities around the new site. There is also risk of contamination due to newly placed wastes, and pollution impacts and disturbances to communities due to works/activities on this site. Such sites and activities shall be avoided, and if quintessential for the project, be carefully chosen and approved only after thorough discussions with KSPCB, and all stakeholders. An assessment of their sensitivity and appropriateness shall be undertaken considering the environmental risks. They shall be audited and assessed for existing and future environmental impacts of such activities and mitigation shall be implemented. However, details on such sites shall be known only based on the final schema of implementation proposed by the contractor. Hence, the Contractor shall update EIA based on this before starting any activity on site.
- OHS impacts: Infectious wastes, fecal matter, clinical wastes and sharps; batteries, e-waste and possible bursting; Hazardous wastes like asbestos and other chemicals dumped; pesticides / insecticides, inoculum storage, handling and use on wastes/land leading to diarrhea, hepatitis, insect & reptile bites, interactions with foraging animals like rats, dogs, cattle, vector (mosquitoes, flies etc) transmitted diseases etc.
- This activity would result in large influx of workers from the region and beyond as this involves dumpsites in two .s. Worker facilities in the labour Camp if any, & site are important, as the density of population is high in Kerala. It is important that camp sites are not set up in the land to be remediated. Periodic health checkups (once a week) are very important as the work involves handling of waste. It is important to also provide periodic health checkup and co-ordination with local Primary Health Center/Central Health Services for medical camps for residents, schools and others during the biomining period.
- Risk of Fire during biomining and due to retrieved material storage; possible Burning of retrieved materials; storage and use of firewood for various purposes, fuel for vehicles. The smoke from burning solid waste can result in respiratory complaints, dizziness, and headaches in the short-term, as well as potentially more serious diseases such as cancers and heart disease in the long term.
- Impacts of other site development works shall be well assessed, EIA/EMP updated, and mitigation measures included in Project costs and implemented by the contractor/ULB (whoever is responsible as per FR/Final Bid document)

### 5.9 Visual impacts, Noise, Odour, Vibrations

- Odour & impacts on workers and communities during biomining, storage and Transport are key determinants of community agreement to the activity. Such odour

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would attract flies and vectors in large numbers, who may also contaminate the food, and water sources of nearby communities. It is important to minimize odor emission as guided by the CPCB Guidelines on Legacy Waste Biomining, 2019. also provide periodic health checkup and co-ordination with local PHC/CHS for medical camps for residents, schools and others during the biomining period.

- Visual impacts of the waste being dug up, screened ad heaped/stored is not appealing. It is important to mask this appropriately.

### 5.10 Traffic impacts

- Impacts due to new access road construction/upgradation. Access road to the site is unpaved and slushy during rains. It is important to minimize temporary pollution due to increased movement men, and materials from and to the site during biomining activity and beyond as it is proposed to store material on site including air and noise pollution, access restrictions to properties nearby, and vehicular conflicts
- Large vehicles moving in and out of the site carrying materials, tools, equipment & pedestrian/worker -vehicular conflicts; increased traffic on roads, large equipments & vehicles, noise, air pollution: vehicle emissions, DG sets
- Vehicles, equipment's not adhering to pollution standards

### 5.11 Other Impacts on existing or proposed activities on site/s

- There may be approvals from various agencies for biomining activities and associated facilities; depending on utilities and uses on site. & associated activities. These permits shall be obtained prior to initiating activities on site.
- Impacts of biomining on existing facilities on site such as MRF, MCF, composting yard etc (disturbance to activities & people due to dust, leachate, noise, odour; additional load of wastes to these facilities, vibration impacts & structural damage, etc).
- Post biomining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped & impacts if this is dumped elsewhere or not processed. This alternate location, being associated facility need mitigation measures to avoid/minimize pollution, Health &Safety impacts on workers, communities. Also forward linkages are considered as associated facilities/linked activities. Impacts of Transportation of these fractions (traffic increase, odor, leachate, dust) impacts during rains & emergencies, and its handling, storage at the identified locations, reuse etc. shall be mitigated.

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## 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT & MONITORING PLAN

### 6.1 Scope of Environmental Management & Monitoring Plan

An Environmental Management Plan (EMP) is a comprehensive strategy designed to manage and mitigate the impacts of activities on humans and the environment, particularly concerning air, water, soil, land, and noise and vibration, and impacts on biodiversity and people.

### 6.2 Environmental Management Plan

The detailed anticipated impacts and corresponding mitigation measures/management of the impacts are given below.

*Table 16 Environmental Management Plan*

| S. No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| *A* | | **Planning and Pre-Construction Stage** | | |
| *1* | ***Planning for biomining facility*** | | | |
| 1 | Biomining & Bioremediation Plan & Capacities | • Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / biomined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these biomined material in line with the agreements with such facility owners and National, State regulations and WB EHS<br>• Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate management Plan.<br>• The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers.<br>• Contractor to get all required licenses & permits before start of any activity on site | Contractor | SPMU/DPMU/ULB |

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| 2 | Site Access Closure | • The total cessation of dumping in the site will be implemented before any works.<br>• All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public.<br>• The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance to indicate that the waste dump has been closed from the operation.<br>• To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br>• Grading shall be performed where necessary to provide a neat appearance | ULB or Contractor as per Bidding mechanism | SPMU/DPMU/ULB |
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – *impact on air quality, odor, water contamination due to leachate. Health and safety impacts of the people working in the site assessment* | • Carry out site assessments as per Guidelines for Biomining of Legacy waste Dumpsites of CPCB<br>• Consider safe biomining & gas / leachate generation from existing capped portion of the site<br>• Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means<br>• Provision of appropriate PPE's to the team undertaking the site assessments<br>• Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits<br>• Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>• Plan for machinery operated which will be operated by skilled operators at all times.<br>• Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. | TSC, ULB, Contractor | SPMU/DPMU/ULB |

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| | | • Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | | |
| 4 | Absence / Delay in Permissions for Developing the biomining facility and associated works as per National regulations | • Required permissions for undertaking biomining at the existing dumpsite and assessments conducted for undertaking biomining as per existing Laws, Regulations; including for associated infrastructure, DG Sets, Consent to Establish; and other licenses including those as per Labor Laws, before the start of works on site | Contractor, ULB | SPMU/DPMU/ULB |
| 5 | Dust impacts due to Site works, screening & stacking of retrieved wastes<br><br>*(Air Pollution) and Visual Blight due to excavation* | • Plan to Provide temporary high screen, buffers around the site before the start of work to curtail dust emissions<br>• Arrange a green belt as early as possible on the area of the site with no / less dump. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers)<br>• PPEs to be used by workers<br>• Awareness to communities & suggest to use PPEs | Contractor and or ULB depending on agreement on bidding mechanism/DPR | SPMU/DPMU/ULB |
| 6 | Material sourcing, transport, and stacking of construction materials<br><br>*(Occupational Health and Safety issues and Air noise pollution)* | • Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism<br>• Prior intimation to nearby Primary Health Centre on work activities need for medical support, emergency support needs, type of laborers on-site and labor camp if any<br>• Materials shall be sourced only from approved quarries<br>• Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions.<br>• The driver should be with required license and follow speed regulations<br>• Materials shall be transported preferably through well-surfaced roads. If road it kuchcha, water sprinkling shall be done to prevent dust emission before and after truck passes<br>• Material transport and unloading activities should not result in noise disturbance to locals and should be during day time | Contractor | SPMU/DPMU/ULB |

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| | | • Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors.<br>• Provide vehicle wheel wash area on site<br>• Workers to be provided with Personnel Protection Equipment (PPE) including safety boots, jackets, ear muffs, gloves.<br>• Proper rest area on site shall be provided with water, first aid, toilets | | |
| 7 | The layout of Labour camp *(Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)* | • Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp<br>• Nearby health center shall be informed about the labor camp & appropriate medical checkup shall be arranged periodically<br>• Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters)<br>• It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with land owners wherever the labour is accommodated<br>• Camp must not be provided in an area prone to Hazards<br>• Camp should be adequately at higher plinth levels to prevent water intrusion<br>• Rooms shall be of appropriate sizes with adequate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG)<br>• Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female labourers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc.<br>• The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security<br>(Refer ECOP section 06 and section 11 of EMF for KSWMP) | Contractor | Site engineer of SPMU, Labour Commissioner, PCB |
| 8 | Nearness/disturbance to sensitive areas such as | • Ensure site selection for any support facilities or activities (such as vehicle storage etc. if no in biomining site) based on the screening checklist and the | Contractor | SPMU/DPMU/ULB |

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| | forests, wildlife habitations, etc. especially in case of providing support facilities<br><br>*(Impacts on Fauna / Flora)* | master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate and Reduce. Obtain requisite permissions from respective authorities such as Pollution Control Board, ULB etc.<br>• Identify appropriate government site to avoid land acquisition and resettlement impacts<br>• Covered and well-marked storage area with cut off drains & odour/fly/dust/ fire prevention shall be ensured for excavated wastes and washing, segregation of the same are to be arranged with due consideration to nearby residences (2 no's near west side,2 no's near south,1 no's in east side and 1 no's in north of the site), slope (towards north east) other landuses | | |
| 9 | Contamination of groundwater due to leaching, Leachate parameters: BOD, COD, TDS, Ecoli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution | • During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant<br>• Depending on the contractors plan for biomining of the capped area on site, adopt plans to manage leachate | Contractor | SPMU/DPMU/ULB |
| 10 | Impacts on flora, fauna" consumption of wastes, leachate impacts, dust smoke – burning, trampling/machinery | • Movement routes of vehicles to be planned to avoid key fauna/flora on site such as<br>*Ailanthus sp.*(Tree) & *Funambulus tristriatus* ( Jungle Palm Squirrel)<br>• Leachate collection & storage/treatment and recirculation shall be planned to avoid impacts on flora, fauna | Contractor | SPMU/DPMU/ULB |
| 11 | Nuisance hazards to neighboring areas | • Ensure proper design and adequate compound wall; high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements | Contractor | |

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| | | • In case of waste mound and site edges are sliding or unsafe; provide engineered retention walls. | | SPMU/DPMU/ULB |
| 12 | Treatment & Disposal of wastes and rejects | • Contractor to Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & inert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventorised and quantified, including Biosarth, rejects, inerts. These shall be tested and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertiliser Control Order 1985 and their amendments. Asbestos Management Plan shall be prepared for management if Asbestos wastes retrieved if any<br>• Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period. | | |
| *B* | **Implementation or Biomining & Bioremediation stage and Construction of ancillary facilities such as access road improvements, compound walls, greenbelts, drainage etc.** | | | |
| **Implementation of biomining of the dumpsite** | | | | |
| 1 | Impact due to the vehicular movement<br><br>*(Air and noise environment & Vehicular - Vehicular & Vehicular - Pedestrian Conflicts)* | • Vehicles and machinery are to be maintained so that emission conforms to National Ambient air quality standards.<br>• All vehicles and machinery should obtain Pollution Under Control Certificates<br>• HORN PROHIBITION signpost to be erected.<br>• Rumble strips/speed breaker to be provided on access roads.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed.<br>• Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle | Contractor, ULB | SPMU/DPMU/ULB |

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| | | • Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements.<br>• Avoid heavy vehicle movement through Kalpetta roads during peak hours 7 a.m to 10 a.m – mention: school hrs / peak hrs; and during important period / festivals when people use the road to access temple<br>• Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents. | | |
| 2 | Impact due to the use of heavy vehicle and equipment<br><br>*(Air and Noise environment)* | • Mixing equipment (in case of construction of ancillary facilities) should be well sealed and be equipped with a dust-removal device.<br>• Equipment Operators & labourers should wear dust masks, ear protection, and hard hats.<br>• Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load.<br>• Labor to be provided masks / PPEs.<br>• Construction / Biomining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spreading into neighboring sensitive land uses<br>• Noise standards at operation machines are to be strictly monitored to prevent exceeding of GOI noise standards.<br>  ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines.<br>  ▪ Using modern, well-maintained and regularly serviced vehicles.<br>  ▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>  ▪ Provision of earmuffs and ear protection to workers and employees in high noise areas.<br>• Workers in the vicinity of strong noise to wear protectors and their working time should be limited as a safety measure.<br>• As Adlaid dumpsite has sensitive receptors and settlement areas within 150m of it, noisy works shall be stopped from 22:00 to 06:00. | Contractor | SPMU/DPMU/ULB |

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| | | • Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum.<br>• Avoid noisy activities/machines near south west side of the site where settlement exist within 50m. Noise barrier shall be provided at all noise-sensitive locations / for noise generating equipment such as DG sets, mixers (for ancillary facilities) especially near south west side of the dumpsite<br>• Adopt required measures as per CPCB guidelines, and site & work specific safety requirements | | |
| 3 | Impact during the construction activities<br><br>*(water environment)* | • Labour camps if any (depending on Contractors work plan & arrangements) are to be located away from water bodies.<br>• Vehicle washing or maintenance near water bodies are to be avoided.<br>• Contaminated water from construction / biomining activities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated on site. | Contractor | SPMU/DPMU/ULB |
| 4 | Leachate and Runoff from biomining activities<br><br>*(Soil contamination and groundwater contamination)* | • Provide site cut off drain around the site to divert off stormwater from entering the site, and to prevent contaminating downstream resources with run off from the dumpsite<br>• Depending on the contractors plan for biomining of the capped area on site, implement leachate management to cause no harm to communities & environment<br>• Ensure stormwater drains will lead to drain outlets (along the north east boundary of the site) on roads adjoining the dump yard<br>• Provide leachate drains – lined – from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area preferably to the north east of the site<br>• Provide proper treatment of leachate and stormwater that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by biomining activities like excavation and waste segregation and stabilization | Contractor | SPMU/DPMU/ULB |

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| | | • The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB.<br>• The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata<br>• Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff and hence reduce infiltration<br>• Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism<br>• Plan the works on-site only during non-rainy seasons and to complete the works before rains<br>• Store leachate preferably in aboveground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide for emergency containment additionally | | |
| 5 | Soil decontamination from accumulated waste levels<br><br>*(Impact on leachate, odor)* | • Decontaminate the soil / stabilized layers remaining after sieving out wastes using windrow and bioculture of appropriate quality in line with standards / regulations or appropriate means as per CPCB Guidelines<br>• Vegetative layer using contaminant absorptive root varieties like Vetiver may be tried on soil and along the edge of the green belt or floating wetlands may be deployed in water channels nearby to maximize absorption of leachate in the soil by root-zone phytoremediation<br>• Soil and water testing shall be done and changes in contamination shall be noted. | Contractor | SPMU/DPMU/ULB |
| 6 | Excavation of waste from the waste mound | • The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound. | Contractor | SPMU/DPMU/ULB |

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| | *(Health and safety impacts)* | • Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided<br>• Machinery operated for excavation should be operated by skilled operators at all times.<br>• Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on wastes.<br>• Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound<br>• In case of the waste mound and site edges are sliding or unsafe; provide engineered retention walls or string boundaries.<br>• When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection & treatment mechanism. | | |
| 7 | Transportation of wastes or retrieved or other material in overloaded and open vehicles<br><br>*(Air, Odour nuisances, spills and littering impacts on Air, Water, Land)* | • All vehicles shall carry only approved load of weight<br>• Regular cleaning of roads & drains and removal of spills if any.<br>• All waste transport vehicles shall be covered and movement shall be during non-peak hours.<br>• Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities.<br>• Adopt required measures as per CPCB guidelines, and site specific safety requirements. | Contractor | SPMU/DPMU/ULB |
| 8 | Spreading and compaction of waste<br><br>*(Safety)* | • Follow technical details in line with CPCB Guidelines<br>• The active working face should be minimized as much as practical an appropriate size is about 2 to 3 times the width of the compactor vehicle. | Contractor | SPMU/DPMU/ULB |

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| | | • Waste should be spread and compacted in layers not greater than 0.6m (2ft.) after compaction.<br>• Compaction of the waste should be on a slope of about 20-30% as guided via the permissible levels and worked from the bottom of the slope to the top | | |
| 9 | Occupational health and safety impacts of the workers during the biomining & construction of support facilities:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage of chemicals/other materials, bicultures or wastes etc; by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | • Avoid direct & double handling of wastes through avoidance measures(suitable planning & equipments), engineering controls & use PPEs<br>• Work area & Labour camps shall be provided with First Aid and other related activities.<br>• Emergency Preparedness plans shall be prepared and implemented for all manpower working centers and its field extension centers.<br>• An Environment Health & Safety policy shall be prepared and implemented<br>• Adequate manpower shall be provided and manager & staff shall listen and act upon the manpower related grievances.<br>• Workers will be provided with PPE such as face mask, gloves, shoes, nose masks & goggles<br>• Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed with out slip, trip, fall especially on waste, leachate or trenches<br>• Proper training will be provided regarding the maintenance of health<br>• Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks & water supply), food, and water in a hygienic environment (with proper handwash). Provide clean eating areas where workers are not exposed to contaminated, hazardous or noxious substances.<br>• First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus<br>• Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health checkups. Arrange daily health checkup for workers | Contractor, ULB | SPMU/DPMU/ULB |

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| | | working on waste heaps<br>• Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals.<br>• Measures such as deferred timings and stretch break to be adopted<br>• Secure all installations from unauthorized intrusion and accident risks;<br>• Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every days start of works / activities. Key hazards would be (but not limited to) are flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and leachate from existing capped area on site, electric shocks, works with heavy machines & equipments, slips of men & material (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc.<br>• EHS specialist with adequate experience & third party supervision are important for biomining activity<br>• Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites<br>• Provide visitor orientation if visitors to the site need to gain access to areas where hazardous conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible<br>• Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;<br>• Ensure moving equipment is outfitted with audible back -up alarms & flag men with whistles or speakers;<br>• Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit. | | |

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| | | • Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenance to be marked well & safe kept before activity start near those .In close proximity to this location, there is a transformer. to be marked well & safe kept before activity start near those<br>• Disallow worker exposure to noise level greater than 85 dBA for more than 8 hours a day without hearing protection<br>• All workers shall be registered as per prevalent labor laws (including a workforce of subcontractors) and provided insurance cover & others as per existing acts/laws<br>• Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractors person/insurance agent<br>• While using heavy machinery like JCB, cranes, etc, inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle.<br>• While using heavy machinery like JCB, cranes, etc, inform communities to prevent children and others from going near operating / movement areas including roads.<br>• Flagmen shall be arranged if work is near schools, hospitals, major roads, and traffic control is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if possible<br>• A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs;<br>• No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor<br>• All works related to working at heights will be undertaken only during the | | |

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| | | daytime when sufficient sunlight is available;<br>• Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done;<br>• All excavation activities to be conducted in supervision of the site contractor;<br>• Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured.<br>• All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans prepared and implemented, as per Banks Incident Reporting Tool | | |
| 10 | Risk of fire due to conditions leading to spontaneous combustion<br><br>*(Air environment, disturbance to communities and workers, health impacts, safety issues)* | • Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for Implementation of SWM Rules 2016 – regdg Fire Incidents at MSW Dumpsites (https://cwcb.nic.in/openpdffile.php?id=UHVlbGlhY3Rub25GaWxlLzQvNDRfMTY1NDE2Mzk3N19tZWRpYXBob3RvNzYxMi5wZGY= ), LSGD Kerala Government GO on Fire Safety of MRF, MCFs (for the MRF on site if used for storage of wastes)and other Regulations, guidelines applicable<br>• Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3; and National/State regulations & WB EHS<br>• Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes<br>• Avoid conditions that can lead to spontaneous combustion such as:<br>  ○ Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard<br>  ○ Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.<br>• Design the facility for access by firefighting equipment, including clear aisles | Contractor, ULB | SPMU/DPMU |

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| | | among waste heaps or work areas and access to adequate water supply.<br>• Ensure workers are briefed of fire hazard & its management<br>• No unauthorized entry shall be permitted to the site; including of workers during holidays, night time, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating "trespassers not allowed"<br>• The following activities should be implemented to prevent fires from occurring at the facility<br>○ adequate fire-fighting equipment should be made available on-site and stored in an accessible manner,<br>○ All operating staff should be trained and able to manage fire outbreaks at any part of the facility.<br>○ Clear signage should be established to inform workers and the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area.<br>○ Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows.<br>○ All fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the biomining, storage, and processing areas.<br>○ All flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating stormwater.<br>• The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the biomining activity in line with National State regulations, guidelines and international good practices<br>• Ensure that appropriate fire safety standards, facilities, equipment are in place | | |

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| | | for storage and transportation stages. Fire mock drills to be conducted monthly once.<br>• Contain all local smokes/small fires inside the dump asap. Fire brigade help shall e sought on all smokes/fires outside the dump asap<br>• Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured.<br>• Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers | | |
| 11 | Construction of new facilities in retrieved land | • The excavated site shall be protected from any dumping during or after the biomining activity and shall be reserved for SWM activities in line with SWM Rules 2016<br>• Any new facility under KSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations | ULB | SPMU/DPMU |
| 12 | Pest / Vermin Control & Visual impacts<br><br>(Odour, flies, rodent / other pest menaces) | • Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center<br>• Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups<br>• Biopesticides / biological control shall be followed. However, biopesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials<br>• Banned pesticides/insecticides shall not be used.<br>• Workers shall be made aware of storage and use of pest control measures and PPEs to be used<br>• Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate management | Contractor, ULB | DPMU, SPMU |
| 13 | Odour nuisance | • Waste with a strong odor to be covered immediately they are emptied from vehicles.<br>• Control and manage leachate treatment to minimize odor. | Contractor, ULB | DPMU, SPMU |

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| S. No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • Provide buffers screens to curtail odor from reaching surrounding communities especially to –South west side of site.<br>• Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor. | | |
| 14 | Storage, Collection, Transport, Treatment & Disposal of wastes and rejects | • Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste<br>• Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters<br>• Waste handling shall be in line with existing regulations & guidelines & avoid health & safety impacts<br>• No material is allowed to remain on site after the contract period<br>• Adequate fire safety arrangements & awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported<br>• Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/inerts in designated or agreed area & are in line with schedule; using GPS | Contractor, ULB | DPMU, SPMU |
| 15 | Other activities | • No activity other than biomining shall take place on site & any activity shall cause no adverse impacts on the environment or people<br>• If existing MCF shall be used for storing bio mining wastes, its safety shall be ensured in terms of fire & structural safety before starting to use the facility. Further usage of the MCF after biomining works shall be after proper cleaning / washing & disposal of all rejects/inerts & tools to ensure good housekeeping & no H&S impacts | | |

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| S. No | Probable negative impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • If existing MCF shall be used by the ULB for storing dry wastes from Town, during biomining period, alternate access shall be arranged & workers shall be adequately protected against any health & safety impacts | | |
| 16 | Energy Efficiency & Water Use efficiency | • All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & biomining / construction techniques<br>• Landscaping & green belts to use local / indigenous plants & trees<br>• Waste water and Leachate to be treated & recycled/reused | Contractor | ULB |
| C | **Future Site Usage (EMP shall be updated in line with EMF & used if future site usage is proposed under KSWMP). This section is not the responsibility of the Contractor for Biomining, but of the future facility operator & ULB** | | | |
| 1 | Future use of the biomined site: Green Park, MCF, MRF, RRF, Treatment plants, landfill cell or any other, preferably for SWM | • ULB to ensure that the site will not be used for future dumping.<br>• Activities at existing MCF to be upgraded to ensure that no waste (even dry wastes) gets dumped around.<br>• ULB shall plan the future use of the site shall be in consultation with the communities.<br>• Phase 1 Environmental Assessment to be carried out, EA for existing facilities & EIA for proposed development in line with EMF in case this is proposed to be developed under KSWMP<br>• All applicable clearances, permits shall be arranged in line with applicable regulations for the proposed new use of the site, and appropriate designs/plans to be prepared & implemented | Future Facility Developer/ Operator & ULB | ULB (SPMU in case it is under KSWMP) |
| 2 | Vehicle movement for new activities: MCF/MRF, RRFs, Treatment plants, landfill cell<br><br>*(Air, water environment, a nuisance to biodiversity,* | • The movement route shall be scheduled for each vehicle.<br>• Enforce speed limits applicable and make drivers aware of this<br>• Vehicles movement shall be tracked by Health Supervisors to ensure keeping up to schedule; preferably using GPS<br>• Any adulterated fuel shall be avoided. There shall be periodic emission tests for vehicles<br>• Provision of Personal Protective Equipment such as face mask, gloves, nose masks & goggles to all workers in C&T vehicles, Maintenance yards<br>• Proper lubrication shall be provided to minimize squeaking noise due to friction | Future Facility operator | ULB |

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| S. No | Probable negative impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | communities, *Health impacts)* | • Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br>• The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public<br>• Traffic will be managed at the site by providing adequate space for parking of vehicles<br>• Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design<br>• No waste or material shall be disposed in any place other than the designated area, including water bodies, coasts/forests, or sensitive areas. | | |
| 3 | Exhaust emissions<br><br>*(Air impacts)* | • No idling of vehicles on site.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed | Future Facility operator | ULB |
| 4 | Plying of vehicles through kutcha / unsurfaced roads and idling<br><br>*(Air pollution: SPM, CO, CO2)* | • Vehicle movement shall be well planned – through topped roads. In case of necessity to move through Kutcha roads, ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Future Facility operator | ULB |
| 5 | Odor<br><br>*(Nuisance, Air)* | • Daily soil covers to compacted wastes to manage odors.<br>• Waste with a strong odor to be covered immediately they are emptied from delivery vehicles.<br>• Control and manage leachate treatment plant to minimize odor.<br>• Adhere to air quality regulations with quarterly air quality monitoring Maintenance of the buffer zone and protective berms<br>• Provide buffers screens to curtail odor from reaching surrounding communities | Future Facility operator | ULB |

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| S. No | Probable negative impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 6 | Impact on the ambient noise quality during the operations<br><br>*(Noise, nuisance to sensitive receptors; health impacts)* | • Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines;<br>• Using modern, well-maintained and regularly serviced vehicles;<br>• Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>• Provision of earmuffs and ear protection to workers and employees in high noise areas | Future Facility operator | ULB |
| 7 | Occupational health and safety impacts of the workers:<br><br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | • All OHS and CHS measures to be followed in line with applicable regulations, guidance<br>• Workers & communities shall be made aware of OHS, CHS risks and impacts & mitigation measures adopted<br>• Emergency management plan to be prepared & followed<br>• Workers shall be appropriately trained on OHS during construction & Operation of all future facilities | Future Facility operator | ULB |
| 8 | Pest / Vermin Control<br><br>(Odour, flies, rodent / other pest menaces) | • Regular cleaning and approved pest control measures to be adopted<br>• Biopesticides / biological control shall be followed.<br>• Banned pesticides/insecticides shall not be used.<br>• Workers shall be made aware of storage and use of pest control measures and PPEs to be used | Future Facility operator | ULB |

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| S. No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 9 | Fire Safety | • The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented in line with National State regulations, guidelines and international good practices | Future Facility Operator | ULB |
| 10 | Energy Efficiency & Water Use efficiency | • All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & construction techniques<br>• Landscaping & green belts to use local / indigenous plants & trees<br>• Waste water to be treated & recycled/reused | Future Facility Operator | ULB |

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## 6.3 Emergency & Disaster Management Plan

### Hazards Associated with Dumpsite Activities

The Disaster Management Act, 2005 mandates every Government Department to prepare, review and update Disaster Management Plan

### 6.3.1 Identified Emergency Situations

*Table 17 Hazards associated with Dumpsite Biomining & Bioremediation*

| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| As per World Bank EHS Guidelines | |
| Waste Storage | **Regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases** |
| Waste Segregation | **Regular audit of segregation of biomined wastes** |
| Monitoring records for hazardous waste collected,stored, or shipped should include | **1. Material Identification:**<br>- Name and identification number of the hazardous material(s) present in the waste.<br><br>**2. Physical State:**<br>- Indicates whether the waste is in a solid, liquid, gaseous form, or a combination of these.<br><br>**3. Quantity:**<br>- Specify the amount of hazardous waste, and biomedical waste retrieved from site typically measured in kilograms or liters, or by the number of containers. All such waste shall be staked in appropriate places/ containers for disposal; duly marked & records kept.<br><br>**4. Waste Shipment Tracking:**<br>- Documentation tracking details include:<br>- Quantity and type of hazardous waste.<br>- Dates of dispatch, transportation, and receipt.<br>- Records of the originator, receiver, and transporter involved in the waste shipment. |


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| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| | **5. Handling and Treatment:**<br>- Describes the method and date of various actions taken with the retrived waste, such as storing, repacking, treating, or disposing it.<br>- Cross-referenced with specific manifest document numbers relevant to the hazardous waste.<br><br>**6. Location within Facility:**<br>- Specifies the specific locations within the facility where retrived – various type shall be stored or processed.<br>- Includes information about the quantity of waste at each location. |
| Falls and Slips at the dumpsite<br>Slippery surfaces or uneven surfaces and poor access to work areas climbing on and off the facility, equipments/machinery or the waste segregation/other facilities set up | Tidy workplace by maintaining good housekeeping. Handholds wherever necessary and clear/ safe access to work areas with proper PPE to the persons working at the site. |
| Fire Hazard<br>Fire risk may occur due to the following<br>Storage of flammable liquids / Gas like LPG, Diesel<br>Any combustible materials<br>Sparks<br>Open flames<br>Absence of Fire hydrant network may increase the risk in case of major fire accident | Combustible/flammable materials should be properly managed and stored/used. Fire extinguishers and Fire hydrant Network with reserve water (As per NFPA Code) should be made available. Emergency Plan in case of fire. |


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| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| Absence of Personal Protective Equipment Lack of adequate footwear, Helmets, hearing/ eye protection, gloves & goggles may lead to injuries and death. | Proper footwear, Helmets, hearing/ eye protection, gloves & goggles should be given to the workers at the dumpsite. Proper training should be given to the workers on the use of PPE. |
| Electrical Hazard<br>Electric wires if any damaged<br>Poorly insulated<br>During temporary repairs<br>Circuits overloaded may lead to major accident | Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit. |
| Ladders<br>Risk may occur due to the following<br>Not secured against dislodgement<br>Defective ladders<br>Not sufficient length<br>Incorrectly placed | Ladder risk can be mitigated by the following<br>Secured against movement or footed<br>Ladders in good condition<br>Regular inspection<br>Ladder should be extended one (1 m) meter above platform to avoid injuries |
| Excavations<br>Risk may occur due to the following<br>Trench collapse<br>Gas emission | Risk can be mitigated by the following<br>• Soil stability should be known before excavation<br>• No water accumulation<br>• V500 mask should be used at the in order to counter the gas emission.<br>• Emergency Plan |
| Defective or wrong Hand Tools<br>Wrong/defective tool may end up with injuries to the workers using the tool | Right tool for the job should be used properly and it should be in good condition |
| Accidents due to vehicular movement<br><br>Vehicle movement inside the site | Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents |


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| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| Noise Hazard<br>Noise levels over 85 decibels would cause trouble to the people working at the site | Noise Levels should be maintained below 85 decibels and with proper protection |
| Falling Material<br>Fall during carrying/Lifting of waste and materials from overhead work areas. | Risk can be mitigated by preventing the falls by barriers, training, strengthening the materials used for works and the following<br>Use of hard hats.<br>Person operating the Jcb/machine must be provided with walkie talkie/hand signals to know about the clearances. Also the services of flag staff with flag & whistle to be arranged |
| Visitors Presence at site<br>Insufficient fencing may lead to attract pedestrians to enter the site. | Fencing and barricades with proper signage boards indicating "trespassers not allowed" |

### 6.3.2. Proposed Organizational Structure for Disaster Management

The Organizational structure for the Disaster management contains the following team members.

**Emergency Response Team:**

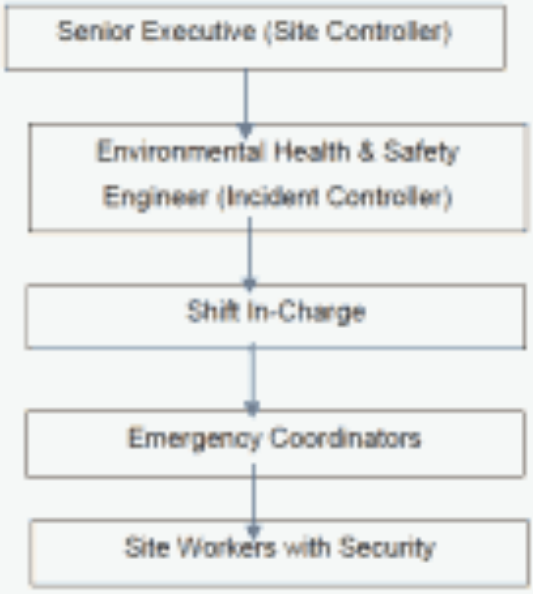
A response team needs to be set in assistance with a senior executive (Site controller), Manager Safety (Incident controller), Shift in charge, and Emergency Coordinators.

Incident controller would be reporting to the Site Controller. Incident Controller organizes a team responsible for controlling the incidents with the personnel under his control.

Shift In-charge would be the reporting officer, who would bring the incidence to the notice of the Incidence Controller and Site Controller.

Emergency Coordinators would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential support services. For this purpose, security in-charge, personnel department, essential services personnel would be engaged. All these personnel would be designated as key personnel.


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**Organizational structure for the Disaster Management Team**

### 6.3.3 Emergency Response Facilities

Emergency Control Center – with access for emergency shutdown procedures, duties and contact details of key personnel and government agencies, emergency equipment, etc.

- Assembly Point – with minimum facilities for safety and rescue
- Emergency Power Supply – connected with diesel generator, flame proof emergency lamps, etc.
- Fire Fighting Facilities – first aid fire-fighting equipment, fire alarms, etc.
- Location of Wind Stock – located at appropriate location to indicate the direction of wind for emergency escape
- Emergency Medical Facilities – Stretchers, gas masks, general first aid, emergency control room, breathing apparatus, other emergency medical equipment, ambulance The medical centre should display poster for treating burns and first aid. Some medicines and facilities to be kept in the medical centre are suggested.

**Health and Safety Measure for the workers**

All workmen employed in working conditions will be provided with adequate personal safety equipment as applicable to the work including (but not limited to):

- Safety shoes/boots
- Safety Helmets
- Hand gloves
- Ear muffs


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**Monitoring Plan**

The considerations in an emergency planning include the following:

- Identification and assessment of hazards and risks
- Hazard consequences analysis
- Alarm and communication procedures
- Identification and equipping emergency control centre identify assembly, rescue points, medical facilities
- Emergency preparedness plan, procedure, steps to be taken before during and after emergency
- Formulation of plan and emergency sources
- Training rehearsal, evaluation and updating the plan
- Machinery should be examined regularly
- Medical examination: Every employee shall be examined by doctors at least 3 months in a calendar. Health register should be maintained by the individual industry coming in the project site

**Emergency Action Plan for Fire**

In case of Fire the immediate plan of action will be "RACE" that stands:

R - Rescue: When you discover a fire, rescue people in immediate danger if you can do so without endangering yourself.

A - Alarm: Sound the alarm by pulling a fire pull station and call fire station, from a safe distance, notify security of precise location of fire

C - Confine: if possible

E - Evacuate: Evacuate the place

Immediately informed the response team on the site and local fire brigade. Response team moves to the point of fire and take all necessary steps to stop the fire. Fire brigade to join at the earliest. If the fire is not controllable and spreads then the manager in charge should inform the district authorities and call for additional external help. Complete an Incident/Accident Report within 24 hours.

Firefighting system is proposed to prevent and control fire outbreaks. The firefighting system will consist of portable fire extinguishers, hose reel, wet riser, yard hydrant, automatic sprinkler system, and manual fire alarm system. In case of dumpsite biomining it is also important to shave fire lines in the biomining area & also in the storage area where material retrieved is stored.

**Emergency Action Plan for Electric Fire**



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- Disconnect the affected areas electric supply
- If fire is small scale than $NAHCO_3$ or Sand will be effective.
- Attempt to extinguish fire with the help of CO2 based extinguisher
- Seek support of fire brigade

Action Plan of on-site Emergency Plan

- The action plan considered is given as follows:
- To constitute Disaster Management Committee under senior officer not below the rank of General Manager
- To identify potential hazards areas in the layout map
- To predict degree of burns and distance of the risk zone by using model
- To evacuate the area within risk zone
- To localize the emergency and if possible eliminate it
- To minimize the effects of accidents on people and property
- To take remedial measures in the quickest possible time to contain the incident and control it with minimum damage
- To mobilize the internal resource and utilize them in the most effective way
- To get help from the local community and government official to supplement internal manpower and resources
- To minimize the damage in other sections
- To keep the required emergency equipment in stock at right places and ensure that they are in working condition
- To keep the concerned personnel fully trained in the use of emergency equipment
- To give immediate warning to the surrounding localities in case of emergency situation arising
- To mobilize transport and medical treatment of the injured
- To educate the public in the surrounding village regarding hazards
- To arrange treatment of causalities
- To safe guard the people
- To identify the causalities and communicate to persons known to them
- To render necessary help to concerned
- To rehabilitate area affected

**Urban Floods:**

Floods are extreme events, usually triggered by extreme precipitation (river/inland floods) and/or storms (coastal floods). If these rainfalls exceed the retention capacity of the basins, drainage speed and volume, it causes floods.

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**Different Types of Flooding:**

1) Localized flooding due to inadequate drainage;

2) Flooding due to overflows from Rivers/channels/drains where the dumpsite is on or near flood plains or when flood plains are occupied by various settlements & other infrastructure without space for water to flow.

**Stakeholders in Disaster Management:**

The policy also systematizes a frame work of operation for the following set of stakeholders that play key roles in disaster management.

- Kerala State Disaster Management Authority
- State and Central Government Departments and Disaster response forces
- District Disaster Management Authorities
- Local authorities including Municipal Corporations/Municipalities, District/Block/Grama Panchayaths, Taluk/Village Officers etc.
- Voluntary and Civil Society Organizations
- Red Cross, multilateral aid agencies and U.N agencies
- Community – Village Disaster Management Committees / Task Forces
- Public sector Undertakings
- Private sector undertakings
- Army, Navy, Air Force, Coast guard, Airport Authority, National Disaster Response Force etc.

- District disaster teams shall be informed of the proposed activity and its schedule

### 6.4 Environmental Monitoring Plan

Monitoring at a dumpsite site is carried out in four physical zones as follows:

i. On and within the dumpsite
ii. In the unsaturated subsurface zone beneath and around the dumpsite
iii. In the groundwater (saturated) zone beneath and around the dumpsite
iv. In the atmosphere/local air above and around the dumpsite

The Environmental Monitoring Program involves the following:

- Conducting survey and sampling program.
- Analysis of samples and data / information collected, and interpretation of data and information.
- Preparation of reports for submitting to management and statutory authorities.
- Environmental monitoring is carried throughout the project operation to detect changes in the key environment quality parameters, which can be attributed to the project.

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The results of the monitoring program used to evaluate the following.

- Extent and severity of the environmental impacts against the predicted impacts
- Performance of the environmental protection measures or compliance with pertinent rules and regulations.

### 6.4.1 Air Environment

The potential sources of air pollution from the dumpsite include vehicular movement, emission of dust from biomining activities & wastes retrieved and stacked. Passive leakage of landfill gas from the disposal site. Other important contributor is odour emissions from the existing legacy site disturbed. Monitoring of the air environment will be carried out during the operational phase in and around the project site.

### 6.4.2 Noise Environment

The operations shall induce noise due to operations of transport trucks (men & material), JCB loaders and other types of machinery required at the dumpsite for moving wastes, screening, stacking, turning etc and the biomining activity. Monitoring of ambient noise levels and also the exposure of the workers to that environment is essential.

### 6.4.3 Water Environment

Water quality to be monitored during the operational phase. The monitoring frequency needs to be increased if higher concentrations are expected. Both groundwater regime and surface water domain is anticipated to be most-affected, through leachate contamination. Therefore surface & ground water will be periodically monitored for the parameters particularly increase in BOD, heavy metals and the hazardous chemicals.

### 6.4.4 Land Environment

The soil in the dumpsite and neighboring areas will be analyzed for the relevant parameters.

The details of Environmental Monitoring Programs are given below:

*Table 18 Environmental Monitoring Parameters*

| Environmental components | Locations | Frequency | Parameters |
|---|---|---|---|
| Ambient Air quality | Nearby habitations and locations | Quarterly [1 sample] | $PM_{10}$, $PM_{2.5}$, NOx, CH4, CO. Ammonia |
| Noise | Outside the site towards residential area | Monthly | Noise levels |
| Ground and Surface water | Ground water from the nearest well, | Quarterly | IS 10500:2012 drinking water |


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| | | | |
|---|---|---|---|
| | drain upstream & downstream of where leachate is disposed, and Thodu upstream & downstream of were the drain joins | | parameter for ground water welks, class D, E for drain & Thodu (if these are not used as drinking water source) |
| Accidental release | Chemical, oil and fuel spills | Daily | Near chemical, oil, storage areas Incident reports |
| Health safety Hazards | Medical records, documentation of injuries and accidents, Health and safety assessments | As and when accident/injury occurs | Incident reports |
| Leachate | 1 point per leachate at swamp area. | Weekly during biomining activity | • pH<br>• Biological Oxygen Demand- BOD<br>• Chemical Oxygen Demand-COD<br>• Nitrogen (Ammonia, Nitrate, Nitrite)<br>• Oxidation-Reduction Potential- ORP<br>• Electrical Conductivity-EC<br>• Total Organic Carbon (TOC) Dioxins |

In case, any deviation from FR, this would be updated and mitigation and monitoring measures would be revisited. Currently the location of disposal of biomined material, or type of transport of biomined material is unknown & hence, these impacts & mitigation,


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monitoring requirements will be updated & implemented by the Contractor. This aspect should be made a Bid condition

### 6.5 Environmental & Social Safeguard Budget

The details of Environmental Budget for Implementation and Supervision of Environmental Management Plan (EMP) is given below:

*Table 19 Detailed Cost Breakup*

| S. No. | Description | Frequency | Unit Price | Qty | Amount in Rs |
|---|---|---|---|---|---|
| | **Environmental Safeguards** | | | | |
| 1 | Deodorizer equipment (power sprayer) | Only Once | | | |
| 2 | Green Net ( Approx., 350 m Length – Height – 3 m) and installation charges | Based on requirement | | | |
| 3 | Spillage Kit | Only Once | | | |
| 4 | Monitoring of Environmental parameters [Air, Ground water, Surface water, Noise, Soil and Leachate] Actual Noise abatement, odour management, dust management measures to be included in DPR cost | Quarterly, first six months by contractor and next two years by ULB | | | |
| 5 | Gas monitoring to check the gas accumulation at the dumpsite | Gas monitoring should be conducted at least twice a day for about 7 consecutive days | | | |
| 6 | Personal protective equipment | Entire Process | | | |
| 7 | Training on capacity building | Entire Process | | | |
| 8 | Leachate Management (Full costs included in DPR. This | Only gap incidental costs. | | | |


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| S. No. | Description | Frequency | Unit Price | Qty | Amount in Rs |
|---|---|---|---|---|---|
| | is only for incidental mitigation of odur, leaks, spillage, flies etc. ) | The rest are all included in DPR | | | |
| 9 | Site Accesss Improvisation | Only once | [redacted] | [redacted] | [redacted] |
| | **Social Safeguards** | | | | |
| 10 | Overall Budget for Social Safeguards | | [redacted] | [redacted] | [redacted] |
| **TOTAL (actual costs for works involved for mitigation measures are to be included by the contractor in DPR costs based on his work method. This is only indicative cost for incidental mitigation & management measures. EHS in Labour camp also not included here; but shall be included by the contractor based on his work plan as this is combined with multiple other dumpsite biomining works)** | | | | | [redacted] |


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## 7. INSTITUTIONAL ARRANGEMENTS

### 7.1 Proposed Institutional Arrangements

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of Terms of Reference (ToR) for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation. The Support Organization will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments. Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level. The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances. The PIU will submit the compliance reports on clearances, permits, and environmental and
social safeguards to D-ESDU.

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### 7.2 Capacity Building

- Sensitize and orient different stakeholders of the project with adequate communication of benchmark standards on various project components. Ensure up gradation of awareness generation at different levels. Special focus: Health Hygiene and sanitation Sub Activity
- Training program for HKS (Health & Hygiene, source level waste segregation and source level treatment, Fire and Safety)
- Training program for ULB Councilors and Ward convener (Proposed SWM project plan of KSWMP)
- Training program for Political and trade union leaders (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for workers of Municipal Sanitary workers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for school / college students (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for ULB officials (Proposed SWM project plan of KSWMP, proposed policies, existing policies etc. to improve the existing pattern into zero waste concept of the municipality)

### 7.3 Grievance Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizen can lodge complaint either directly to ULBs, toll free number or through digital platforms (website/email – https://kswmp.org/grievances / grmkswmp@gmail.com / Toll free number-18004250238). The complaint will automatically be recorded in login of ward level official of ULB and an escalation system is constituted according to the category of each complaint to close the complaint in time. The complainer can close the complaint through a feedback form according to their satisfaction.

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## 8. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

"Public Consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate.

In 2010 the waste dumping stopped after result of public agitation. Now the proposal is to remediate the existing site in order to protect the environment and human health. The summary of the document will be made available in the website, which will also be featured in a newspaper advertisement in Malayalam language for public disclosure.

### 8.1 Public Consultation

In connection with the dumpsite remediation, a consultation meeting was conducted on 01.06.2023 at Municipal office Kalpetta. Stakeholders from different social entities participated in consultation meeting followed by a transect walk. Municipal ward councilor, HKS, Kudumbashree officials from DPMU, ULB, PIU and TSC were participated.

In the meeting, Environmental Engineer, DPMU explained about the proposed dumpsite remediation activities with a positive note on how the remediation activities beneficial to the local community. The ward councilor extended whole support from the side of local people. Further, a detailed description on dumpsite remediation was given by Social and Communication expert, DPMU. Participants expressed their concerns regarding the proposed project activities and its implementation modalities. The participants were happy that the lifelong bad image of 'trenching ground' would get removed since it was highly a stigmatized usage.

### 8.2 Outcome of the meeting

A transect walk was carried out followed by the meeting with the participation of stakeholders. The local community, after the meeting and interactions, extended support for the dumpsite remediation activity. The meeting also discussed various aspects of dumpsite remediation in detail including the possible social and environmental issues that may affect their routine life as well as the free movement during the time of operation

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*Figure 5 Transect Walk at Dumpsite - Kalpetta*

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### 8.3 Information, Education and Communication (IEC) Plan

*Table 20 IEC Plan for Kalpetta dumpsite remediation*

| Programme | Methodology | Topic | Responsibility | Monitoring |
|---|---|---|---|---|
| **Sensitization/ Awareness programme** | Meeting with all concerned Stakeholder's with prior notification to discuss about the process and remediation methods | Process of dumpsite remediation Developing as a Recreational park | Contractor | TSC/ DPMU/ DPMC |
| **Informative standees in all** | Visible places nearby the dumpsite | Protocol to the public who residing in nearby areas and also trespassers. | Contractor | TSC/DPMU/ DPMC |
| **Announcement vehicle** | All across places near the dumpsite | Health and hygiene protocols during the dumpsite remediation process | Contractor | TSC/DPMU/ DPMC |
| **Digital campaign (Social media)** | Areas surrounding waste dumping and all affected areas | Arrangement of a public audio system to address all people in the surrounding areas.<br><br>Short video presentations to communicate through different digital platforms like WhatsApp pertaining to the existing scenario and proposal of Recreational Park with self-explanation | Contractor | TSC/DPMU/ DPMC |

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| | | | | |
|---|---|---|---|---|
| **Cautionary notification boards** | About vehicle movement and the transit of waste | precautionary measures should the general public take. | Contractor | TSC/DPMU/ DPMC |

**Conclusion**

The dumpsite remediation activity at Kalpetta involves moderate social risks. However, a set of anticipated risks are mentioned in the scoping of social management plan to overcome the identified risks and its negative impacts. Formation and regular meeting of GRM & stakeholder's committee, awareness generation, counseling for the aggrieved parties, gender sensitization, legal awareness are the major proposed mitigation measures. This proposal is made to reduce the social risk associated with dumpsite remediation and to minimize the negative social impacts.

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ANNEXURES

## Annexure 1 – Environmental Screening

**Environmental Screening**

**Sub Project Details**

| Name of Subproject: | Dumpsite Biomining and Bioremediation |
|---|---|
| Sub project Components: | Dumpsite Biomining and Bioremediation |
| Subproject Location (City / Town/ Village with ward numbers): | Kalpetta ULB, Ward 23 Adlaid, Wayanad District. |

**Stage 1: Exclusion List**

| Sl.No | Non-permissible Activities |
|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i) any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to siting criteria as per SWM Rules 2016 (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible) |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides |
| The project does not fall under the above conditions as mentioned under exclusion list | |


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**Stage 2: Environmental Screening Checklist**

| Sl.No | Components | Details |
|---|---|---|
| 1 | Project Components | Dumpsite Biomining and Bioremediation |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste management, centralized non-biodegradable waste management facilities, centralized biodegradable waste management facilities, sanitary landfills, biomining of dumpsites, including for Linked activities / associated facilities) | This proposed project involves biomining of existing dumpsite.<br>This remediation process involves<br>**Pre-processing of legacy waste**<br>1. Clearing and grubbing of site<br>2. Windrow formation for stabilising the excavated waste<br>3. Windrow turning, tilling and cone formation<br>**Machinery erection**<br>1. Site levelling for Plant erection on the site and commissioning of machineries.<br>2. Operation of plant for processing the waste.<br>3. Office set up and fire safety measures<br>The byproducts of the process are<br>1. Bio earth and coarse fraction soil – will be used within the site<br>2. RDF – will be send to nearby waste to energy plants like cement plant and power plant which further processing it will be used as fuel<br>3. Recyclables – will be send to the authorised recycling agency |


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| Sl.No | Components | Details |
|---|---|---|
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project; including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination) Site Survey No:/s (attach map) with ownership details, Geographical co-ordinates of the site location (including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | Latitude: 11°35'26.2"N,<br>Longitude 76°03'21.1"E<br><br>Land ownership: Kalpetta Municipality<br><br>Land use: Public<br><br>Disaster Zone: It falls under Zone III (Moderate) |
| 4 | Land Area proposed to be used: Location wise (in sq. km / sq. m) | It is remediation of land and hence no land required |
| 5 | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | Operational phase – 0.5 KL/day<br>Domestic use – 1.0 KL/day |
| 6 | Power Required and Source of Power | Demand load for the proposed equipment during the remediation process is available and additional power required will be made available by DG sets |

**Baseline Environmental Conditions**

| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| 1<br><br>(i) | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers) | | No | The project site is not located near any Critically Vulnerable Coastal Areas (CVCAs), Eco sensitive Areas (ESAs) |


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| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| | Critically Vulnerable Coastal Areas (CVCAs), Eco sensitive Areas (ESAs) | | | |
| (ii) | Cultural Heritage site, protected monuments - listed by ASI/State | | No | The project site is not located near any cultural Heritage or protected monuments as listed by ASI/state |
| (iii) | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensative area, with any schedule 1 species? If yes, which is the area? | | No | The project site is not located near Natural Forests / Protected Areas / Bio-Reserves |
| (iv) | Other Wetlands/ Mangrove/ Estuarine Region | | No | The project site is not located near any Wetlands/ Mangrove/ Estuarine Region |
| (v) | Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves | | No | The project site is not located near any Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas areas with natural features like waterfalls, sacred groves<br>Banasuramala Meenmutty water falls located an aerial distance of 15 km from the proposed project site. |
| (vi) | Other Sensitive Environmental Components listed in EMF | | No | No other sensitive environmental components listed in EMF exist nearby the project site |
| (vii) | Drinking water source, upstream and downstream uses of rivers, etc | | No | No river source is resorted for drinking water use<br>Downstream the ground water source is available |


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| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| (viii) | Low-lying areas/areas of Tidal Influence (provide CRZ details) | | No | The sea is located 3 km (Aerial Distance) from the project site. There won't be any influence of tidal influence |
| (ix) | Sensitive Receptors – a) Habitations / Households / Hostels, other special areas, etc. b) School c) Religious Places d) Tourist Areas | Yes | | a. Nearest Habitation- Houses are located at an aerial distance of 700 m<br>b. Religious Place- Temple (Padapuram Sree Maheswari Temple) is located at an aerial distance of 1.35 km away from unit<br>c. School – Kristu Raja Public School is located at an radial distance of 450 m<br>d. Tourist Places – Chembra peak view point is located at an aerial distance of 5.75 km from the proposed project site. |
| 2 | Is the site in Critical / Over Exploited Ground Water Block. Provide the level of the groundwater table | | No | Semi critical |
| 3 | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other (specify) | | No | The site does not fall under major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion.<br>There may be chance of fire due to<br>1. Fire breaking due to high temperature<br>2. Electrical short circuit due to poor maintenance.<br>3. Smoking in the premises near the waste storage.<br>4. Burning of the waste by unauthorized persons<br>5. Keeping highly flammable materials like, cooking gas, kerosene, match boxes, etc.<br>6. Not having provisions for proper fire/smoke detecting system. |


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| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| 4 | Describe the type of soil and vegetation on site | Yes | | Hard laterite soil with few trees present in the site |
| 5 | Is the site present in the flood plains as recorded in the last 100 years. Provide the HFL level of the site/region | | No | The sea is located 45 km (Aerial Distance) from the project site.<br>During 2018 peak flood the site experienced minimal problems or issues. |
| 6 | Existing pollution/contamination or degradation on site | Yes | | Dumpsite located in Kalpetta ULB is the existing contamination and detailed under chapter 5 |
| 7 | Any other remark on baseline condition | Yes | | Based on the test result of environmental baseline for Kalpetta dumpsite certain parameters exceeds the permissible limits and test report are given under chapter 5 |

**Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology, and Soils**

| S.No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Total extend of land to be covered/built | Yes | | 3.65 acres |
| 2 | Total extend of land where the waste will be dumped openly / or expected to get contaminated by waste or leachate/material storage | Yes | | Due to open dumped area |
| 3 | Extend of Land to be remediated | Yes | | 1.12 acres |
| 4 | Extend of land expected to be under green belt | Yes | | Will be under the scope of contractor |
| | proposed project cause the following on Land / Soil: | | | |
| (i) | Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains | | No | There will be no major impact other than the operational phase as this project is remediation project. |


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| S.No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| | | | | During operational phase the anticipated impacts are identified and mitigation measures are provided |
| (ii) | Substantial removal of Top Soil (mention area in sqm) | | No | Nil |
| (iii) | Any degradation of land / eco-systems expected due to the project? | | No | There will be no Land degradation instead it will be a remediation of land from further contamination |
| (iv) | Loss or impacts on Cultural/heritage areas/properties | | No | There will be no loss or impacts onCultural/heritage areas /properties |
| (v) | Does the project activity involve cutting and filling/ blasting etc? | | No | The project does not involve cutting and filling/ blasting as the building is existing |
| (vi) | Will the project cause physical changes in the project area (e.g., changes to the topography) due to excavation, earthwork, or any other activity? | | No | The project will have change in a positive way by clearing the waste dumped into vacant land |
| (vii) | Will the project involve any quarrying/ mining etc? | | No | The project does not involve any quarrying/ mining |
| (viii) | Will the project / any of its component contaminate or pollute the Land? | | No | Presently there is contamination and due to the project activity the further contamination shall be eliminated and natural system shall be restored |


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| S.No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| (ix) | Will the project contribute to any long term significant adverse (negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | No | There will be no negative impact due to the proposed project |
| (x) | Will the Project or related activities cause negative impacts on the land in combination with other anticipated / existing projects in the region? | | No | There will be no negative impact due to the proposed project |

| S.No | Impacts on Air and Noise Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the project cause or increase air pollution due to dust and / or vehicle emissions? | Yes | | It will be temporary and adequate mitigation measures will be taken to reduce the impact during the operational phase. |
| 2 | Will the project cause or increase pollution due to GHG emissions? | | No | Nil |
| 3 | Will the project cause or increase odour nuisance? | Yes | | The Biomining project will be create odour nuisance but it is temporary and once the process is completed there will be no odour nuisance. |
| 4 | Is there a potential for release of toxic gases or accident risks (eg: potential fire outbreaks) | Yes | | There may be chance for any release of toxic gases or potential fire outbreaks which will be mitigated through proper mitigation plan by adopting gas collection system. |
| 5 | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | Yes | | The Biomining project will create increase in noise level but it is temporary and once the process is completed there will be no noise. |


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| S.No | Impacts on Water Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the activities proposed at the site(s) impact water quality (surface or ground) – leachate, runoff, wastes deposition, erosion? | | No | The leachate generated will be properly collected in leachate collection tank and thus avoiding the impact with the surface or ground water |
| 2 | Will the activities proposed at the site(s) impact water resource availability and use – leachate, runoff, wastes deposition, erosion? | | No | The leachate generated will be properly collected in leachate collection tank and thus avoiding the impact with the surface or ground water |
| 3 | Chances of Pollution of Water bodies / groundwater wells, nearby or downstream | | No | There will not be any chance of pollution of water bodies / groundwater wells, nearby or downstream |
| 4 | Will the activities proposed at the site(s) hinder natural drainage | | No | As the existing dumpsite will hinder the natural drainage pattern. The proposed activity once completed will improve the natural pathway without any obstacles. |
| 5 | Will the activities proposed at the site(s) decrease permeability /rainwater percolation | | No | The activities proposed at the site will not decrease permeability /rainwater percolation |


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| S.No | Impacts on Bio diversity & Host Communities | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the project necessitates cutting of Trees /Loss of Vegetation | | No | There will be no cutting of Trees. But there will be Loss of Vegetation due to this project |
| 2 | Will the project necessitate substantial removal of Top Soil (mention area in sqm) | | No | There will be no Substantial removal of Top Soil.<br>During the excavation of waste there is a slight chance of the top soil to get removed and the same will be mitigated with by-product (bio earth) of this activity |
| 3 | Any degradation of land / eco-systems expected due to the project? | | No | There will be no degradation of land / eco-systems expected due to the project activity.<br>Also, the proposed activity will protect the land from further contamination |
| 4 | Will the project result in Health & Safety Risks in the neighbourhood including the release of toxic gases, leachate, accident risks | Yes | | There may be chance of accidental risks due to leachate and toxic gases, which will mitigated by proper lined leachate drain and PPE kits |
| 5 | Potential Noise, Light Pollution/movements causing disturbance to nearby habitats/communities | | No | There will be no major impact.<br>During operational phase there will be noise pollution due to movement of vehicles which will be curtailed by adopting mitigation measures. |
| 6 | Potential disruption to common property, accessibility, traffic disruptions, conflicts, or disruption to the local community within the subproject area? | | No | There will be no major impact.<br>During operational phase there will be slight increase in traffic due to movement of vehicles which will be mitigated by adopting movement of vehicles during off peak hours.. |


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**Project Categorization and Need for Safeguards Instruments**

| Project category | ☐ E1 ☑ E2 ☐ E3 |
|---|---|
| Key Reasons | During screening, it has found that the proposed subproject is moderately causing impact to the base line environment, land/ soil / water /noise environment, biodiversity or to the community. Site is not close to any Environmental Sensitive Receptor. Moreover, Project results positive impacts on Environment. The Environmental Baseline analysis reveals that dumpsite not having any Heavy metal contamination. Hence it is categorized as E2. |
| Safeguards Instruments Required | a) E1: Project-specific EIA (impact assessment considering the project details & location) by Independent Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>b) E2: Project-specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>c) E3: signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities |

| Status | Agency / Official | Name, Signature with Date and Seal |
|---|---|---|
| Prepared by | PIU or ULB (project in charge) | |
| | Environmental Engineer | |
| Checked, categorised as ___ (E1, E2, E3) & Vetted/signed by: | DESDO / SESDO | |
| | Environmental Specialist | |


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## Annexure 2 – Fire and Risk Assessment

A fire and risk assessment is a systematic evaluation of potential fire hazards and associated risks within a particular environment or premises. The assessment aims to identify potential fire hazards, assess the level of risk they pose, and recommend measures to mitigate or manage those risks effectively. Fire and risk assessments are essential for ensuring the safety of the workers, protecting property, and complying with fire safety regulations.

The existing legacy waste dumpsite, occupying about 3.65 acres in ward 23, aims to fully reclaim the land for future development. Bio-mining, a technique chosen after careful evaluation will be used to recover the land and ensure sustainable and environmentally friendly treatment of the waste. The process will yield various by-products, which require immediate attention to prevent fire hazards.

The by-products are as follows:

1. The bio earth & C&D waste 5577 tons.
2. Retrieved plastics, rags, paper & other combustibles that cannot be recycled, but may be used as Refused derived fuel (RDF) 1792 tons.
3. Recyclables 271 tons

The retrieved plastics, rags etc that cannot be recycled and the recyclables if stored on site poses a potential fire risk and requires proper handling. To mitigate the risk, a storage and disposal process spanning 3 to 4 months shall be devised by the contractor in line with his work plan. During this period, the contractor shall implement various protective measures to prevent the possibility of a fire outbreak. These following measures are important for preventing fires, ensuring the safety of workers and nearby communities, and minimizing risks to the environment and property.

### Pre-Construction/Planning Stage:

1. Fire Safety and Emergency Plan: Develop a comprehensive fire safety plan and emergency response plan to address potential fire incidents.
2. Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard.
3. Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.
4. Fire Equipment: Ensure that the site is equipped with fire extinguishers.

### Storage of Waste & RDF:



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**Fire Standards and Facilities:** Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.

Below equipment and their required quantities should be strategically positioned according to the site's specifications.

- Fire extinguisher (A, B, C powder): It will be used to immediately put off fire caused by wood, Paper and textiles, flammable liquids and flammable gases. Commonly can be placed anywhere inside the site
- Fire extinguisher (Foam spray): Mainly used to put off the fire caused by flammable liquids. It should be placed in diesel storage area, lubricant storage area and DG sets.
- Fire extinguisher (Co2): Mainly used to put off the fire caused by Electrical short circuit. It should be placed near the control panel room/operation room.
- Fire bucket filled with sand: It should be placed near the diesel storage area

To ensure rapid response in case of a fire, it's essential to have a water tanker filled with water, equipped with a fire-fighting hose, readily accessible along with the portable motor. The presence of this equipped water tanker ensures timely and effective action during fire emergencies. All requirements in line with National / State regulations and as advised y the Local Brigade shall be arranged & followed

The following points to be considered for assessing the fire risk and procedure to mitigate it.

1. **Identification of Fire Hazards:** The first step involves identifying potential fire hazards in the premises. These hazards could include sources of ignition (e.g., electrical equipment), combustible materials (e.g., flammable liquids, paper, cardboard), and other factors that could contribute to the outbreak of a fire.
2. **Assessment of Risk:** Once the hazards are identified, the next step is to assess the level of risk associated with each hazard. This involves evaluating the likelihood of a fire occurring and the potential consequences if a fire were to break out.
3. **Escape Routes**: Since operational phase occurs in an open environment, the need for conventional escape routes in the event of a fire emergency may not be required.
4. **Fire Safety Measures:** The assessment reviews existing fire safety measures in place, such as fire alarms, fire fighting equipment, and fire suppression systems. Proper assembly point is required in case of fire break out
5. **Emergency Procedures:** The assessment evaluates the effectiveness of emergency procedures and evacuation plans in the event of a fire, ensuring that workers can safely evacuate the premises.
6. **Fire Training and Awareness:** The assessment considers the level of fire safety training provided to workers and the awareness of fire hazards and evacuation procedures.


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7. **Record-Keeping:** Detailed records of the assessment process, findings, and recommended actions are maintained for future reference and regulatory compliance.
8. **Recommendations:** Based on the assessment, the fire risk assessor provides recommendations for improving fire safety, which may include installing additional fire safety equipment, conducting training programmes, or implementing any changes to reduce fire risks.
9. **Review and Updates:** Fire and risk assessments should be regularly reviewed and updated to account for any changes in the premises or regulations.

Fire and risk assessments play a crucial role in preventing fires and minimizing their impact if they occur. They are particularly important for dumpsites and other places with a higher risk of fire hazards to ensure the safety and well-being of workers.

NOTE: The major assessments had been referred based on the EMF Vol-II Part A - Indicative EMP.

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## Annexure 3 – Dumpsite screening checklist

Checklist for screening of dumpsites for potential landfill/ processing facility

| Name of the contact person from ULB/ Phone number and email Address | Kalpetta |
|---|---|

| S.No. | Item | Norm | Information |
|---|---|---|---|
| 1 | Land ownership (including that required for approach road) (in line with revenue records) (supporting data to be provided as annex) | | Kalpetta Municipality |
| 2 | Name of the location of site and Map of the site (include as an annex) | | Adlaid, Kalpettaa |
| 3 | GPS coordinates of site | | Latitude: 11°35'24.276"N, Longitude 75°03'19.277"E |
| 4 | Is there a Pollution Control Board permit for dumping/SWM activity? | | Yes |
| 5 | Is there a notified no development zone or buffer or green belt around the dump? | | No |
| 6 | Possible area to be kept as buffer green belt around (within / outside the site for purchase) | | Not available |
| | Site Selection Criteria - give distances, wherever applicable | | |
| 7 | Groundwater (m below liner bottom) | 2m | No |
| 8 | Private water sources (well etc.)- distance from site boundary (to be | 100 m (river) | No |
| | | 200 m (Pond) | No |
| | | 30 m (Local Canal) | No dumpsite |


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| | | | |
|---|---|---|---|
| | adjudged based on approx. distances during screening exercise) | | |
| 9 | Env. Sensitive Areas/ Wetlands | Not Permitted | No |
| 10 | Site having Rare and Endangered Species | Not Permitted | No |
| 11 | Site should not be within Protected/ Reserve Forests | Not Permitted | Site is Not within the Protected/ Reserve Forests |
| 12 | Residential Development within prescribed buffer zone of 200 m | Not Permitted | No. Local Residents nearby Dumpsite within 400 m |
| 13 | Perennial Stream within site | Not Permitted | No |
| 14 | Airport | 20 Km | No |

| S.No | Item | Norm | Information |
|---|---|---|---|
| 15 | Distance to the nearest village in the predominant wind (m)direction | | Adlaid |
| 16 | Flood prone site | | No |
| 17 | Accessibility - Road access for heavy vehicles | | 5 m wide Approach road. Adlaid - Kalpetta |
| | i. Starting point of the access road | | Kalpetta |
| | ii. length and width of the access road | | 3.5 m wide |
| | iii. Current condition of the access road (visual assessment) | | Tarring Road with good condition. |

| S.No. | Site Description | | |
|---|---|---|---|
| 18 | Is the site flat/sloping to nearby uses | | Flat |
| 19 | Soil base-soft soil/murrum,soft rock etc | | Hard Laterite soil |
| 20 | Direction of Leachate flow out of the site, if any | | No. The biodegradable waste |


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| | | | |
|---|---|---|---|
| | | | dumping stopped since 2010 |
| 21 | Other uses within the dumpsite(recycling yard, compost pad etc) | | Existing MCF&RRF building. |
| 22 | Boundary conditions-walls/fence/what land uses along boundary | | Compound wall |
| 23 | Year since the dump site is existing | | 1970 |
| 24 | Is the dumping Operation Ongoing | | Stopped the Biodegradable waste since 2010 |
| 25 | Any underground utility/gas line etc near the site | | No |
| 26 | Existing power supply, water supply, electric poles going through/over/in the site etc. | | No |
| 27 | Are there pools of leachate ,rat and fly infestations, domestic animals roaming freely, odours,dust, vermin and birds,waste being burnt at dumpsites or families of scavangers picking through the wastes | | No |

| Geography and Climatic aspects | | | |
|---|---|---|---|
| 28 | Average annual rain fall | | 3502 mm |
| 29 | Duration of rainfall | | May to August |
| 30 | Whether any incidents of flooding reported at site/other hazards | | |
| | No | | |
| | Very Rare | | Very Rare |
| | Some times | | |
| | Frequent | | |
| 31 | Any geological fault | | No |


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| | | | |
|---|---|---|---|
| **Waste Characteristics** | | | |
| 32 | Characteristics of the dumps, such as the height and area, characteristics of solid waste based on visual inspection and degree of compaction (subjective), and any details of variability of wastes within the site. | | 7640 tons |
| 33 | Type of waste (MSW/HW) (subjective assessment based on visual inspection) | | MSW |
| | i. 100% MSW | | |
| | ii. 75% MSW +25% (domestic and/ or biomedical/ HW/EW) | | Yes |
| | iii. 50% MSW +50% (domestic and/ or biomedical /HW/EW) | | |
| | iv. > 50% (domestic and/ orbiomedical /HW/EW) | | |
| 34 | Expected waste contamination (visual check of ground water, littering, dust pollution, Smell/odour, Is the ground water being used for drinking purpose) | | Ground water not used for drinking |
| 35 | How much quantum of fresh waste is dumped every day? | | Stopped the dumping of waste. |
| **General Information** | | | |
| 36 | Any reported Environmental and health impacts of existing dump (from ULB eg-media report or complaint) | | NO |
| 37 | Any ongoing litigation or disputes related to site usage | | NO |


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| | | | |
|---|---|---|---|
| 38 | Potential for mining decomposed organic materials (compost from the existing dumps (By visual inspection) | | NO |
| 39 | Presence of rag pickers and approx.. How many/ Male/Female and age group | | Not available as on visit time. |
| 40 | Number of sensitive receptors close to dumpsite (approx.200 m which is buffer zone criteria) (mention distance to closest residence, social profile of the people, school, religious structure, wetland, forest, river, canal, Eco sensitive area, well, lake/pond) | | Nearby Kabini river with in 2 km named as Kabini river ,Kristu raja public school within 500m. |
| 41 | Available open / clean space in the dump yard which can used to develop a treatment facility till such time the dump is cleaned, and land is recovered (percentage of land available for use) | | Yes |
| 42 | Space / covered shed (which may be renovated to house segregation & storage facility) | | No |
| 43 | Estimated time for dumpsite capping/ mining/ remediation. Does it fall within the project lifetime? | | 150 days |
| 44 | Possible Range of solutions: rehabilitate existing open dumps through landfill mining where the resource recovery might serve as a source of energy, recycle and reuse of metals, plastic and glass ware, use of compost as fertilizer for agriculture and as a cover material for future landfills, etc. | | RDF materials can be processed and used for cement kilns. |


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| | | | |
|---|---|---|---|
| 45 | Is dumpsite remediation likely to benefit in regaining a suitable site for an engineered landfill cell or for setting up any other waste management facility? If yes, what could be set up? | | According to feedback from nearby residents, there is a demand for the establishment of a Recreational Park. |
| 46 | Likely area of the site which can be salvaged for future use More than 70%, 50-70%, 30-50%, Less than 30% | | 50 % . |

| | | | |
|---|---|---|---|
| **Upstream Linkages required** | | | |
| 47 | Stop the waste coming to the site or delineate a separate area for proper processing of waste. | | Dumping of waste stopped |
| 48 | Intention of anchor ULB (where the site is located) to allow the facility to be used as a regional facility, with other ULBs falling in the cluster, on a cost sharing basis. | | After thorough stakeholder consultation, the recommendation is to process the waste at a standalone site. |
| **Downstream Linkages required.** | | | |
| 49 | Off-take of all the products coming out of the biomining - Plastic & RDF - cement factories, soil/bio-earth - farmers or gardens, inert - SLF/closure | | Forward linkage for the RDF yet to be finalized |
| 50 | Any wastewater treatment facility whether available within 10 km where leachate can be transported for treatment. | | No |


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## Annexure 4 - Occupational Health and Safety

Occupational Health and Safety Risk Assessment for Dumpsite Remediation is as follows

**1. Introduction:**

The purpose of this Occupational Health and Safety (OHS) Risk Assessment is to identify, assess, and mitigate potential hazards and risks associated with the implementation of a Biomining project for dumpsite remediation. Biomining is a sustainable and environmentally friendly method used for the disposal of dumped waste and reclamation of land.

**2. Scope:**

This risk assessment focuses on the occupational health and safety aspects of the Biomining process for dumpsite remediation. It covers the potential hazards and risks that workers may encounter during site preparation, Biomining operations, and waste disposal activities. The assessment will also outline control measures to minimize or eliminate these risks.

**3. Hazard Identification:**

Biomining process identifies potential hazards, which include but are not limited to:

a. Chemical Hazards: Exposure to hazardous chemicals present in the dumpsite waste and chemicals used in the Biomining process.

b. Biological Hazards: Potential health risks associated with the presence of pathogens, disease-causing microorganisms, and vectors within the waste. These hazards can arise from the decomposition of organic matter, the presence of infectious materials, and the attraction of disease-carrying organisms such as rodents, insects, and other vermin.

c. Physical Hazards: Potential for slips, trips, and falls on uneven terrain or during equipment operation.

d. Mechanical Hazards: Risks associated with operating and maintaining heavy machinery.

e. Ergonomic Hazards: Strain and injuries related to improper handling of equipment or materials.

f. Environmental Hazards: Adverse effects on air and water quality during the Biomining process.

**4. Risk Assessment:** The risk assessment will categorize the identified hazards based on their severity and likelihood of occurrence. Each hazard will be evaluated using a risk matrix to determine the level of risk and priority for mitigation.

**5. Risk Mitigation Measures:**



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To ensure the safety of personnel involved in the Biomining project, the following risk mitigation measures will be implemented:

a. Engineering Controls:

- Regular maintenance and inspection of machinery to prevent mechanical failures.

- Providing appropriate personal protective equipment (PPE) to workers.

b. Administrative Controls:

- Developing standard operating procedures (SOPs) for Biomining operations.

- Implementing a comprehensive training program for all personnel involved in the project.

- Scheduling regular breaks and rotation of tasks to minimize fatigue.

c. Environmental Monitoring:

- Regular monitoring of air and water quality to ensure compliance with safety standards.

- Establishing emergency response protocols in case of any unexpected environmental events.

d. Emergency Preparedness:

- Developing and practicing emergency response plans for potential accidents or incidents.

- Providing workers with first-aid training and easily accessible medical facilities.

e. Personal Protective Equipment (PPE):

- Mandating the use of appropriate PPE, such as respirators, gloves, safety goggles, and protective clothing.

**6. Worker Health Surveillance:**

Implementing a health surveillance program to regularly monitor the health of workers involved in the Biomining project. This may include medical examinations and assessments to detect any health issues related to exposure during the remediation process.

The work site to be equipped with first aid and the contractor must have tie-up with nearest primary health center/ medical facility for the welfare of the labors.

**7. Training and Education:**

Conducting comprehensive training and educational programs for workers and supervisors to raise awareness of potential hazards, proper handling of equipment, and the correct use of PPE.

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## 8. Conclusion:

By proactively identifying potential hazards, assessing risks, and implementing appropriate control measures, this Occupational Health and Safety Risk Assessment aims to ensure the safe and successful execution of the dumpsite remediation Project through Biomining. Continuous monitoring and improvement will be essential throughout the project to maintain a safe work environment.

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FEASIBILITY REPORT

# DUMPSITE BIOMINING AND BIOREMEDIATION, ADLAYED KALPETTA MUNICIPALITY



NOVEMBER 2023

KSWMP

LSGD

LSGD

State Project Management Unit

Kerala Solid Waste Management Project (KSWMP)

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## EXECUTIVE SUMMARY

Kalpetta is a Municipality in Wayanad District, of Kerala State. Even though the ULB has an excellent practice of waste management, the primary environmental issue currently faced by municipal authorities revolves around a longstanding existing legacy waste dumpsite. Despite discontinuing waste dumping activities, these dumpsites remain as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. As a consequence, these sites pose significant environmental, social, and economic challenges for the communities and ecosystems surrounding them. The SWM Rules 2016 directs all local bodies to identify the legacy dumpsites and to scientifically remediate it in order to ensure a safe and healthy environment. In acknowledgment of this imperative, the Government of Kerala has undertaken the endeavor through the Kerala State Solid Waste Management Project (KSWMP) to address the issue of remediating legacy waste dumpsites across all Urban Local Bodies (ULBs). As a component of the project's first phase, the remediation of the existing dumpsite located in Adlayed, Kalpetta, has been proposed.

The Kalpetta municipality has an area of 40.74 sq.km with 28 wards. The municipality intend to remediate the existing legacy waste dumpsite at Adlayed and recovery land for development of waste management activities. The Adlayed dumpsite is used for dumping of solid waste from the year 1989 to year 2010. The dumping of the solid waste was stopped due to protest from the local residents for addressing the issues of the problems created by odour and leachate from dumpsite and local residents are in demand to remediate the legacy dumpsite and to utilize the remediated land for social cause. The total quantity of legacy waste is estimated to be approximately 7227.86 Tons. Since the cessation of dumping activities in 2010. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes.

To assess the quantity & composition of the legacy waste & also evaluate the environmental baseline of the dumpsite, the samples from the strategic locations were collected and analyzed for various parameters viz., physical and chemical analysis of Legacy waste, Soil, Air, Noise, leachate, Ground Water and Surface Water. As part of the study, detailed site investigations were carried out as follows – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Chemical, Environmental Analysis by M/s Poluchem Laboratories. From the results of the investigations, it was found that the waste was found to a depth of 3 m. The total estimated quantity of legacy waste was found to be around 9485.375 m3 (7227.86 T)

As per the SWM Rules 2016, selection of the applicable method/type or technique for dumpsite remediation needs to be arrived from the Feasibility study carried out and based on the results, remediation can be done by a) Capping without land recovery, b) Bio-mining – reclamation/recovery of land c) capping with partial land recovery. The selection of technology shall also depend on the available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for optimum land recovery and forward linkages/utilization of processed aggregates/by-products. Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term

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sustainability and environmentally sound treatment of legacy waste and optimum land recovery/remediation legacy waste dumpsite.

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by-products as per the requirements of the utilization/forward linkage. Based on the detailed assessment of the selection parameters, mobile/compact screening is the machineries are which shall be the optimum screening machineries for processing the stabilized legacy waste of 9485.375 m3 within the stipulated timeline of 31st March 2024 by NGT for remediation of legacy waste dumpsite.

Environmental & Social safeguards: The project attracts E2 Environmental category based on the project activities and status of the environment baseline. The project is categorized as possessing a moderate level of social risk, as determined through social mapping and a transect walk. This involves engaging with the local community residing near the prospective project site to evaluate the challenges posed by the existing legacy waste dumpsite and the potential ramifications during the project's implementation.

By-products utilization/forward linkages/Usage

The bio earth & inerts quantity 4742.69 m3 & 2181.64 m3 and waste will be utilized for development of the reclaimed legacy waste dumpsite as recreational park/facility.

Refused derived fuel (RDF) of 2224.32 m3 will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the processes

Recyclables of 336.73 m3 will be sold to authorized recyclers and will be collected from the dumpsite.

The activities of the bio-mining will be commenced from the Dec 2023 and end by Mar 2024. An expanse of 1.12 Acre is designated for reclamation, aiming to transform it into a facility like potential public-access green park etc., The project is projected to incur a total expenditure of [redacted]/-. The expense linked to the processing and disposal of legacy waste per cubic meter amounts to [redacted]**/-.**

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## 1. INTRODUCTION

Kalpetta Municipality stands as a swiftly advancing urban local body within the Wayanad district. While demonstrating commendable waste management practices, the principal environmental concern confronting the municipal authorities pertains to an enduring legacy waste dumpsite. Despite ceasing waste disposal operations, these residual dumpsites persist from an era when waste disposal practices were less sophisticated and ecologically attuned compared to the present standards. Consequently, these sites present substantial environmental, societal, and economic complexities for the neighboring communities and ecosystems.

As the SWM Rules 2016, all local bodies to identify the legacy dumpsites and to scientifically remediate it in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the project of remediation of legacy waste dumpsites in all the ULBs. As part of the project, in phase -1 the existing dumpsite of Adlayed, Kalpetta is proposed to be remediated.

The legacy waste dumpsite remediation needs to be arrived from the feasibility study outlining the technical, economic, and social factors which will have implication of the process of remediation of legacy waste dumpsite. Based on the detailed field investigations & assessment and market sounding, the method proposed for remediation of legacy waste dumpsite will ensure long term sustainability and environmentally sound treatment which will be technically feasible, economically viable, and socially acceptable. `

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## 2. GENERAL DESCRIPTION ABOUT PROJECT

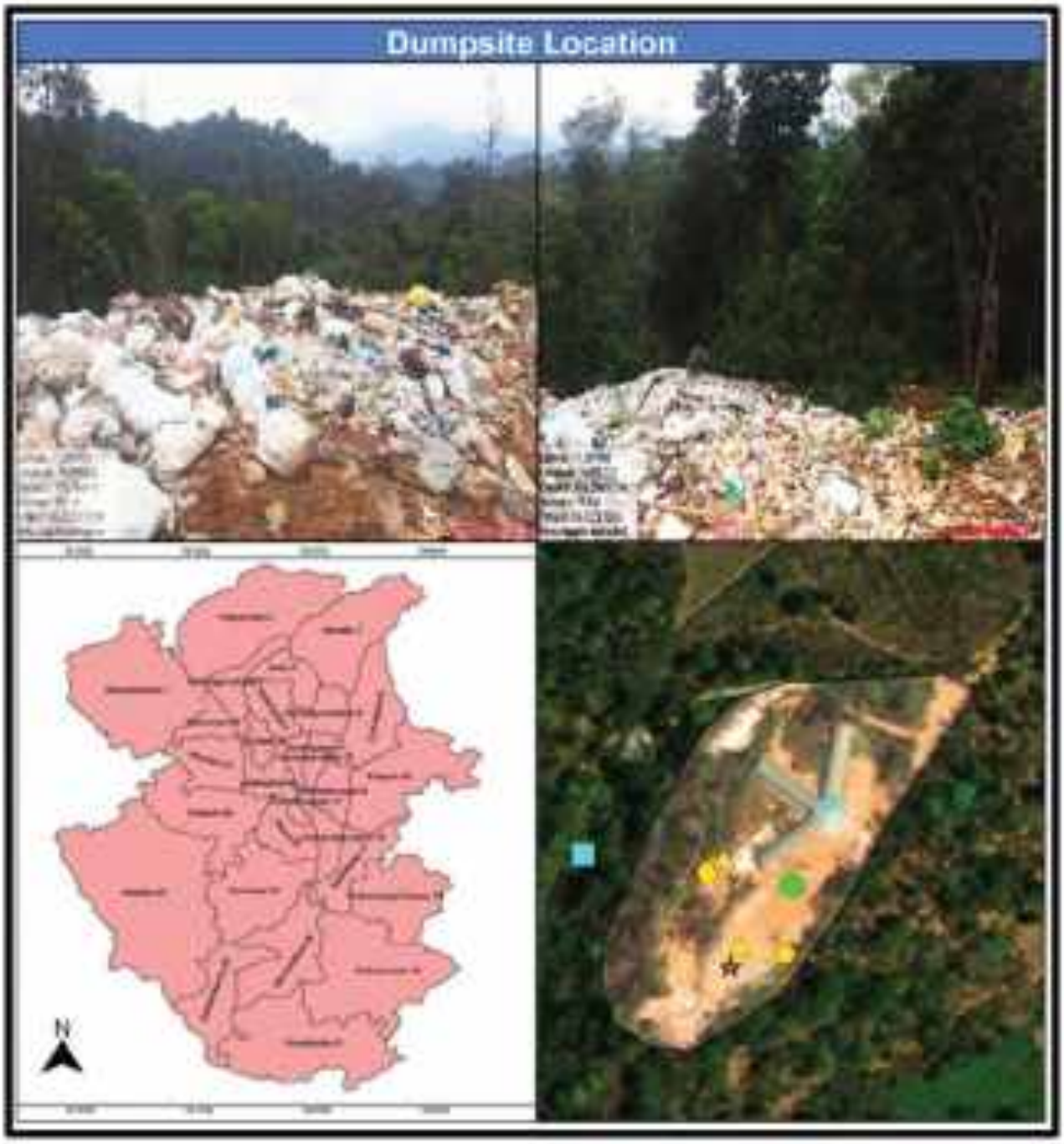
The Kalpetta municipality has an area of 40.74 sq.km with 28 wards. Solid waste generated from 9216 households and 2492 institutions including commercial establishments. The municipality intend to strengthen and enhance the existing treatment facilities of the bio degradable & non – degradable waste system at household, institutional and community level for effective management of the solid waste generated and also remediation of existing legacy waste dumpsite.

The Adlayed dumpsite was used for dumping of solid waste from the year 1989 to 2010. The dumpsite is closed due to public protest. The legacy waste is spread in an area of 1.12 acres with approximate height of 3 m and a portion of the dumpsite is capped as part of the remediation. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes. The municipality intend to remediate the existing legacy waste dumpsite at Adlayed, Kalpetta and recovery land for development of recreational park for the public. The details of the legacy waste dumpsite are provided below:

*Table 1 Dumpsite Details*

| Name of ULB | Kalpetta |
|---|---|
| District | Wayanad |
| Taluk | Kalpetta |
| Location | Adlayed, Kalpetta - ward 23 |
| GPS Co-ordinate of the Site | Latitude: 11°35'24.3"N and Longitude: 76°03'19.2"E |
| Total dumpsite area (in acres) | 3.65 |
| Legacy waste spread (in acres) | 1.12 |

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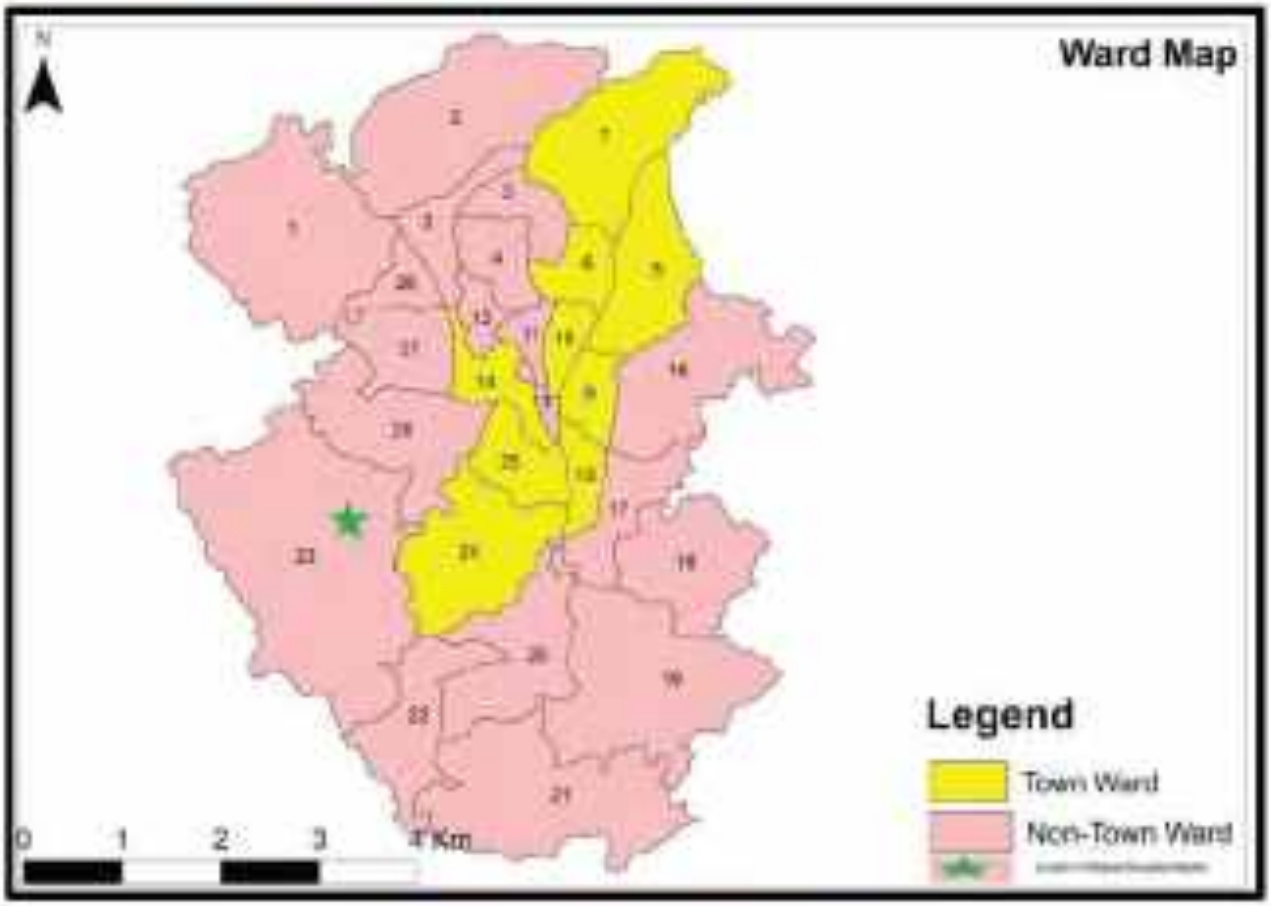



*Figure 2 Dumpsite location Map*

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## 3. LOCATION, DEMOGRAPHY, ACCESS, LAND-USE, WATER TABLE AND CLIMATE OF THE ULB

### 3.1 LOCATION

Kalpetta is a major town and municipality in the Wayanad district. Kalpetta is the headquarters of Wayanad district as well as the headquarters of Vythiri taluk. It is a bustling town surrounded by dense coffee and tea plantations and mountains. It lies on the Kozhikode-Mysore National Highway NH 766 at an altitude of about 780 m above sea level.




The Kalpetta municipality has a total area of 40.74 Sq. km. The land use indices of Kalpetta municipality are shown in below figure

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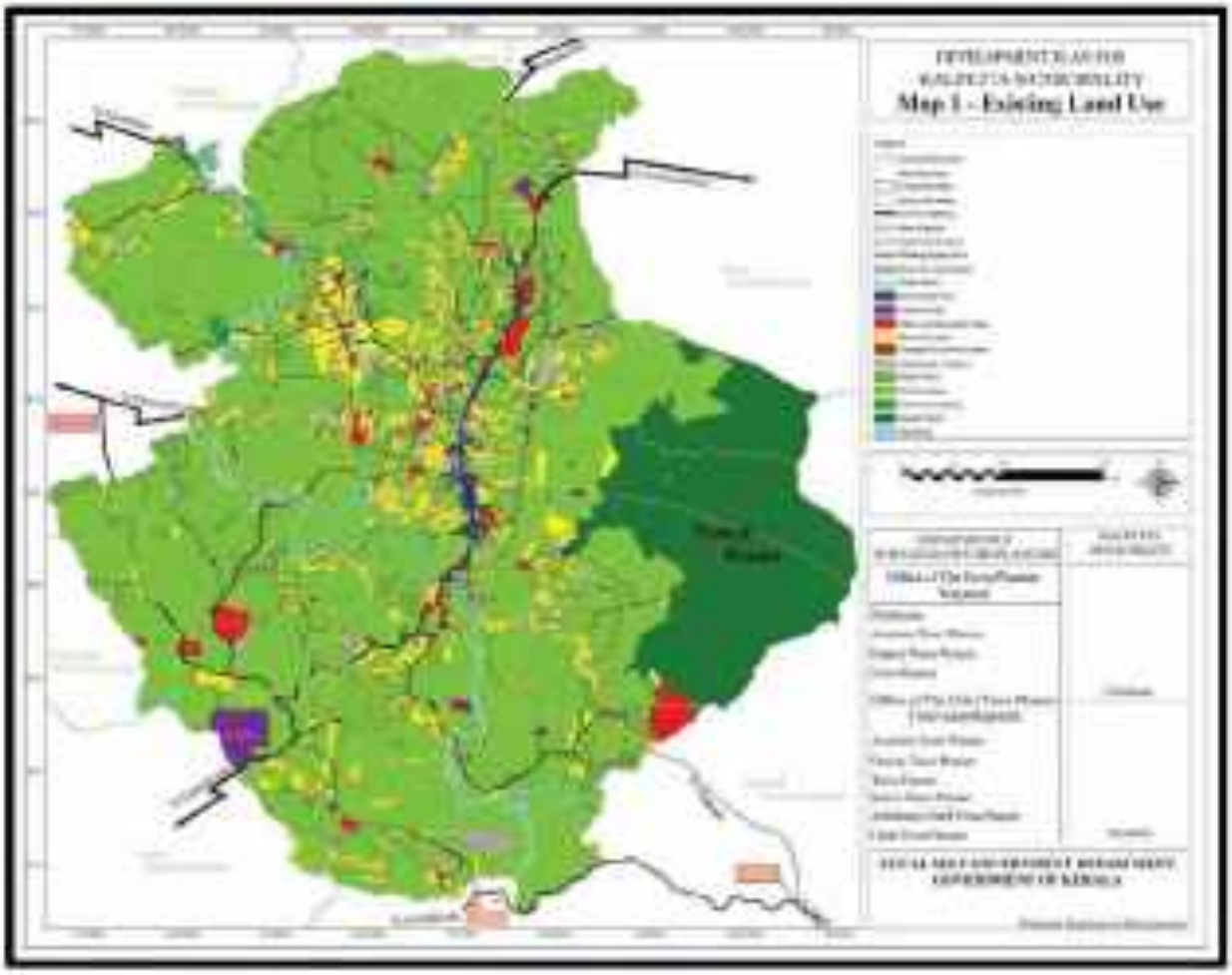



*Figure 4 Land Use Map of Kalpetta Town*

### 3.2 POPULATION, DENSITY AND LITERACY RATE

As of the 2011 Census of India Kalpetta had a population of 31580, with males constituting 15401 of the population and females 16179. The sex ratio is 1051 females for 1000 males. The gross density of population as per 2011 census is 780 persons/sq. km. Kalpetta has an average literacy rate of 91.18%, higher than the national average of 74.04%; male literacy is 94.13%, and female literacy is 88.40%. The population of children below 6 years is 3597.

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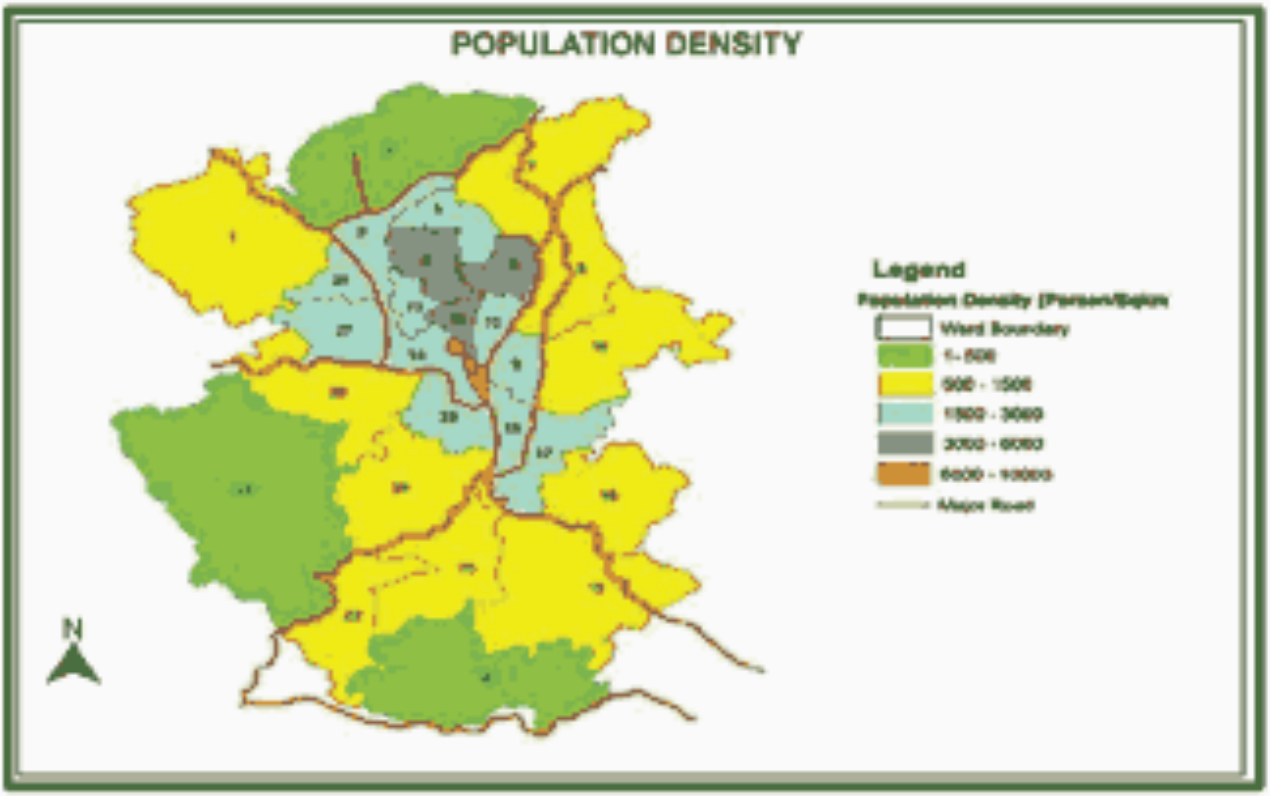



*Figure 5 Ward Wise Population Density (Person/ha)*

### 3.3 LAND USE

The Kalpetta municipality has a total area of 40.74 Sq. km. The land use indices of Kalpetta municipality are shown in below figure. The study area's land use has been assessed through satellite data interpretation and confirmed during on-site visits. The primary findings regarding the Kalpetta Dumpsite from this analysis are as follows:

1. The predominant land use in the area is residential.

2. There is a nearby Fecal Sludge Treatment plant located approximately 120 meters away.

3. A Concrete Batching Plant is situated at an approximate distance of 300 meters.

4.Swamp is located near 350 m from dumpsite.

The land use indices of Kalpetta municipality are shown in below figure.

Table 2 Land use indices

| Description | Area (in sq.km.) | Land Use % |
|---|---|---|
| Residential | 7.4 | 18.2% |
| Commercial | 0.5 | 1.2% |
| Agricultural | 23.4 | 57.6% |
| Recreational, open space | 0.1 | 0.1% |

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| Description | Area (in sq.km.) | Land Use % |
|---|---|---|
| Transportation | 0.8 | 2.0% |
| Water bodies | 0.9 | 2.1% |
| Forest | 6.2 | 15.2% |
| Revenue Surplus land | 1.0 | 2.4% |
| Other Vacant land | 0.1 | 0.2% |
| Other (specify)- Industries | 0.4 | 0.9% |
| Total | 40.80 | 100 |

Source: Master Plan for Kalpetta town 2031(draft)

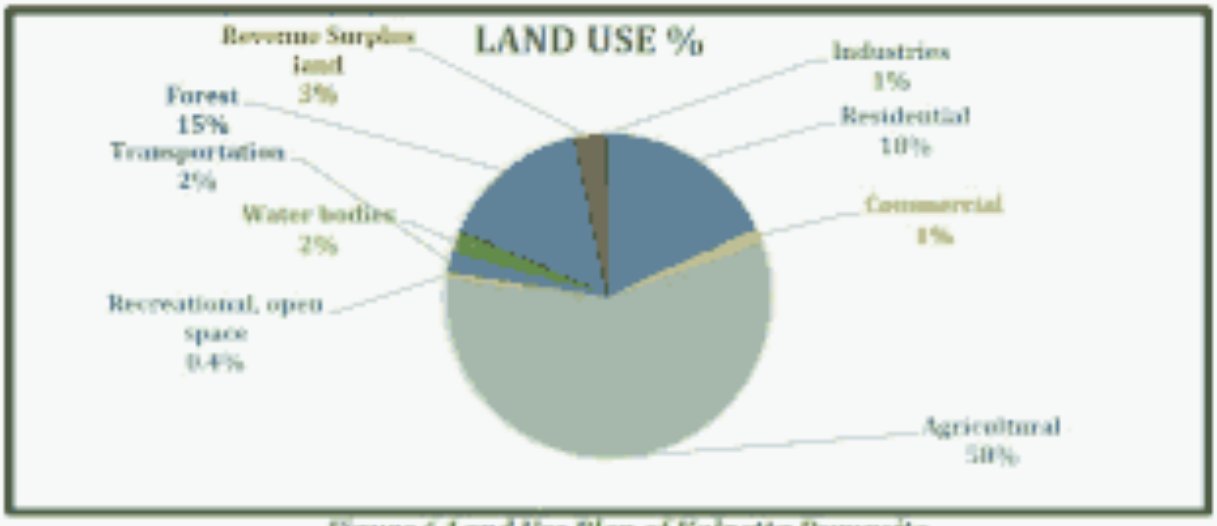



*Figure 6 Land Use Plan of Kalpetta Dumpsite*

*Source - http://townplanning.kerala.gov.in*

### 3.4 TRANSPORTATION CORRIDOR

*Table 3 Transportation corridor details*

| Mode | Details |
|---|---|
| Road | Kalpetta has very good road connectivity with the rest of Kerala and neighbouring South Indian cities. NH766 connects Kalpetta with Kozhikode and Mysore. State Highways connect Kalpetta with Ooty in Tamil Nadu and Madikeri in Karnataka. En route to Mysore on NH 766, past Wayanad district boundary, NH 766 passes through Bandipur National Park. |
| Train | No railway station in Kalpetta municipality. The nearest major railway stations are Kozhikode (72Km) and Vadakara (83 Km). |

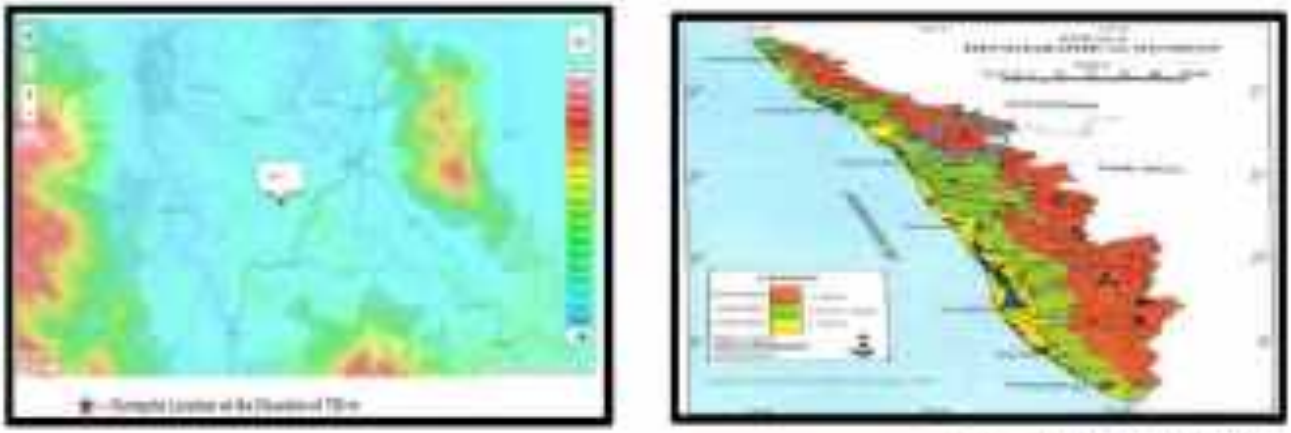
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| Mode | Details |
|---|---|
| Air | The nearest airport is Calicut International Airport 00 km and Kannur international airport is 95 km from Kalpetta. |

NOTE : The access road leading to the dumpsite, known as Puzhamudy-Adlayed road, measures 5 meters in width. The link from the Puzhamudy-Adlayed Road to the dumpsite is crucial, but it presents a significant challenge as it is quite narrow, with widths dropping below 3 meters in certain sections. This limited width poses a concern for fire rescue vehicles, and it also makes it impractical for larger vehicles such as the Mobile trommel and other heavy vehicles to reach the dumpsite via this narrow road

### 3.5 TOPOGRAPHY

Majority of the land area in Kalpetta is highland. The elevation of Kalpetta Municipality is ranges between 700m to 2000m. The type of land in this area can be classified as predominantly mountainous terrain with undulating hills and valleys. The region is covered with dense forests, tea and coffee plantations, paddy fields, and other agricultural lands. The soil in this area is rich in minerals and organic matter, making it suitable for growing a variety of crops.



Source: en.in.topographic-map.com

*Figure 8 Topography Map for the Kalpetta*

### 3.6 CLIMATIC CONDITION

#### 3.6.1 TEMPERATURE & RAINFALL

Kalpetta Municipality falls within the tropical to sub- tropical climatic region and dominant feature is the monsoon. The maximum temperature in the region varies almost between 24.4°C to 30.4°C and minimum temperature ranges from 16.7°C to 20.8°C. The annual rain fall is 2904mm.

*Table 4 Temperature & Rainfall Data - Kalpetta*

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average high °C | 27.2 | 28.8 | 30.4 | 30.4 | 29.4 | 25.9 | 24.4 | 25.1 | 26 | 26.6 | 26.5 | 26.5 |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average low °C | 16.7 | 17.9 | 19.5 | 20.8 | 20.8 | 19.7 | 19.3 | 19.4 | 19.2 | 19.4 | 18.6 | 17 |
| Average precipitation mm | 4 | 10 | 19 | 99 | 210 | 664 | 1229 | 637 | 275 | 239 | 92 | 18 |

Source: Climate-Data.org

According to the Rainfall Data, the most favourable working period spans from December to March due to the lower precipitation levels.

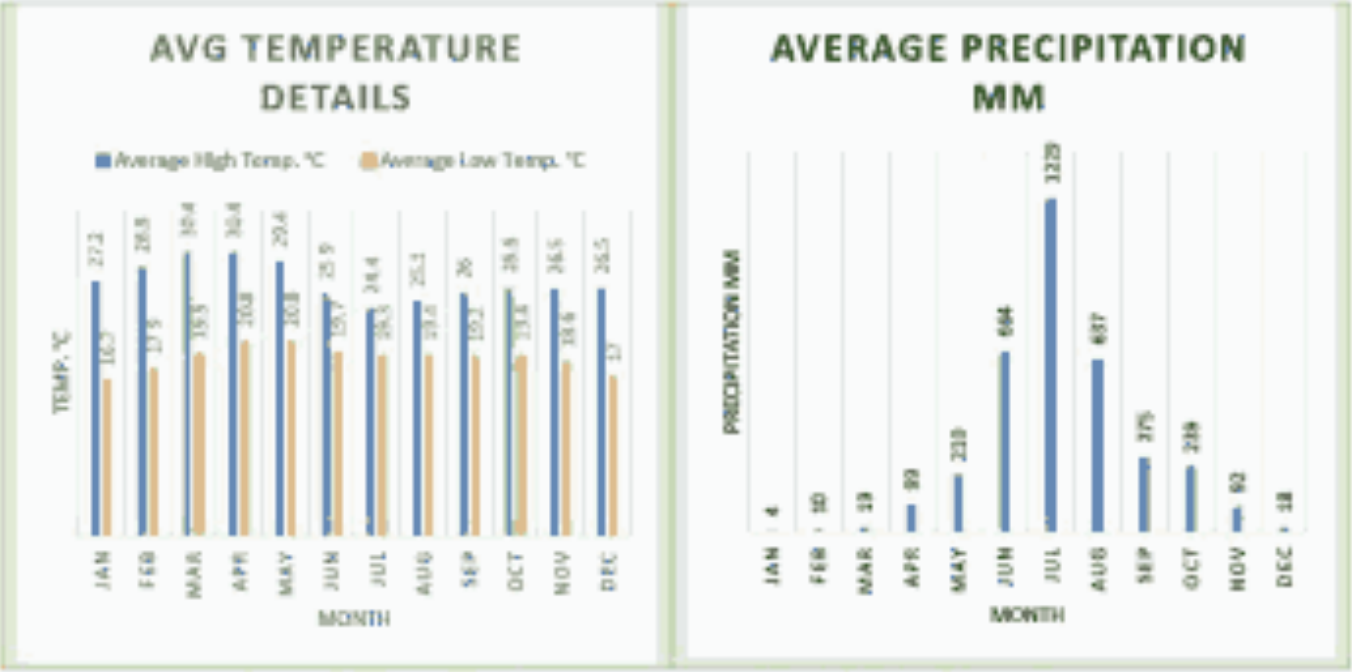



*Figure 9 Monthly Variation of Climate and Rainfall for Kalpetta Town*

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### 3.7 FLOOD ZONE

According to the 2022 Flood Probability Report published by the Kerala State Disaster Management Authority, the Kalpetta municipality has an area of 0.31 square kilometers (1.85% of the total area of 16.76 square kilometers) that is susceptible to flooding, with a peak elevation of 1.48 meters.

*Table 5 Flood zone details*

| DESCRIPTION | BASE YEAR | 1 in 10 YEAR (CC - RCP 8.5) | | 1 in 25 YEAR (CC - RCP 8.5) | | 1 in 50 YEAR (CC - RCP 8.5) | | 1 in 100 YEAR (CC - RCP 8.5) | |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | 2011 | Flood Inundation Area ($km^2$) | Max. Flood Level (m) | Flood Inundation Area( $km^2$) | Max. Flood Level (m) | Flood Inundation Area( $km^2$) | Max. Flood Level (m) | Flood Inundation Area( $km^2$) | Max. Flood Level (m) |
| | | 1.27 | 3.94 | 1.28 | 1.61 | 1.29 | 4.13 | 1.31 | 4.13 |

Source: *Flood Probability Report - KSDMA*

### 3.8 EARTHQUAKE ZONE

The Bureau of Indian Standards (BIS) has grouped the country into four seismic zones viz. zones II, III, IV and V as detailed in the Map below. The Kerala state falls under Seismic Zone 3.

### 3.9 COASTAL REGULATION ZONE

As per the Coastal Regulation Zone (CRZ) notification 2011 and further amendment in CRZ notification 2019, the Kalpetta legacy dumpsite does not fall under the CRZ zone.

### 3.10 GROUND WATER LEVEL

The details of groundwater level during pre-monsoon and post-monsoon, and the average fluctuation is provided in the table below.

*Table 6 Details of Ground Water level*

| Pre-monsoon (m) | Post-monsoon (m) | Avg. Fluctuation (m) |
|---|---|---|
| [illegible] | 6.31 | 1.37 |

Source: *Ground Water Information Booklet of wayanad District, Kerala State, CGWB*

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## 4. DETAILED DESCRIPTION OF THE DUMPSITE

### 4.1 PHYSICAL FEATURE OF THE SITE

The total expanse of the dumpsite measures approximately 3.65 acres, with a portion of 1.12 acres being occupied by legacy waste. The average elevation of this legacy dumpsite is 5 meters (as per total station survey). This historical waste repository is situated at geographical coordinates Lat: 11° 35'24.276" N, Long: 76°03'19.277" E in the region known as Adlayed (ward-23), within the Kalpetta district of Wayanad.

### 4.2 INFORMATION ON SITE MANAGEMENT

The Adlayed dumpsite has served as a repository for solid waste disposal from 1989 to 2018, spanning a period of over 40 years. This site is closed in 2010. The compound wall is available at front side of dumpsite only.

To mitigate any potential disruption to the workforce in close proximity to the MCF/RRF facility, a dedicated access point has been established for entry to the biomining worksite.



*Figure 10 Proposed New Entry for the Biomining Site*

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### 4.3 SITE HISTORY INCLUDING PUBLIC PROTEST

In 2009, a protest emerged in response to the disposal of human excreta at a designated dumpsite. Up to 2000 the waste was dumped near to the NH at Vellaramkunnu. Due to public agitation waste transferred to the current land parcel. After the great flood 2018, enormous quantity of waste also dumped in this place. Rather than proper capping for the sake of concealing waste from view and to abate odour spread ULB used to lay a layer of soil intermittently.

### 4.4 DIRECTIONS FROM AUTHORITIES LIKE NGT, PCB, ETC.

#### 4.4.1 NGT DIRECTIONS & ORDERS

The National Green Tribunal (NGT) has set norms and guidelines (O.A. No. 606/2018) to address legacy waste accumulated at long-operating dumpsites, to mitigate environmental and health hazards. The norms focus on closure and remediation of dumpsites, waste segregation and treatment using appropriate technologies, conducting Environmental Impact Assessments (EIAs), implementing land use planning and zoning regulations, monitoring and compliance measures, and promoting public participation and awareness regarding legacy waste management. These guidelines aim to stabilize dumpsites, prevent further pollution, and involve communities in decision-making and risk education.

#### 4.4.2 LOCAL SELF GOVERNMENT DEPARTMENT - GUIDELINES

The remediation of dumpsites is further directed by Honorable NGT in its order OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. Remediation of Legacy Waste Dumpsites through Bioremediation - G.O.(Rt)No.2629/2022/LSGD Dated, Thiruvananthapuram, 29-10- 2022

#### 4.4.3 KSPCB - GUIDELINES FOR DUMPSITE REMEDIATION

The Kerala State Pollution Control Board (KSPCB) has established guidelines (PCB/HO/SEE2/Model City/Kozhikode corporation/2019 dated 09/09/2021) for dumpsite remediation to address the environmental and health impacts of waste disposal. The recommended steps include conducting a site assessment, developing a remediation plan based on risk assessment, selecting appropriate remediation technologies, implementing remediation activities under supervision, verifying the success of remediation, and ensuring long-term management and monitoring of the site. By following these guidelines, the KSPCB aims to mitigate the adverse effects of waste disposal, protect the environment, and safeguard public health.

#### 4.4.4 CPCB GUIDELINES

Hon'ble NGT warned that due to incremental growth of Municipal Solid Waste (MSW), these MSW dumps are converting into virtual mountains. Hon'ble NGT further directed that every city/town should adhere to clause 'J' of Schedule–I (capping is not the first option for environmentally safe legacy waste management) of SWM Rules, 2016. Finally, Hon'ble NGT directed CPCB to propose Standard Operating Procedure (SOP) for implementation of Bio-mining and Bioremediation of legacy solid waste.

#### 4.4.5 SWACHH BHARAT MISSION (SBM) ADVISORY

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The advisory on dumpsite bioremediation addresses the challenges of legacy waste and promotes sustainable waste management practices and emphasizes the importance of dumpsite bioremediation as a sustainable solution for managing legacy waste. By adopting these guidelines, municipalities can address the environmental and health risks associated with dumpsites and promote a cleaner and healthier living environment for communities.

### 4.4.6 CENTRAL PUBLIC HEALTH AND ENVIRONMENTAL ENGINEERING ORGANIZATION (CPHEEO) GUIDELINES

The guidelines aim to provide a comprehensive approach to remediate dumpsites in a safe and environmentally sustainable manner. Key points from the guidelines include conducting site assessments, segregating waste, and implementing engineering and biological measures to control contamination, treating leachate to prevent groundwater contamination, and conducting post-remediation monitoring. These guidelines are crucial to ensure effective and environmentally sound dumpsite remediation that protects public health and the environment.

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# 5 SCOPE OF WORK

Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at Kalpetta includes the following steps.

- Conducting detailed field investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical, and Environmental Baseline Analysis by M/s Poluchem Laboratories.
- Assessment & Analysis of detailed investigation report submitted by the Laboratories.
- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.
- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the By-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation (Optimum land recovery – Biomining, Capping partially Biomining & Capping), Methods/Technologies (Stationary & Mobile- compact), Implementation mode, Forward linkages (Utilization/Management of By-products) and Environmental & Social categorization as per the ESMF of World Bank.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Sensitive mapping, Baseline assessment, impact & risk assessment, mitigations measures and Environmental Management & monitoring plan.
- Social Safeguards - Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.
- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport, Environmental and social monitoring costs, Revenue from the project, Funding for project
- Project Implementation plan –contractual models and timelines.

## 5.1 OBJECTIVES:

- To remediate the legacy waste of approximately 7227.86 Tons by 31st March 2024.
- To reclaim area i.e., 1.12 acres and to develop waste management activities, thereby eliminating the chances of dump fires, leachate generation, and foul odor.
- To reduce greenhouse gas emissions, soil pollution, and groundwater contamination.

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# 6 COMPOSITION, CHARACTERISTICS OF LEGACY WASTE AND ITS IMPACTS

## 6.1 DETAILED INVESTIGATION STRATEGY

To understand the nature and composition of the legacy waste and the existing baseline environmental conditions, samples from waste, surface and groundwater, leachate, soil, air, and noise were collected as per the requirements given in the Project Implementation Manual, considering the state and national guidelines. Samples were collected as mentioned below;

- ✓ Bore hole upto a depth of 7.5 m and collection of 3 (nos) samples from the soil at interval of 1.5 m
- ✓ Waste analysis viz., leachate sample from 1 (nos) locations and physical analysis from 2 (nos) location, and chemical analysis from 1 (nos) location.
- ✓ Environmental baseline analysis surface water 1 (nos) location and ground water samples from 3 (nos) location (Well Water Samples -1 up gradient, 2 down gradient) and Air sampling from 2 (nos) locations and noise sampling from 1 (nos) location

## 6.2 DETAILED INVESTIGATIONS

The detailed investigations carried out for the legacy waste dumpsite is given in the table below:

*Table 7 Investigation details*

| S.No | Parameters | Sampling Nos. |
|---|---|---|
| I | Geotechnical Investigation | |
| A | Boreholes up to 10m depth (as per CPHEEO Manual) | 1 |
| B | Permeability test- (as per CPHEEO Manual) standard penetration test SPT and collection of undisturbed samples - Soil Investigation - Classification, gradation, Atterberg's limit, Bulk density, dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, strength, compressibility (vertically-3 samples per borehole) | 1 |
| 2 | Waste & Environmental Analysis | |
| A | Leachate Analysis (TCLP usepa 1311) (SCHEDULE II of SWM rules, 2016), Suspended solids, Dissolved solids (inorganic),pH, Ammonical nitrogen (as N), Total Kjeldahl nitrogen (as N), BOD, COD, Arsenic (as As), Mercury, Lead, Cadmium, Copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds | 1 |
| B | Physical Analysis of waste (As per CPHEEO manual) including Density, Bulk Density, Moisture Content, Size of waste Constituents, Calorific Value | 2 |
| C | Chemical Analysis of waste/soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), total Carbon, C/N ratio, calorific value, Bio-chemical - biodegradable factor | 1 |
| D | Ground Water (Well Water Samples -1 up gradient, 2 down gradient) - (shallow and deep wells): pH, Colour, EC, Turbidity, SS, TDS, TOC, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, | 3 |

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| S.No | Parameters | Sampling Nos. |
|---|---|---|
| | TKN, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total Coliforms (IS 10500 – 2012) | |
| E | Surface Water (pH, Colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, TKN, Total Alkalinity, Total hardness, Ecoli and Total Coliforms (IS 10500 – 2012) | 1 |
| F | Ambient Air Quality (Sulphur Dioxide (So2), Nitrogen Dioxide (No2), Particulate Matter 2.5, Particulate Matter 10, Ozone (O3), Lead (Pb), Carbon Monoxide (CO), Ammonia (NH3), Benzene (C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | 2 |
| G | Ambient Noise Level (E(p)Rules) for 24 hours | 1 |

## 6.3 METHODOLOGY OF SAMPLING

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed sampling methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat./Long) were considered. The following table shows the strategic location details of samples selected for the detailed investigation.

*Table 8 Details of sampling location*

| S.No | Description | Sampling location | Justification |
|---|---|---|---|
| 1 | Air sampling (2 Locations) | Within the dumpsite | As per the wind rose diagram, the direction and speed of the wind are determined and based on the existing wind-rose data the air sampling location fixed at two locations |
| | | Dumpsite entry point | |
| 2 | Noise (1 Location) | Within the dumpsite | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. |
| 3 | Surface water (1 Location) | Surface water near to the dumpsite [stream] | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope. This steep slope on southeast direction possesses a potential risk of leachate runoff, which could result in the contamination of surface water on that particular side of the site. So, the location of surface water is taken on the southeast direction. |
| 4 | Ground water (3 Locations) | 3 wells identified near the dumpsite area | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope (SE). The infiltration of leachate which could result in the contamination of ground water. |

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| S.No | Description | Sampling location | Justification |
|---|---|---|---|
| | | | Based on the possible infiltration and slope direction, two ground water samples are collected in the east direction and one of the west direction |
| 5 | Bore Hole (1 Location) | Within the dumpsite area | Not Applicable |
| 6 | Legacy Waste | Within the dumpsite area | Not Applicable |

*Table 9 Direction and Distance of the sampling location*

| S.No. | Description | Direction | From the Centre of Dumpsite (m) | From the nearest Boundary (m) |
|---|---|---|---|---|
| 1 | Surface Water | North | 350 | 95 |
| 2 | Ground water-1 | East | 415 | 308 |
| 3 | Ground water-2 | North | 108 | 40 |
| 4 | Ground water-3 | East | 575 | 460 |
| Note: Air and Noise Monitoring are monitored inside the dumpsite | | | | |

*Table 10 Quantity of sampling & location*

| S. No | Items | Quantity of sample collected | Location |
|---|---|---|---|
| 1 | Solid Waste | 25 kg | Location -1: N- 11 °35'25.572" E -76°03'18.707"<br>Location -2: N- 11 °35'24.126" E -76°03'20.07" |
| 2 | Surface Water | 1.5 Litres | Location -1:N- 11 °35'25.876" E -76°03'16.589" |
| 3 | Ground Water | 1.5 litres | Location -1:N- 11 °35'28.428" E -76°03'18.347"<br>Location -2:N- 11 °35'33.228" E -76°03'29.7"<br>Location -3:N- 11 °35'38.31" E -76°03'32.099" |
| 4 | Leachate | 1.5 litres | Location -1: N- 11 °35'23.91"E -76°03'19.098" |
| 5 | Ambient Air Quality | 2 Nos | Location -1:N- 11 °35'24.276"E -76°03'19.277"<br>Location -2:N- 11 °35'25.777"E -76°03'19.007" |
| 6 | Ambient Noise Quality | 1 Nos | Location -1: N- 11 °35'25.308"E -76°03'20.171" |

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*Figure 11 Sampling Locations – Borehole & legacy waste sample*

### 6.4 ANALYSIS AND INTERPRETATION OF EXPLORATORY DATA

As part of the feasibility study, Technical Support Consultants (IPE Global Ltd) has entrusted the geotechnical investigation & Environmental baseline assessment to M/s Matter Material Testing & Research Laboratory (P) Ltd and M/s Polluchem Laboratories (P) Ltd respectively.

The initial site visit was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd on 05th June 2023 along with the experts of TSC and PIUs. Field Geotechnical investigation to collect the soil samples after drilling through the legacy waste was started on 23th June 2023 and was completed on 26th June 2023. Positioning of Air samplers & Noise monitoring equipment, sampling of surface/groundwater, leachate, and legacy waste were done on 14th June 2023 by M/s Polluchem Laboratories (P) Ltd. The lab analysis reports were submitted by the investigation agencies to TSC. The lab analysis reports are provided in Annexures – A & B

#### 6.4.1 GEOTECHNICAL EXPLORATORY DETAILS

For assessing the depth of legacy waste and contamination of the soil below the legacy waste, bore hole samples were collected using rotary drill. The exploratory data of the bore hole revealed a maximum depth of 3.0 m for waste and 4.5 m for the soil. Lateritic rock was encountered below the soil stratum. The Geotechnical investigation was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. The details of the exploratory data of the bore hole is provided below.

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*Table 11 Exploratory Data of Bore Log*

| S. No | Borehole location | Total Depth of the Borehole (m) | Depth of Soil (m) | Depth of Legacy Waste (m) | Remarks |
|---|---|---|---|---|---|
| 1 | N- 11°35'38.062"<br>E-75°36'20.735" | 7.5 | 4.5 | 3 | Lab Analysis Report provided in Annexure A |
| Note: Bore hole terminated at the depth of 4.5 m below ground level due to Laterite rock. | | | | | |

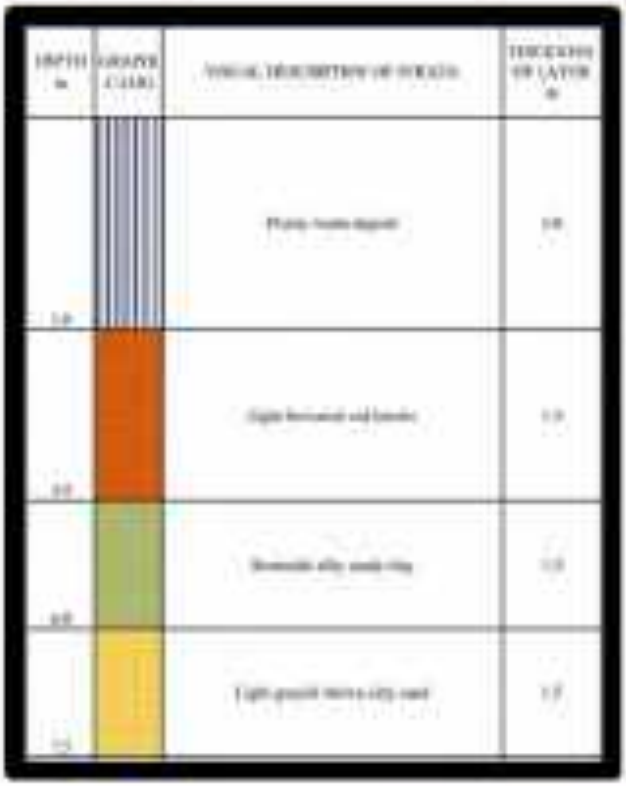




*Figure: SEQ Figure * ARABIC 12 Soil Profile & Geotechnical Investigation*

### 6.4.2 ESTIMATED TOTAL QUANTITY OF WASTE

The total quantity of waste is estimated based on the contour/topography survey profile of the waste over the ground level and exploratory data of the bore log (Geotechnical investigations). The details of the estimated total quantity of waste is provided below:

*Table 12 Quantity of waste below & above ground level*

| Level | Volume of Legacy Waste ($m^3$) | Density of Waste ($t/m^3$) | Total Quantity of Waste (T) | Remark |
|---|---|---|---|---|
| Below & Above | 9485.375 | 0.762 | 7227.86 | *As per the Contour Survey Report by ULB |

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*Table 13 Estimated total quantity of waste*

| Estimated total quantity of waste | |
|---|---|
| Total Quantity of Legacy Waste ($m^3$) | 9485.375 |
| Total Quantity of Legacy Waste (T) | 7227.86 |
| Total Quantity of Legacy Waste (T) Approximately | 7223 |

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### 6.4.3 LEGACY WASTE CHARACTERIZATION

The characteristics of the legacy waste were assessed by collecting 2 samples of 25 kg from 2 (nos) locations within the dumpsite. The legacy waste samples were collected on 14th June 2023 by M/s Polluchem Laboratories (P) Ltd. The assessment of waste characteristics was done based on the results of the analysis. The details of the characteristics viz., composition, physical & chemical characteristics, heavy metals, and estimated quantity of by-products are provided in the tables below:

| S.No | Items | Quantity of sample collected | Location |
|---|---|---|---|
| 1 | Solid Waste | 25 kg | Location -1: N- 11°35'25.572" E -76°03'18.707"<br>Location -2: N- 11°35'24.126" E -76°03'20.07" |

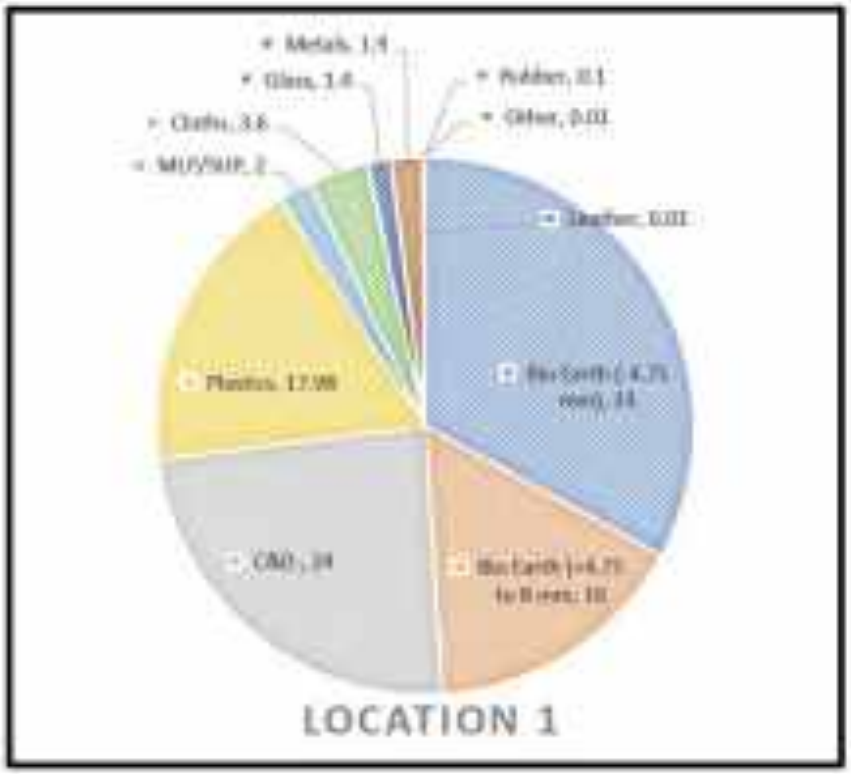
**Physical Composition:**

*Table 14 Physical Composition for Location- 1, 2 & Average*

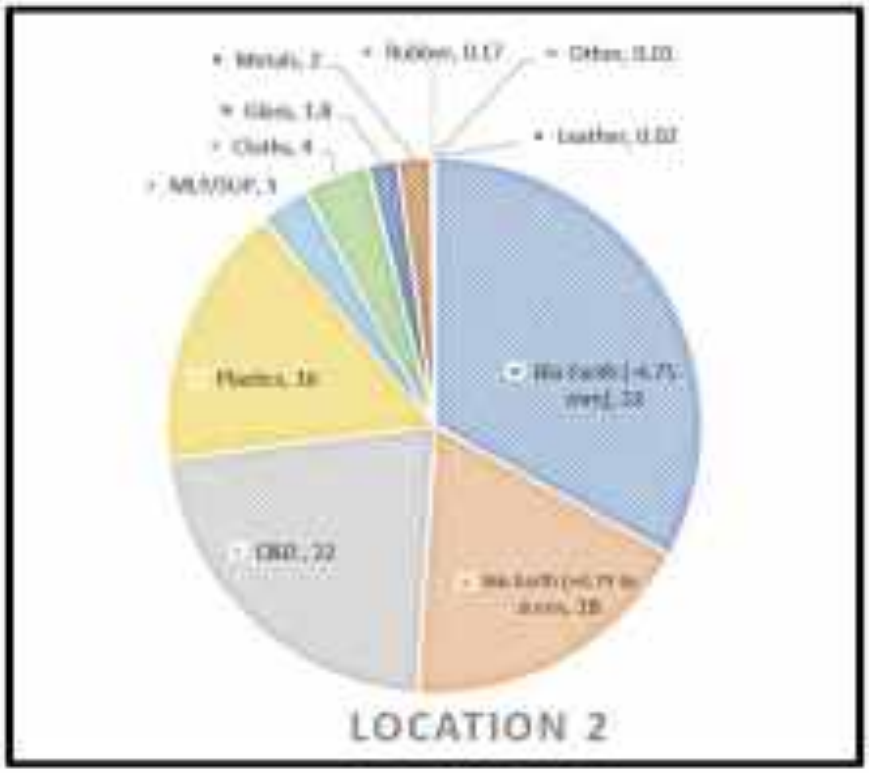
| Sl. NO | Total Quantity of legacy waste (cu.m) | Parameters | Location – I | | Location – II | | Average | |
|---|---|---|---|---|---|---|---|---|
| | | | Avg. Percentage (%) | Quantity (cu.m) | Avg. Percentage (%) | Quantity (cu.m) | Avg. Percentage (%) | Quantity (cu.m) |
| 1 | 9485.38 | Bio Earth | 33 | 3130.17 | 33 | 3130.17 | 33 | 3130.17 |
| | | Bio Earth (+4.75 to 8 mm) | 16 | 1517.66 | 18 | 1707.36 | 17 | 1612.51 |
| 2 | | C&D | 24 | 2276.49 | 22 | 2086.78 | 23 | 2181.63 |
| 3 | | Plastics | 17.98 | 1705.47 | 16 | 1517.66 | 16.99 | 1611.56 |
| 4 | | MLP/SUP | 2 | 189.47 | 3 | 284.56 | 2.5 | 237.13 |
| 5 | | Cloths | 3.6 | 341.47 | 4 | 379.41 | 3.8 | 360.44 |
| 6 | | Glass | 1.4 | 132.79 | 1.8 | 170.73 | 1.6 | 151.766 |
| 7 | | Metals | 1.9 | 180.22 | 2 | 189.70 | 1.95 | 184.96 |

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| Sl. NO | Total Quantity of legacy waste (cu.m) | Parameters | Location – I | | Location – II | | Average | |
|---|---|---|---|---|---|---|---|---|
| | | | Avg. Percentage (%) | Quantity (cu.m) | Avg. Percentage (%) | Quantity (cu.m) | Avg. Percentage (%) | Quantity (cu.m) |
| 8 | | Rubber | 0.1 | 9.48 | 0.17 | 16.125 | 0.135 | 12.80 |
| 9 | | Other | 0.01 | 0.948 | 0.01 | 0.948 | 0.01 | 0.948 |
| 10 | | Leather | 0.01 | 0.948 | 0.02 | 1.897 | 0.015 | 1.422 |

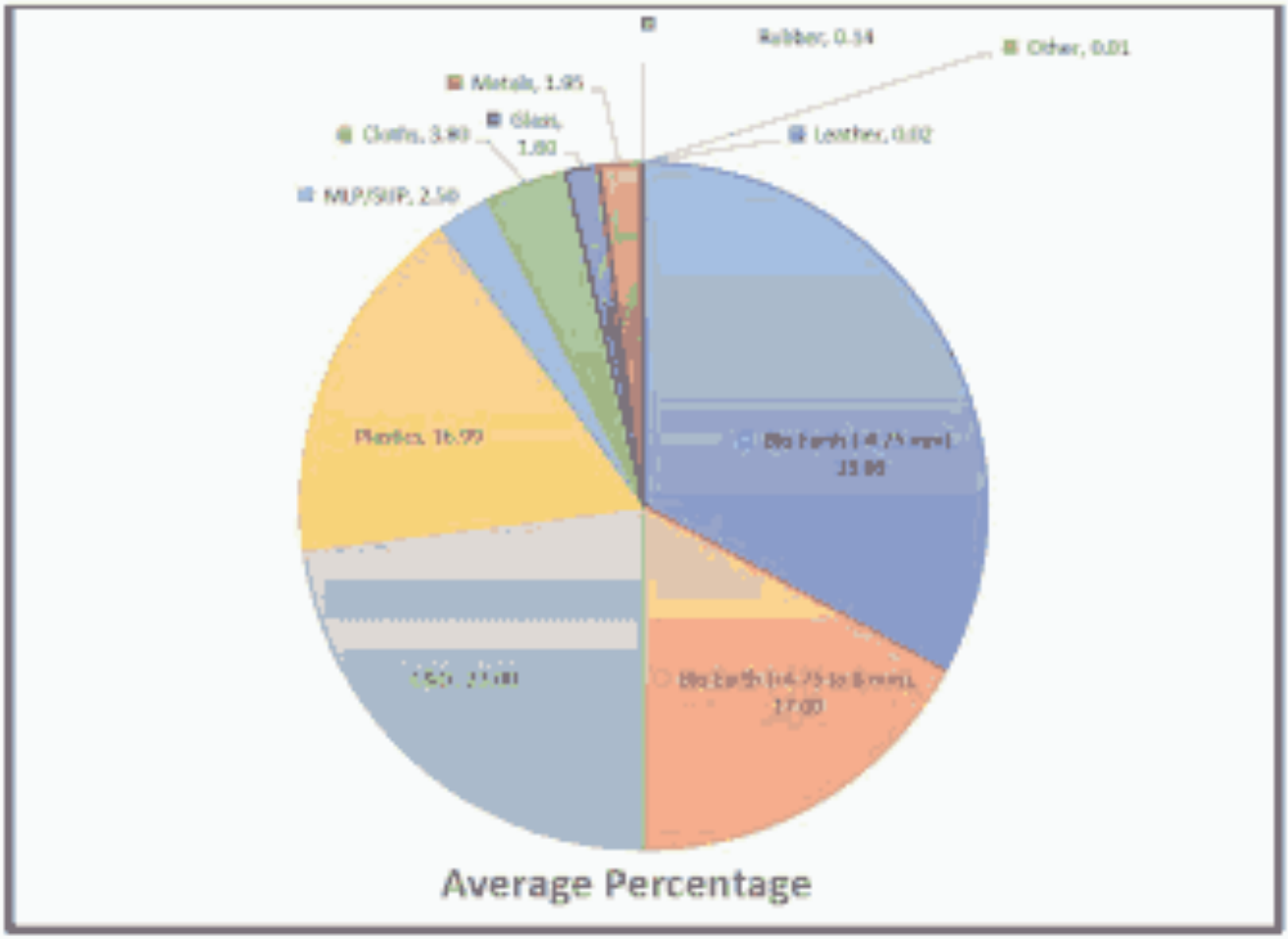


LOCATION 1



LOCATION 2

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**Physical Analysis:**

*Table 13 Physical Analysis*

| S.No | Parameters | | | Test Method | Unit | Location 1 | Location 2 | Avg. | Limit as per FCO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Moisture@105°C | | | ASTM D 2216 | % | 25 | 32.4 | 28.7 | 15.0-25.0 |
| 2 | Bulk Density | | | USEPA | kg/m³ | 763 | 821 | 792 | |
| 3 | Density | | | USEPA | g/cm³ | 0.731 | 0.793 | 0.762 | <1 |
| 4 | Calorific Value | | | ASTM D 5865 | Kcal/kg | 1264 | 1347 | 1305.5 | – |
| 5 | Size of waste Constituent | Sieve Size(mm) | AST M No | | | Retained | Retained | Retained | |
| | | 75 | -- | Retained 0 | Retained 2.3 | 1.15 | 1.6 | 0.9 | |
| | | 40 | – | 0 | 35.4 | 17.7 | 8.7 | 5.5 | |
| | | 20 | – | 28.8 | 24.6 | 26.7 | 9.8 | 8.2 | |
| | | 8 | – | 35 | 8.9 | 21.95 | 8.3 | 10.4 | |
| | | 4.75 | 4 + | 16.4 | 2.3 | 9.35 | 4.05 | 5.8 | |
| | | 2.36 | 8 | 9.6 | 14.2 | 11.9 | 8.6 | 7.5 | |
| | | 1.18 | 16 | 10.2 | 7.5 | 8.85 | 12.4 | 14.4 | |
| | | 0.6 | 30 | 0 | 4.8 | 2.4 | 18.6 | 24.9 | |
| | | 0.3 | 50 | 0 | 0 | 0 | 19.53 | 16.1 | |
| | | 0.15 | 100 | 0 | 0 | 0 | 6.54 | 5.5 | |
| | | 0.09 | 170 | 0 | 0 | 0 | 1 | 0.5 | |
| | | 0.075 | 200 | | 0 | 0 | 0.88 | 0.4 | |
| | | 0.045 | 325 | | 0 | 0 | 0 | 0.0 | |
| Lat/Long: Location -1: N- 11°35'24.126"E -76°03'20.07" and Location -2: N- 11°35'25.572", E -76°03'18.707" | | | | | | | | | |

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**Chemical Analysis:**

*Table 16 Chemical Analysis*

| S. No | Parameters | Test Method | Unit | Location -1 |
|---|---|---|---|---|
| 1 | pH@25°C | USEPA | .. | 7.43 |
| 2 | Biodegradable Factor | USEPA | % | 4.1 |
| 3 | Total carbon | USEPA 9060A | % | 3.8 |
| 4 | Phosphorus(P) | USEPA | % | 0.017 |
| 5 | Nitrogen(N) | USEPA | % | 0.28 |
| 7 | Potassium(K) | USEPA | % | 0.023 |
| 8 | C/N Ratio | USEPA | .. | 13.5:1 |
| 9 | Calorific Value | ASTM D 5865 | K.cal/kg | 1165 |

**Heavy Metal Analysis:**

*Table 17 Heavy Metal Analysis*

| S. No | Parameters | Test Method | Unit | Location -1 | Limit as per Organic Compost (FCO 2009) |
|---|---|---|---|---|---|
| 1 | Iron (Fe) | USEPA 3050 | % | 3.1 | -- |
| 2 | Arsenic (As) | USEPA 3050 | mg/kg | <0.1 | 10 |
| 3 | Selenium (Se) | USEPA 3050 | mg/kg | <0.1 | -- |
| 4 | Nickel (Ni) | USEPA 3050 | mg/kg | 15.4 | 50 |
| 5 | Zinc (Zn) | USEPA 3050 | mg/kg | 35.7 | 1000 |
| 6 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 | 5 |
| 7 | Copper (Cu) | USEPA 3050 | mg/kg | 30.2 | 300 |
| 8 | Chromium (Cr) | USEPA 3050 | mg/kg | 12.4 | 50 |
| 9 | Lead (Pb) | USEPA 3050 | mg/kg | 24.5 | 100 |
| 10 | Mercury (Hg) | USEPA 3050 | mg/kg | <0.1 | .15 |
| 11 | Manganese (Mn) | USEPA 3050 | mg/kg | 97.2 | -- |

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**By-Products:**

*Table 18 By-Products*

| By-Products | Bio Earth | C&D Waste | RDF | Recyclable |
|---|---|---|---|---|
| Percentage (%) | 50% | 23% | 23.4% | 3.6 % |
| Quantity (cu.m) | 4742.69 | 2181.64 | 2224.32 | 336.73 |

### 6.4.4 ENVIRONMENTAL BASELINE

The environmental baseline was assessed from the analytical results of air, surface &groundwater, noise and leachate from the location as mentioned in the section 6.3. The samples were collected on 14th June 2023 by M/s Polluchem Laboratories (P) Ltd. The Environmental baseline was analyzed with reference to the lab analysis reports. The details of analysis & inferences are provided in the tables below:

**Surface Water Analysis:**

*Table 19 Surface water Analysis*

| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 – 1983RA2017 | 5.91 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 – 1983RA2017 | >500 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 327 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 240 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 156 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 54 mg/l | --- | -- |
| Total Hardness as CaCO3 | IS 3025 (P) 21 – 1983RA2014 | 52 mg/l | 200 mg/l | -- |
| Total Alkalinity as CaCO3 | IS 3025 (P) 23 – 1986RA2014 | 28 mg/l | -- | -- |

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| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Chloride as Cl- | IS 3025 (P) 32 – 1988RA2014 | 49.4 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as SO4 | IS 3025 (P) 24 – 1986RA2014 | 30.63 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 – 1989RA2014 | 3.2 mg/l | 6 mg/l | 4 mg/l |
| B.O.D ( 3 days at 27º C ) | IS 3025 (P) 44 - 1993RA2014 | 4.8 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 - 2006RA2017 | 14 mg/l | --- | -- |
| TOC | APHA5310 | BDL(MDL-0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 5.4 mg/l | --- | -- |
| Nitrate as NO3 | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1mg/l) | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 - 2008RA2014 | BDL(MDL-0.1mg/l) | 1.5 mg/l | 1.5 mg/l |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL-0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL-0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL-0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL-0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL-0.01mg/l) | 0.5 mg/l | --- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL-0.001mg/l) | 0.001 mg/l | --- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | 0.65mg/l | 15 mg/l | 15 mg/l |

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| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 37.00mg/l | 0.3 mg/l | 0.5 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL-0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37-1988RA2014 | BDL(MDL-0.01mg/l) | 0.05 mg/l | 0.2 mg/l |
| Location | **Inference** | | | |
| 1 | The analysis reveals that surface water is slightly acidic, the color range is very high than the permissible limit. $BOD_3$ is slightly greater than the allowable limit (A-class). Also, iron content is very high than permissible limit.. | | | |

**Note:** The sampling location and its respective distance from the dumpsite have been incorporated into Table 10. The stream is not use for any public use.

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**Ground Water Analysis:**

*Table 20 Groundwater Analysis*

| Parameter | Test Method | Location -1 | Location -2 | Location -3 | Acceptable Limit As per IS-10500-2012 |
|---|---|---|---|---|---|
| pH | IS 3025 (P) 11 – 1983RA2017 | 5.89 | 6.63 | 5.99 | 6.5 - 8.5 |
| Color | IS 3025 (P) 04 – 1983RA2017 | >500 Hazen Unit | 80 Hazen Unit | 6 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 241.5 NTU | 91 NTU | 1.4 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 420 µS/cm | 140 µS/cm | 90 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 296 mg/l | 91 mg/l | 58.5 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 85 mg/l | 64 mg/l | BDL(MDL-1mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 148 mg/l | 44 mg/l | 28 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 76 mg/l | 48 mg/l | 26 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 66.5 mg/l | 11.4 mg/l | 13.3 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 3.47 mg/l | 2.41 mg/l | 2.14 mg/l | 200 mg/l |
| COD | IS 3025 (P) 58 - 2006RA2017 | 18 mg/l | 14 mg/l | 14 mg/l | --- |
| TOC | APHA5310 | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 3.4 mg/l | 2.2 mg/l | 3.2 mg/l | ---- |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | 6.4 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 - 2008RA2014 | 0.1 mg/l | 0.16 mg/l | 0.29 mg/l | 1.0 mg/l |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.02 mg/l |

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| Parameter | Test Method | Location -1 | Location -2 | Location -3 | Acceptable Limit As per IS-10500-2012 |
|---|---|---|---|---|---|
| Cadmium as Cd | IS 3025(P) 41-1992RA2014 | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47-1994RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42-1992RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59-2006RA2017 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 - 1994RA2014 | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 - 1994RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 5.0 mg/l |
| Iron as Fe | IS 3025 (P) 53 - 2003RA2014 | 29.14 mg/l | 4.85 mg/l | BDL(MDL-0.05mg/l) | 1.0 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 - 2003RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37-1988RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.01 mg/l |
| Lat/Long: Location -1: [N- 11 °35'28.428", E -76°03'18.347"], Location -2 [N- 11 °35'33.228", E -76°03'29.7"], Location -3 [N- 11 °35'38.31", E -76°03'32.099"] | | | | | |

| Location | Inference |
|---|---|
| 1 | The analysis reveals that pH slightly acidic, color, turbidity and iron content is very higher than permissible limits. |
| 2 | The analysis reveals that color and turbidity is very higher than permissible limit and iron content is slightly higher than permissible limit. |
| 3 | The analysis reveals that pH is slightly acidic and color and turbidity is very higher than permissible limit. |

**Note :** The sampling location and its respective distance from the dumpsite have been incorporated into Table 10.

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**Ambient Air Quality:**

*Table 21 Ambient Air Quality*

| Parameters | Test Method | Location -1 | Location -2 | Limits as per NAAQS |
|---|---|---|---|---|
| Particulate Matter ($PM_{10}$) | IS 5182 Part 23 2006RA2012 | 60.3 µg/m³ | 42.3 µg/m³ | 100 µg/m³ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 34.5 µg/m³ | 22.4 µg/m³ | 60 µg/m³ |
| Sulphur Dioxide ($SO_2$) | IS 5182 Part 2 2001 RA 2017 | 8.7 µg/m³ | 6.7 µg/m³ | 80 µg/m³ |
| Nitrogen Dioxide ($NO_2$) | IS 5182 Part 06 2006 RA2017 | 12.6 µg/m³ | 8.72 µg/m³ | 80 µg/m³ |
| Carbon monoxide (CO) | SOP/PCL/COA/17 | 1.1 mg/m³ | <1 mg/m³ | 4 mg/m³ |
| Ammonia ($NH_3$) | CPCB | < 1 µg/m³ | < 1 µg/m³ | 400 µg/m³ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m³ | < 0.1 µg/m³ | 1 µg/m³ |
| Arsenic (As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m³ | <0.1 ng/m³ | 6 ng/m³ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m³ | <0.1 ng/m³ | 20 ng/m³ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m³ | < 1 µg/m³ | 100 µg/m³ |
| Benzene ($C_6H_6$) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m³ | < 0.1 µg/m³ | 5 µg/m³ |
| Benzo (a) pyrene (BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m³ | < 0.1 ng/m³ | 1 ng/m³ |
| Lat/Long: Location -1 [N- 11°35'24.276", E -76°03'19.277"], Location -2 [N- 11°35'25.777", E -76°03'19.007"] | | | | |

| Location | Inference |
|---|---|
| 1 | Within permissible limits |
| 2 | Within permissible limits |
| NOTE: The contractor is required to implement all necessary protective measures during the biomining process to ensure that air quality levels are maintained within permissible limits. | |

**Note :** The sampling location and its respective distance from the dumpsite have been incorporated into Table 10.

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**Ambient Noise Level:**

*Table 22 Ambient Noise level*

| Date | Hourly Interval | Unit | Result | Limits in dB(A) Leq |
|---|---|---|---|---|
| 14.06.2023 | 14.00 Hrs | dB (A) | 56.4 | Commercial Area:<br>Day time -65 dB(A) Leq<br>Night time -55 dB(A) Leq |
| | 15.00 Hrs | dB (A) | 62.0 | |
| | 16.00 Hrs | dB (A) | 50.5 | |
| | 17.00 Hrs | dB (A) | 63.7 | |
| | 18.00 Hrs | dB (A) | 51.0 | |
| | 19.00 Hrs | dB (A) | 50.9 | |
| | 20.00 Hrs | dB (A) | 53.7 | |
| | 21.00 Hrs | dB (A) | 55.2 | |
| | 22.00 Hrs | dB (A) | 54.7 | |
| 15.06.2023 | 23.00 Hrs | dB (A) | 56.7 | |
| | 00.00 Hrs | dB (A) | 52.3 | |
| | 01.00 Hrs | dB (A) | 49.8 | |
| | 02.00 Hrs | dB (A) | 51.2 | |
| | 03.00 Hrs | dB (A) | 49.6 | |
| | 04.00 Hrs | dB (A) | 52.4 | |
| | 05.00 Hrs | dB (A) | 50.2 | |
| | 06.00 Hrs | dB (A) | 54.6 | |
| | 07.00 Hrs | dB (A) | 57.4 | |
| | 08.00 Hrs | dB (A) | 59.8 | |
| | 09.00 Hrs | dB (A) | 58.6 | |
| | 10.00 Hrs | dB (A) | 57.4 | |
| | 11.00 Hrs | dB (A) | 62.7 | |
| | 12.00 Hrs | dB (A) | 59.6 | |
| | 13.00 Hrs | dB (A) | 61.7 | |
| Avg Leq Day – 57.0 dB (A) | | | | |
| Avg Leq Night – 51.7 dB (A) | | | | |

| Location | Inference |
|---|---|
| 1 | The assessment indicates that the noise levels exceed permissible limits, necessitating the implementation of measures to alleviate the noise pollution. |

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**Leachate Analysis:**

*Table 23 Leachate Analysis*

| Parameters | Test Method | L1 | Limits as per SWM Rules 2016 |
|---|---|---|---|
| pH | IS 3025 (P) 11-1983 RA2017 | 7.61 | 5.5 to 9.0 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16-1984 RA2017 | 845 mg/l | 2100 mg/l |
| Total Suspended Solids | IS 3025 (P) 15-1984 RA2017 | 180 mg/l | 100 mg/l |
| Chloride as Cl | IS 3025 (P) 32-1988 RA2014 | 394.2 mg/l | 1000 mg/l |
| COD | IS 3025 (P) 58-2006 RA2017 | 210 mg/l | 250 mg/l |
| BOD( 3 days at 27 deg.cel) | IS 3025 (P) 44-1988 RA2014 | 80 mg/l | 30 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34-1988 RA2014 | 18.7 mg/l | 100 mg/l |
| Ammonical Nitrogen as N | IS 3025 (P) 34-1988 RA2014 | 5.89 mg/l | 50 mg/l |
| Phenolic Compound as C6H5OH | IS 3025 (P) 43-1992RA2014 | 0.65 mg/l | 1 mg/l |
| Fluoride asF | IS 3025 (P) 60-2008RA2014 | 0.8 mg/l | 2 mg/l |
| Cynadte as CN | IS 3025 (P) 27-1986 RA2014 | BDL(MDL-0.01 mg/l) | 0.2 mg/l |
| Nickel as Ni | IS 3025 (P) 54-2003 RA2014 | BDL(MDL-0.01 mg/l) | 3 mg/l |
| Cadmium as Cd | IS 3025 (P) 41-1992 RA2014 | BDL(MDL-0.001 mg/l) | 2 mg/l |
| Lead as Pb | IS 3025 (P) 47-1994 RA2014 | BDL(MDL-0.01 mg/l) | 0.1 mg/l |
| Copper as Cu | IS 3025 (P) 42-1992 RA2014 | 0.87 mg/l | 3 mg/l |
| Mercury as Hg | IS 3025 (P) 48-1994 RA2014 | BDL(MDL-0.001 mg/l) | 0.01 mg/l |
| Zinc as ZN | IS 3025 (P) 49-1994 RA2014 | 3.6 mg/l | 5 mg/l |
| Total Arsenic as As | IS 3025 (P) 37-1988 RA2014 | BDL(MDL-0.01 mg/l) | 0.2 mg/l |

| Location | Inference |
|---|---|
| 1 | The analysis reveals that all the parameters fall within the acceptable limit except BoD, which is slightly higher than the allowable limit, indicating that the leachate is containing biological contents. |

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# 7 EVALUATION OF REMEDIATION TECHNIQUES

Although the term "legacy waste" has not been defined in any official government document in India, it typically refers to aged municipal solid waste in landfills or dumpsites. These legacy dumpsites are creating various irreversible environmental/health/livelihood hazards. The major sources of pollution are:

- ✓ Puddles of leachate flowing through the adjacent area and reaching the water table long-term issues of greenhouse gas emissions
- ✓ Surface water and groundwater pollution due to erosion and seepage
- ✓ Dumpsite fires
- ✓ Due to the faster urban development and increased waste generation per capita and mismanagement of generated waste.

The dumpsites have emerged as pollution hubs, especially those situated in human settlements, as cities have grown over the decades. It has, therefore, become a necessity for the city authorities to remediate the existing dumpsites in an environmentally sound and economically viable manner.

**Remediation of legacy waste dumpsite**

Remediation is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

1. Uplift of the environment- reduction in greenhouse gas emissions, soil pollution, ground water contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.
2. Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in nearby real state value and rental values.
3. Land - Dumpsite land becomes available for public use or for setting up SWM facility on the reclaimed land.
4. Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled, or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels.

For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- ✓ A total station survey for assessment of volumetric quantity of legacy waste above the ground level.
- ✓ Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- ✓ History of the site, Physical features of site, as –is/current situation and compositional analysis of waste.
- ✓ Baseline study of heavy metals in surface;

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- ✓ Water, rainfall, soil type, surface hydrology, topography, wind direction etc. shall be studied before and after bioremediation.
- ✓ Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area.

The details of the remediation techniques for the remediation of the legacy waste dumpsite remediation are as follows

## 7.1 BIO-MINING – RECLAMATION/RECOVERY OF LAND

Bio- mining is the scientific technique to extract materials of economic interest from legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) and followed by sustainable management through recycling, co-processing, road construction etc.

*Table 24 Phases of Bio-mining*

| Phases of Bio-mining | |
|---|---|
| Phase 1: Stabilization | The legacy waste is formed into equal-sized windrows, and which are turned frequently, bio-culture is added and de-odourizer (an odour-controlling agent) sprayed. This phase removes stench, reduces moisture and eliminates pathogens. |
| Phase 2: Sorting & Segregation | In this phase, stabilized legacy waste is sorted/segregated into bio earth, recyclables, refused derived fuel (RDF) and C&D through series of various sizes of Trommels/circular rotatory sieves and manpower. |
| Phase 3: Disposal & Utilization | In this phase, the non-combustible fractions such as soil and stones are disposed of for further processing into finer aggregates or for earth filling. The combustible fractions are called refuse-derived fuel (RDF) are sent for co-processing in cement industries. |
| Salient Aspects | Optimum land recovery, increase in value of land and available for public use/habitation with immediate effect.<br>Ensures long-term sustainability and environmentally sound treatment of legacy waste and present lucrative revenue-generating opportunities.<br>Bio products/aggregates generated from the process can be used as alternative construction material, fuel and recyclables.<br>Compliance to SWM Rules and NGT orders.<br>Improvement in aesthetics and quality of life & health. |
| Applicability | The ownership is well defined.<br>Working space is available in the dumpsite.<br>Linkage for utilization by-products is available |

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## 7.2 CAPPING WITHOUT LAND RECOVERY

Capping is a scientific process of profiling legacy waste and covering with barrier layers consisting of soil, high density polyethylene (HDPE) liner, gas collection system surface drainage system, and a vegetative cover to minimize the percolation of rainwater into the legacy waste.

| | |
|---|---|
| Salient Aspects | The capped area becomes a green space and can be developed into parks/recreational areas.<br>Capped area will be equipped with environmental monitoring systems for post-closure maintenance to monitor pollution levels in groundwater and surface-water sources and air (especially methane emissions) at least 15 years.<br>Capped area needs to be inspected periodically for settlement due to physical, chemical and biological transformation, leachate generation, erosion and naturally occurring invasion by deep-rooted vegetation. Recurring expenditure will be incurred for regular maintenance.<br>On July 17, 2019, the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested bio-mining as environmentally safe and the most preferable approaches to dumpsite remediation.<br>SWM rules do not permit habitation over it for at least 15 years because of the danger posed by toxic gases release by the waste. |
| Applicability | Capping could be a solution for legacy waste where bio-mining is not possible because of steep terrain, inaccessible ravines and narrow valleys.<br>Lack of linkage for utilization/ disposal of segregated components<br>Lack of working space & resources |

## 7.3 CAPPING WITH PARTIAL LAND RECOVERY

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can linked to relevant buyers and the inert material will be capped to prevent further degradation of the environment.

| | |
|---|---|
| Salient Aspects | The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.<br>Ensures short -term sustainability and environmentally sound treatment of legacy waste.<br>Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area |
| Applicability | Legacy waste dumpsite area partial of steep terrain, inaccessible ravines and narrow valleys.<br>Lack of linkage for disposal of inert |

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Recovery land for public use is not a priority

## 7.4 SELECTION OF REMEDIATION OPTION

Selection of the applicable method/type or technique is based on the factors like., salient aspects & applicability of remediation types viz., Capping without land recovery, Bio-mining – reclamation/recovery of land 100% & capping with partial land recovery and also available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for 100% and recovery and forward linkages/utilization of processed aggregates/by-products.

Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land 100% is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and 100% land recovery/remediation legacy waste dumpsite. It may be noted that the bio-earth and C&D material which will be recovered by remediation is proposed to be used for development of the reclaimed legacy waste dumpsite as recreational park/facility (for site development work/ profiling). The bio-earth and C&D material recovered will be subjected to bi-weekly sampling and conform to the parameters mentioned in Schedule II of SWM Rules 2016 before using the material. Considering the same, there won't be any leachate generation using this material. There won't be any capping done and hence the question of erosion etc. doesn't arise.

**Salient parameters for opting the Bio-mining – reclamation/recovery of land 100%.**

1. Based on the assessment from the chemical analysis report from the M/s. Pollechem, all the heavy metals are within the permissible limits as prescribed by the regulatory authorities Soil is free of contamination viz., heavy metals, chemical and other toxic substances.
2. 100% Land recovery, increase in value of land and available for public use/setting of SWM facility with immediate effect. An area of 1.12 acres will be reclaimed through bio-mining
3. Adequate downstream linkages for the management/disposal waste viz., Bio earth and C&D waste will be utilized for development of the reclaimed legacy dumpsite as recreational park/facility, recyclables will be sold to the authorized recyclers & will be collected from the project site and RDF will be sent to Cement industries for co-processing viz., as supplement to the conventional fuel.
4. Ilr products/aggregates generated from the process can be used as alternative construction material (after processing), fuel and recyclables.
5. The Solid Waste Management Rules, 2016 and several National Green Tribunal (NGT) directives have mandated that urban local bodies opt for bio-mining over capping.

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# 8 TECHNICAL DESCRIPTION OF THE SELECTED OPTION

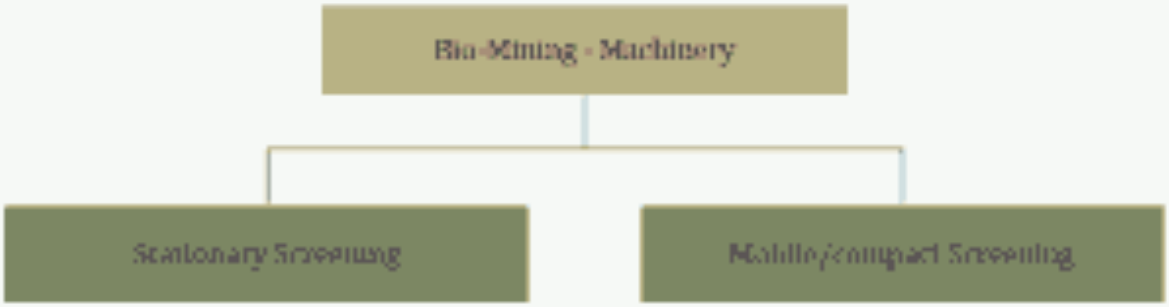
## 8.1 METHODOLOGY

The legacy waste dumpsite reclamation through bio-mining with recovery of land 100% involves Phase 1: stabilization, Phase 2: sorting & segregation and Phase 3: disposal & utilization

The type of machinery, capacity and type of screens to stabilize of the legacy waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) will depend on the physical site conditions including quantity & characteristics of legacy waste and utilization of the aggregates/by-products/recovered material.

The type machinery available for the bio mining are as follows:

1. Stationary screening machinery and
2. Mobile/compact machinery.




### 8.1.1 STATIONARY SCREENING MACHINERY

A Stationary trommel is a specialized piece of equipment used in legacy waste bioremediation processes to separate and classify solid waste materials. It is designed to efficiently screen and sort different components of the waste based on size and other characteristics. Technical description of a Stationary Trommel used in legacy waste bioremediation are as follows:

- ✓ Structure: The Stationary trommel consists of a frame made of steel or other durable materials. It is designed to withstand the harsh conditions of waste treatment facilities. The frame supports a cylindrical drum that is inclined at an angle for optimal material flow.
- ✓ Drum: The drum is the main component of the Stationary Trommel and is typically made of perforated metal or mesh. It is cylindrical in shape and rotates on its axis using a motorized drive system. The drum's 3- 5 mtr diameter and 10 mtr length can vary depending on the specific requirements of the waste treatment process.
- ✓ Motor and Drive System: The Stationary Trommel is equipped with a motor and drive system that powers the rotation of the drum. The motor is typically electrically powered and is connected to the drum through a gearbox or direct drive mechanism. The rotational speed of the drum can be adjusted to optimize the screening process.

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- ✓ Inlet and Outlet: The Stationary Trommel has an inlet where the legacy waste is fed into the drum for processing. The waste material enters the drum at one end, typically assisted by a conveyor or loader. The screened waste material is discharged from the opposite end of the drum through an outlet.
- ✓ Screening Mechanism: As the drum rotates, the legacy waste inside it is subjected to a combination of tumbling and rolling actions. The perforated drum allows smaller-sized particles and materials to pass through, while larger items such as bulky waste, debris, and contaminants are retained inside the drum. The drum's perforation size can be customized to achieve the desired separation efficiency.
- ✓ Waste Sorting: The Stationary Trommel facilitates the separation of different components within the legacy waste. It effectively segregates organic waste, inert materials, recyclables, and other categories based on their size and physical properties. This sorting process prepares the waste for further treatment or disposal.

Source: DCC Infra., Gurugram Site



Salient Features of Stationary Screening Machinery:

- Land requirement high for setting of machinery and processing area.
- Erection, Installation and Commissioning is time consuming
- Cost Intensive – CAPEX & OPEX high
- Electrical Power Intensive and Consumption is high
- Breakdown of the Machinery is high, onsite technicians should be available.
- Manpower – skilled & unskilled Intensive
- Suitable for quantity more than 2,00,000 ton of legacy waste.
- Less suitability for reuse of the machinery/screenings for more than one site/location

### 8.1.2 MOBILE/COMPACT SCREENING MACHINERY

The Mobile Trommel is a technical apparatus utilized in legacy waste bioremediation processes. Its primary function is to separate and sort various types of waste materials, such as solid waste and organic matter, for effective bioremediation.

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**Structure:** The trommel consists of a cylindrical drum, typically made of heavy-duty metal, which is inclined at a slight angle. The drum is supported by a framework and set in motion by a motor or engine, causing it to rotate slowly. The rotation of the drum allows the waste materials to be fed into the trommel at one end, while simultaneously moving the materials along its length. Large screening area (9.5 sq m). Helps in good quality segregation & high productivity.

**Screening Mechanism:** The Mobile Trommel incorporates various mechanical features to facilitate waste separation. As the waste enters the drum, it encounters a series of screens or perforations arranged along the length of the drum. These screens have different mesh sizes, which allow for the separation of different-sized particles. The smaller particles, such as sand or fine soil, pass through the screens and fall through openings at the bottom of the trommel, while larger materials, such as plastics or larger debris, are retained and carried along by the rotation of the drum.

**Separation System:** Additionally, the Mobile Trommel may be equipped with paddles or lifters mounted inside the drum. These paddles help to agitate and tumble the waste materials, assisting in the separation process by ensuring proper contact between the waste and the screens. They also help to break up clumps or aggregates, aiding in the release of trapped organic matter. Four different screen inclination angles for operations between 20°-35° are available for selection provides flexibility.

**Treatment Process:** In the context of legacy waste bioremediation, the Mobile Trommel plays a crucial role in preparing the waste for subsequent treatment steps. By separating the waste into different fractions based on particle size, it allows for targeted bioremediation processes. For example, the fine fraction may be subjected to aerobic or anaerobic composting, while the larger fraction can undergo mechanical or physical treatments.

**Transport:** Quick and easy folding of conveyor helps in quick setup time.

**Discharge height:** Wider conveyor and higher discharge heights help in making bigger stockpile and eliminates the frequent loader usages.



*te)*

**Salient Features of Mobile/Compact Screening Machinery:**

- Full Mobility: Plants are fully mobile like excavator. Plants can be moved across the most difficult of surfaces and terrain and can accommodate the most inaccessible locations.

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- Quick Set up time: Track-Mobile plants can normally be set-up within 1 hour, as it normally does not require additional conveyors, feed hopper to link separate machines, thus increasing machine utilization.
- Versatility: Track-Mobile plants can be operated independently or in combination of two or three stage screening depending upon user requirements.
- No Civil works required: Plants do not require any civil works, can be erected & shifted quickly. Thus offer quicker return on investment.
- Manpower requirement is less.

## 8.2 SELECTION OF MACHINERIES

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land 100%) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by- products as per the requirements of the utilization/forward linkage.

Based on the detailed assessment of the selection parameters listed above, the site conditions, legacy waste characteristics, statutory requirements etc, mobile / compact screening shall be the optimum screening machinery for the Kalpetta Dumpsite. The 7227.86 tons legacy waste can be remediated within the stipulated time by NGT i.e. 31st March 2024

**Salient parameters for opting the Mobile/Compact screeners.**

1. Sorting/segregation of the stabilized legacy waste of 9485.38 m³/ 7227.86 tons within the stipulated timeline of 31st March 2024.
2. The remediation process will be guided by National, State Regulations & EIA/EMP in line with KSWMP ESMF.
3. Salient Features of Mobile/Compact Screening Machinery – details are in the section 8.1.2

## 8.3 SYSTEM REQUIREMENTS

### 8.3.1 CAPACITY SIZING OF MOBILE COMPACT SCREENER

The capacity of the Mobile compact screener is assessed as **50 TPH.** The calculation shown is only indicative and the contractor is required to propose own design and capacity to complete the works in the stipulated time and standards. The details of plant capacity sizing are provided in the table below:

*Table 25 Capacity sizing of Mobile Compact Screener*

| Description | Quantity |
|---|---|
| Quantity of waste (Tons) | 7227.86 |
| Mobilization and site preparation (days) | 60 |
| Weekends & Holidays | 20 |
| Rainy Days | 20 |
| Break downs (Days) | 15 |

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| Description | Quantity |
|---|---|
| No of days (Nov 2023 - Mar 2024) | 75 |
| Effective processing days | 25 |
| Processing per day (Tons) | 300 |
| Capacity of the Plant - Considering working 8 hrs/day | 38 |
| Proposed Capacity of plant TPH | 50 |

### 8.3.2 MACHINERIES & VEHICLES

As the site access road measures below 3 meters in numerous areas, making it impassable for many heavy vehicles, including firefighting vehicles, a suggested solution to address potential future fire issues involves constructing a 25,000-liter water tank with firefighting capabilities. Detailed assessment of quantity (nos) of machinery, vehicles, auxiliary items required for effective processing of the legacy waste are provided in the Annexure – E. The summary of machineries and vehicles requirements are provided in the table below:

*Table 26 Machineries & Vehicles*

| S. No. | Description | Quantity(Nos) | Remarks |
|---|---|---|---|
| 1 | Mobile Trommel @ 100TPH | 1 | Detailed Specifications are provided at Annexure –F |
| 2 | Baling Machine @ 50TPD | 1 | |
| 3 | Ballistic Separator @ 30TPH | 1 | |
| 4 | Magnetic Separator | 1 | |
| 5 | Front End Loader @ Bucket Capacity 1Cum | 2 | |
| 6 | Chain Mounted Excavator @ Bucket Capacity 1.1 Cum | 2 | |
| 7 | Weighing bridge - 40 Ton | 1 | |
| 8 | Tipper @ 8Cum | 5 | |
| 9 | Tractor - Trolley shift of Materials | 1 | |
| 10 | Tractor -Trolley Water Tanker | 1 | |
| 11 | Mechanical Sprayer | 2 | |
| 12 | Office - Portable cabin (1 Nos) | 1 | |
| 13 | GPS (5 Nos) & Tracking System (1 Nos) | 5 | |
| 14 | CCTV System (Cameras 5 Nos) | 5 | |
| 15 | Fire Safety System - Fire Extinguisher ABC type 4 Kg/cm2 | 10 | |

Note: Considering the size of the site, it is also advised that the implementing agency liaisons with the Fire Department and deploy a fire tender at the site during the period of the contract to manage any fire incident as part of Fire Safety Plan.

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## 8.4 OPERATIONS AND MAINTENANCE

### 8.4.1 MANPOWER:

Detailed assessment manpower required for effective processing of the legacy waste are provided in the Annexure – I. The summary of manpower required are provided in the table below:

*Table 27 Manpower details*

| S. No | Manpower | Nos |
|---|---|---|
| 1 | Site In-charge/Head | 1 |
| 2 | Environmental Health & Safety Engineer | 3 |
| 3 | Security (3 X 8 Hrs) | 3 |
| 4 | Operations Supervisor & Accountant | 2 |
| 5 | Machine Operator, Mechanic & Electrician | 2 |
| 6 | Labors for stone removal | 2 |
| 7 | Labors for spraying Bio culture | 4 |
| 8 | Labors near Screening machinery | 2 |
| 9 | Labors at Baling facility | 11 |
| 10 | Drivers for tipper trucks, excavators, backhoe loaders and tractors | 1 |

### 8.4.2 ELECTRICAL POWER:

*Table 28 Electrical Power details*

| Machineries | Required Electrical Load (KW) | Working Hr. | Total Units (KW-Hr) |
|---|---|---|---|
| Bailing Machine | 5 | 4 | 20 |
| Ballistic Separator | 15 | 6 | 90 |
| Magnetic Separator | 5 | 6 | 30 |
| Weigh bridge | 5 | 6 | 30 |
| Total | 30 | | 170 |

### 8.4.3 FUEL/DIESEL FOR VEHICLES:

*Table 29 Fuel/Diesel for Vehicles*

| Description | Liters per Day |
|---|---|
| Fuel - Diesel Mobile Trommel (12 liters/hour) | 96 |

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### 8.4.4 WATER REQUIREMENTS:

*Table 30 Water Requirements*

| Description | Liters per Day |
|---|---|
| Water required for workers and other uses. | 5000 Liters Per Day |
| (Source – Municipality water Supply-It can be stored in the 5000 liter water tank in the site.) | |

*Note: The calculation shown above is only indicative and the contractor is required to propose own design and capacity to complete the works in the stipulated time and guidelines as per tender. The responsibility of availing necessary power and water connection shall be with the contractor as condition precedent before starting the work.*

*Further, considering the size of the site, it is required that the contractor liaisons with the Fire Department and deploys a fire tender team at the site during the period of the contract works to manage any fire incident as part of Fire Safety Plan. Alternatively, general SOPs for fire safety detailed herewith are to be followed:*

a) *Fire Fighting System including fire hydrant, pressure pumps, 5000 Ltr (min) water storage, adequate hose reel and fire extinguishers to be provided at site.*
b) *Alternate source of power (DG)*
c) *Manual Fire Alarm System with evacuation plan*
d) *Regular check, maintenance of equipment's for firefighting (before initiating work and then at interval of 1 months thereof)*
e) *Training to all men. (Before initiating work and then at interval of 3 months thereof).*
f) *Maintaining fire line while storage of material (RDF). RDF to not exceed 10% of total estimated waste at site at any given time.*
g) *Any other requirement in consultation with local Fire & Rescue Services office.*

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# 9 SCOPE OF DISPOSAL INCLUDING LOCATION OF DISPOSAL FOR RDF, BIO SOILS, C & D WASTE, AND OTHERS AS PER LOCAL DEMANDS

## 9.1 UTILIZATION OF BY PRODUCTS

The details of the utilization of aggregates/by-products screened out by processing of the stabilized legacy waste are provided in the table below

*Table 31 Utilization RDF, bio soils, C & D waste*

| S.No | Component | Quantity (Cu.m) | Utilization/Linkage/Usage |
|---|---|---|---|
| 1 | Bio earth and C&D Waste | 6294.32 | The bio earth and C&D and quantity 6924.32 cu.m waste will be utilized for development of the reclaimed legacy waste dumpsite as recreational park/facility. |
| 2 | RDF | 2224.32 | RDF will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel. Currently the indicative nearest location for the RDF disposal is at Dalmia Cements, Trichy which has the necessary infrastructure for co-processing of RDF. |
| 3 | Recyclables & others | 336.73 | Recyclables will be sold to CKCL/recyclers authorized by KSPCB/CPCB. |
| Note: The contractors engaged in biomining will be responsible for ensuring this disposal of Bio Earth, RDF, recyclables, and others. | | | |

## 9.2 SWM Rules 2016 on usage of RDF

A sound policy framework exists in the country as SWM Rules 2016 recommend the following:

| Reference | Rules/Activities |
|---|---|
| Criteria for waste to energy process | (i) Non-recyclable waste having calorific value of 1500 Kcal/kg or more shall not be disposed off on landfills and shall only be utilised for generating energy either or through refuse derived fuel or by giving away as feed stock for preparing refuse derived fuel.<br>(ii) High calorific wastes shall be used for co-processing in cement or thermal power plants. |
| Duties of the industrial units located within one hundred km from the RDF and Waste to Energy plants based on solid waste | All industrial units using fuel and located within 100 km from a solid waste-based RDF plant shall make arrangements within six months from the date of notification of these rules to replace at least 5% of their fuel requirement by RDF so produced |
| Duties of Central Pollution Control Board | Provide guidance to States or Union Territories on inter-state movement of waste |

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## 10 ESTIMATED PROJECT COST

The details of the estimated cost for bio-mining - recovery of land 100% by remediating legacy waste dumpsite is provided in the table below:

*Table 32 Details of Estimated Project Cost*

| Estimate for Dumpsite remediation considering Forward Linkage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Activity | Details | Rate/ m3 | Cost Index @ 1.35 * A | COP @ 1.15 * C | Round off (INR) | Quantity (m3) | Amount (Rs) |
| | | | A | B | D | | | |
| 1 | Remediation/ Biomining | Rate adopted from Calculation from Suchitwa Mission (DSR 2018 including baling) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 2 | Transportation of RDF | The average distance to cement factories works out to be 400 km. The rate of transportation of of RDF can be considered [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 3 | Disposal of recyclable | Considering that the recyclable will be [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 4 | Disposal of Inert | Considering the disposal cost of [redacted] (market rate) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 5 | Disposal of Compost / Soil enricher | Considering the disposal cost of [redacted] (market rate) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| | | | | | | | | [redacted] |
| | Environmental & Social Safeguard estimated amount for the implementation and monitoring | | | | | | | [redacted] |
| | Grand Total | | | | | | | [redacted] |

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| NOTE | |
|---|---|
| 1 | [redacted] |
| 2 | [redacted] |
| 3 | [redacted] |
| 4 | The estimate is based on the information available. The actual cost may vary from site to site based on results of dumpsite investigations report and contractors forward linkages |

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## 10.1 REVENUE FROM THE PROJECT

The anticipated sources of revenue from the processing of the legacy waste dumpsite viz., by sale Bio earth & C&D waste, organic compost, RDF and recyclables. But due to the following reasons mentioned below no revenue from the project is considered

- Bio earth & C&D waste will be utilized within the remediated dumpsite as filler material for development of recreational park.
- RDF is utilized as fuel (co – processing) in the cement industries, presently most cement industries are only accepting the RDF at no cost whereas transportation cost is required to be borne by the contractor sending the RDF to the cement factory/ WtE facility.
- The uncertainty of quantity and quality of the recyclables from legacy dumpsite due to burnt or crushed or disintegrated, rusted and additional money is required for cleaning of the recyclables for saleable.

## 10.2 FUNDING FOR PROJECT

The estimated cost of [redacted]/- for the project Dumpsite Remediation which equals to [redacted]/- **per m³**. The sources and funding pattern is given below:

*Table 33 Funding for the project*

| Item | External (70%) Rs. | State Govt.(30%) Rs. | Total cost Rs |
|---|---|---|---|
| Bioremediation | [redacted] | [redacted] | [redacted] |

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# 11 PROJECT IMPLEMENTATION PLAN

## 11.1 PROPOSED OPERATIONAL PLAN

The bioremediation of Kalpetta dumpsite will be done with the land recovery and will be executed through an outsourcing model. The proposed operational plan is provided at the Annexure - I

## 11.2 TIMELINE

In compliance with the National Green Tribunal (NGT) orders, it is mandatory to remediate all dumpsites in Kerala by March 2024. To ensure timely completion and compliance with the deadline, timeline for the implementation of project is provided below.

| S.No | Description | Time frame |
|---|---|---|
| 1 | Start date | 01/12/2023 |
| 2 | End date | 31/03/2024 |



## 11.3 CONTRACT MODEL

**Execution Method:**

- Item Rate Contract and disposal/Management of by-products/aggregates with zero residues and land recovery. The work shall be carried out in compliance with SWM Rules 2016 and CPCB Guidelines for the disposal of legacy waste 2019.

**Working Model:**

- 100% work to outsourced to selected private contractor
- Technical Support Consultant (TSC) will assess the quantity of waste and the ULB will hand over the land for setting up the plant to the Contractor.
- Cost of Electricity connection to be provided by ULB for the plant.
- Electricity charges for the usage of the plant to be paid by contractor
- Contractor is responsible for disposal of BioEarth, RDF, recyclables, and aggregates

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## 12 BENEFITS OF THE PROJECT

Remediation of legacy waste dumpsite in the Kalpetta leads to the following anticipated benefits:

- **Reclamation of Land**: An area of 1.12 acres will be reclaimed and will be developed into an Agricultural Nursery for public use. A contamination assessment is to be carried out before any public use project is taken up at the location.
- **Environmental Protection**: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By cleaning up contaminated sites, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity. The project shall arrest GHG emissions from the legacy dumpsite.
- **Health Improvement**: Remediation projects reduce these risks, leading to improved public health outcomes and a reduction in waterborne and airborne diseases.
- **Enhanced Water Quality**: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to the safe drinking water.
- **Aesthetic and Social Benefits**: Remediation of legacy waste dumpsite can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents. Uncontrolled waste dumping will be stopped.
- **Operational & Life cycle Aspects**

Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through bio-mining process.

- **Employment**

During remediation & post- remediation period, requirement of un-skilled labor will be fulfilled by s local sourcing.

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# 13 CONCLUSION

- The activities of the bio-mining will be commenced from Dec 2023 to Mar 2024. An area of 1.12 acres will be reclaimed and will be developed into Agricultural Nursery for public use after contamination assessment.
- Through the process of bio mining the dumpsite, complete land reclamation and recovery, while prioritizing environmental safeguards. This means that the land will be reclaimed and put to use.
- Considering site conditions and quantum, screening of the 9485.375 $m^3$ of legacy waste, mobile / compact screening machinery will be preferred.
- Favorable site conditions for bio-mining:
    1. Optimum width of the road (3 m) is available for movement of the vehicles.
    2. Electrical power infrastructure viz., power lines & electrical transformer is available adjacent to the boundary of the dumpsite.
    3. Piped water supply and a storage of water tank 5000 liters are available at the dumpsite.
    4. At the dumpsite plot, a vacant land parcel of approx. 0.15 acres is available for the installation of auxiliary infrastructures, supporting conditions movement of processing machinery and vehicles.
- The project activity requires to obtained "Site Authorization, Consent to Establish and Consent to Operate" from KSPCB
- By-products utilization/forward linkages/Usage
    1. The bio earth & C&D quantity of 4742.69 m3 & 2181.64 $m^3$ respectively is proposed to be utilized after testing for the contamination for development of the reclaimed land as Agricultural Nursery. The contraction shall level the site in consultation with the PIU/TSC/DPMU.
    2. Refused derived fuel (RDF) of 2224.32 $m^3$ will be to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the processes. The indicative location of cement plant is Dalmia Cements, Trichy.
    3. Recyclables of 336.73 $m^3$ will be sold to CKCL /Private recyclers authorized by KSPCB/CPCB
- The implementation/execution of the project activities shall be conforming to SWM Rules 2016, NGT orders, KSPCB norms, CPCB guidelines and KSWMP ESMF and other regulatory rules & norms.
- Environmental & Social safeguards:
    1. The project attracts E2 Environmental category based on the Environmental Screening and Exclusions mentioned in the Environmental and Social Framework Guidelines.
    2. Site specific Environmental Assessment and Environmental Management Plan has been developed.
    3. The project attracts moderate risk social category based on the social mapping & transect walk to understand the settlements/habitations/establishments etc., and consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.
- Total cost of the project is [redacted]/- (INR [redacted]). The cost per $m^3$ for processing and disposal of the legacy waste is [redacted] per $m^3$.

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ANNEXURES

*Table 34 List of Annexures*

| Annexures | Description |
|---|---|
| Annexure A | GEOTECHNICAL TEST REPORT |
| Annexure B | ENVIRONMENTAL TEST REPORT |
| Annexure C | PHOTOGRAPHS –SAMPLING |
| Annexure D | VOLUMETRIC ANALYSIS |
| Annexure E | SITE PLAN |
| Annexure F | SURVEY CONTOUR PLAN |
| Annexure G | REQUIREMENT OF VEHICLE & MACHINERY |
| Annexure H | SPECIFICATION OF MACHINERIES & VEHICLES |
| Annexure I | PROPOSED OPERATIONAL PLAN |
| Annexure J: | LSGD GUIDELINES FOR REMEDIATION OF LEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION |

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# Annexure A : Geotechnical Test Report

MatterLab
Where Quality Matters

Report Number: **ML/GT/2230/243/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE D OF KSWMP AT VELLARAMKUNNU, KALPETA, WAYANAD DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | Project Manager, IPE Global Ltd. |
| Address | : | 2nd Floor, 16/3878-3879, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 528030 |
| Contact Person | : | - |
| Project No | : | GT-235 |
| Project Name | : | Geotechnical examination of dumpsite under package D of KSWMP at Vellaramkunnu, Kalpeta, Wayanad District. |
| Owner | : | KSWMP |
| Project Location | : | Vellaramkunnu, Kalpeta, Wayanad District |
| Tel / Fax No | : | - |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 19-07-2023 | 1st Submission | Dr. Gautham Adapa | |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Dr. Jimmy Thomas | Geotechnical Expert, Consultant, MatterLab | |
| Approved by: | Freddy Soman | General Manager, MatterLab | |

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## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results

# 1 INTRODUCTION

Matter Material Testing and Research Laboratory Pvt. Ltd has been set-up as a result of increased demand locally from various industries for a multidisciplinary testing, materials consultancy & investigation facility in alignment with global standards and technology advancements. MatterLab is an independent professional and technical services provider to all who are concerned with quality and performance of materials & products.

IPE Global Ltd. which provides technical support consultancy services to the Urban local bodies in different municipalities for the Kerala State Waste Management Project (KSWMP) has entrusted the geotechnical investigative works as part of their DPR study for the remediation of dumpsite in Vellaramkunnu, Kalpetta, Wayanad district to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was bored using a rotary drill. The initial site visit was done on 05$^{th}$ June 2023. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 23$^{rd}$ June 2023 and was completed on 26$^{th}$ June 2023. Standard Penetration test (SPT) was conducted within the borehole as required. Representative and undisturbed soil samples were collected to conduct relevant laboratory tests to acquire the necessary parameters. This report presents results of the geotechnical investigation of the ground encountered after drilling through the waste at the dumpsite.

# 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil samples and performing necessary laboratory tests on the collected samples to obtain the desired parameters of the ground profile.
- Preparation of report with laboratory test results.

# 3 OBSERVATIONS FROM SITE VISIT

Matterlab has deputed a team from our geotechnical department along with Mr. Kamal Kishore Jha of IPE Global during the first week of June 2023, in order to collect the information regarding the site prior to mobilising the equipment for drilling.

The dumpsite is situated well away from any human habitation. The site at this location is a sloping terrain. The surface at this site is made horizontal to make the site accessible for manual opeerations.



**Figure 1 :** Location of the borehole drilled at the dumpsite.

## 4 GEOTECHNICAL INVESTIGATIONS

### 4.1 Rotary drilling

Rotary drilling technique was adopted for advancing and cleaning out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste at the dumpsite.

### 4.2 Drilling equipment

Mechanical rigs of rotary drilling machine were used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The borehole of 150mm diameter was formed using a drag bit (Soil Cutter) in soil. The drag bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by

drilling mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

### 4.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as representative samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log the commencement and completion date, location of borehole, elevation of top and bottom of boring, ground water table, boundaries of

each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelog is attached as **Appendix-I.**

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant Standard Codes. A summary of laboratory tests carried out is shown below in **Table 1** and the complete results of laboratory testing are presented in **Appendix II**.

**Table 1: Details of various laboratory tests and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 1 | Soil | Grain-Size Analysis | IS: 2720(Part-4)-1985 |
| 2 | | Atterberg's Limit | IS: 2720(Part-5)-1976 |
| 3 | | MDD/OMC(Light Compaction) | IS:2720(Part-7)-1980 |
| 4 | | Moisture Content | IS 2720(Part 2)-1973 |
| 5 | | Bulk Density | BS:1377-(Part-2)-1990 |
| 6 | | Permeability | IS :2720 (Part-17)-1986 |
| 7 | | Unconfined compressive strength | IS:2720(Part-10)-1991(R2015) |



(a)



(b)



(c)



(d)

**Figure 2 :** Laboratory tests performed at MatterLab.

## 6 SUMMARY

The geotechnical examination on the soil samples collected after boring through the waste at the dumpsite at Vellaramkunnu, Kalpeta, Wayanad was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a single borehole was bored using a rotary drilling method. The maximum depth of investigation was 7.5 m (3.0 m in waste and 4.5 m in the ground). SPT and collection of undisturbed samples were carried out at regular intervals. Various laboratory tests were carried out on the SPT and undisturbed soil samples.

Based on the investigations carried out, it was observed that the original ground below the waste comprises of a Lateritic soil with an average SPT N-value of 22 until 4.5 m followed by a sandy clay layer having an average SPT N-value of 25 underlain by a silty sand sand layer with an average N-value of 19 until the depth of termination at 7.5 m below the top of waste. The tests mentioned in the above table were performed on the samples in the laboratory following the respective codes to obtain the necessary parameters. The laboratory results on samples obtained from the site are appended in **Appendix II**.

# APPENDIX-I

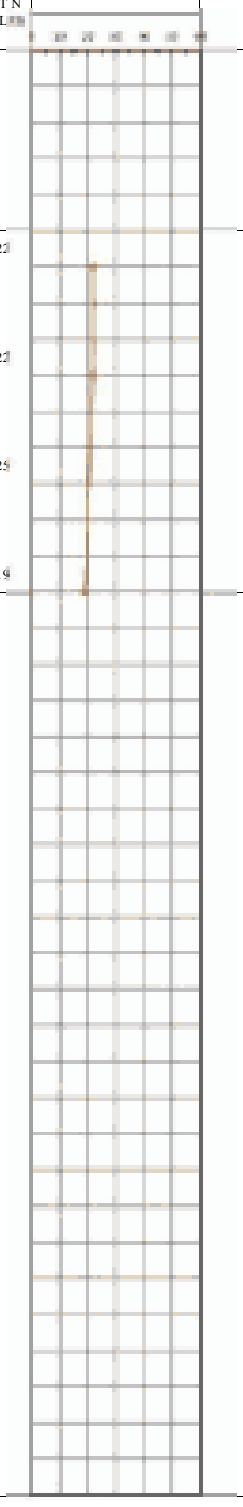
# BORELOGS

Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT** | **: Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta** | **SHEET NO.** | **: 1 of 1`** | **START DATE** | **: 23/06/2023** |
| **CLIENT** | **: Project Manager, IPE Global.** | **BORE DIAMETER (mm)** | **: 150** | **END DATE** | **: 26/06/2023** |
| **Proposed Structure** | **: Dumpsite remediation** | **BORING TYPE** | **: Rotary** | **REDUCED LEVEL (m)** | **: -** |
| **LOCATION** | **: Vellaramkunnu, Kalpetta, Wayanad District.** | **TERMINATION DEPTH (m)** | **: 7.5** | **EASTING (m)** | **: - 76.055345** |
| **BOREHOLE NO.** | **: BH-01** | **WATER LEVEL** | **:** | **NORTHING (m)** | **: - 11.590092** |

| DEPTH m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM N1 | N2 | N3 | SPT N VAL | DEPTH V/S N VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.0 | | Plastic waste deposit | 3.0 | | | | | | | | |
| | | | | 3.0 | SPT-1 | 5 | 7 | 15 | 22 | | |
| | | | | 3.5 | UDS-1 | | | | | | |
| | | Light brownish red laterite | 1.5 | 4.0 | UDS-2 | | | | | | Sample slipped |
| 4.5 | | | | 4.5 | SPT-2 | 7 | 8 | 14 | 22 | | |
| | | | | 5.0 | UDS-3 | | | | | | |
| | | Brownish silty sandy clay | 1.5 | 5.5 | UDS-4 | | | | | | |
| 6.0 | | | | 6.0 | SPT-3 | 7 | 11 | 14 | 25 | | No sample |
| | | | | 6.5 | UDS-5 | | | | | | |
| | | Light greyish brown silty sand | 1.5 | 7.0 | UDS-6 | | | | | | |
| 7.5 | | | | 7.5 | SPT-4 | 9 | 11 | 8 | 19 | | |
| | | **Bore hole terminated at the depth of 7.50 m below top of waste (4.5 m below original ground)** | | | | | | | | | |



Abbreviations
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
CR- Core Recovery, RQD- Rock Quality Designation

Sd/-
Site Supervisor

# APPENDIX-II

# LABORATORY TEST RESULTS

# SUMMARY OF LABORATORY TEST RESULTS

**Report Number : ML23/R-02364 Report Date:13/07/2023**

**Project : Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpeta**

**Borehole ID : BH-01**

| N value | MatterLab ref | Depth (m) | Type of sample (SPT/UDS/RC) | Soil description | IS Classification | Atterberg Limit | | | Grain size distribution | | | | | | | Water content (w), % | Maximum dry density, gm/cc | Optimum moisture content, % | Bulk Density, gm/cc | Permeability, cm/s | Unconfined Compressive Strength (UCS), kPa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit,% | Plastic Limit,% | Plasticity Index | Coarse Gravel,% | Fine Gravel,% | Coarse Sand,% | Medium Sand,% | Fine Sand,% | Silt,% | Clay,% | | | | | | |
| 22 | ML23/W-02364/S1 | 3 0 | SPT | | | 34 | 20 | 14 | | | | | | | | | | | | | |
| | ML23/W-02364/S2 | 3 5 | UDS | | | | | | | | | | | | | 17 | 1 78 | 16 | 2 11 | 1 72 E-07 | 257 |
| 22 | ML23/W-02364/S3 | 4 5 | SPT | Clayey sand with traces of gravel | SC | 44 | 22 | 22 | | 8 | 10 | 15 | 23 | 18 | 26 | | | | | | |
| | ML23/W-02364/S4 | 5 0 | UDS | | | | | | | | | | | | | 16 | | | 2 04 | | 225 |
| | ML23/W-02364/S5 | 5 5 | UDS | | | | | | | | | | | | | | 1 76 | 16 | | 2 50 E-07 | |
| | ML23/W-02364/S6 | 6 5 | UDS | | | | | | | | | | | | | 19 | | | 2 27 | | |
| | ML23/W-02364/S7 | 7 0 | UDS | | | | | | | | | | | | | | 1 65 | 19 | | 1 55 E-06 | |
| 19 | ML23/W-02364/S8 | 7 5 | SPT | Sandy clay of intermediate plasticity | CI | 44 | 21 | 23 | | 2 | 0 | 10 | 20 | 39 | 29 | | | | | | 89 |

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Mini Bypass Road, Thiruvambadi Kada (PO) Thiruvambadi,
Kozhikode, Kerala, 673020

# Water Content of Soil Test Report

Report No: ML23/W-02364/1
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, PE Global |
| Address: | 2nd Floor, 18/3878 - 3879, Kaveriatt Building, Karayanoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellaramkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 05/07/2023 | Client Sample Ref.*: | Soil (UD6-1), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02364 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02364/02 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 29/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(Kg): | 5 Approx |
| Sample Location*: | Vellaramkunnu, Kalpetta, Wayanad District | Date Tested : | 06/07/2023 - 07/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UD6-1), BH 01, Depth 3.50m |
| Tested By: | GR | Client Sample Desc.*: | Soil (UD6-1), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

Test Results:

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 17 | - |

For and on behalf of Matter Lab

Comments:
*Information provided by client

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Kozhikode, Kerala, 673028.

TC-18745

## Water Content of Soil Test Report

Report No: ML23/R-02384/2
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 16/3878 - 3879, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellaramkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 05/07/2023 | Client Sample Ref.*): | Soil (UDS-3), BH 01, Depth 8.00m |
| Work Order ID: | ML23/W-02384 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02384/S4 | Source*): | BH 01, Depth 8.00m |
| Date Sampled: | 29/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2132 - 1986 | Sample Size(Kg): | 5 Approx |
| Sample Location*): | Vellaramkunnu, Kalpetta, Wayanad District | Date Tested : | 06/07/2023 - 07/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 8.00m |
| Tested By: | GR | Client Sample Desc.*): | Soil (UDS-3), BH 01, Depth 8.00m |
| Test Location: | MatterLab - Kozhikode | | |

### Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 18 | - |

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Kozhikode, Kerala, 673625

# Water Content of Soil Test Report

Report No: ML23/N-02364/2
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IRE Global |
| Address: | 2nd Floor, 16/3878 - 3879, Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellarmkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellarmkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 26/06/2023 | Client Sample Ref.*): | Soil (UDS-5), BH 01, Depth 6.50m |
| Work Order ID: | ML23/N-02364 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/N-02364/58 | Source*): | BH 01, Depth 6.50m |
| Date Sampled: | 26/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vellarmkunnu, Kalpetta, Wayanad District | Date Tested : | 06/07/2023 - 07/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-5), BH 01, Depth 6.50m |
| Tested By: | GK | Client Sample Desc.*): | Soil (UDS-5), BH 01, Depth 6.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 19 | - |

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Kozhikode, Kerala, 673025

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23R-02364/I
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 19/3678 - 3679, Kaveratt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellaramkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 3.00m |
| Work Order ID: | ML23W-02364 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02364/01 | Source*: | BH 01, Depth 3.00m |
| Date Sampled: | 26/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vellaramkunnu, Kalpetta, Wayanad District | Date Tested : | 06/07/2023 - 09/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 3.00m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 3.00m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3: Mechanical Method | Liquid Limit,% | 34 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 20 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 14 | - |

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# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23R-023684
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| **Client:** | Project Manger, IPE Global |
| **Address:** | 2nd Floor, 16/3878 - 3879, Kavenatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| **Contact:** | - |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Vellaramkunnu, Kalpetta, Wayanad District |
| **Tel / Email:** | - |

UIN:423107AJ230000049517F

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 06/07/2023 | **Client Sample Ref.*:** | Soil, BH 01, Depth 4.50m |
| **Work Order ID:** | ML23WI-023684 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23WI-023684/S3 | **Source*:** | BH 01, Depth 4.50m |
| **Date Sampled:** | 28/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2131 - 1981 | **Sample Size(kg):** | 5 Approx. |
| **Sample Location*:** | Vellaramkunnu, Kalpetta, Wayanad District | **Date Tested :** | 06/07/2023 - 09/07/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil, BH 01, Depth 4.50m |
| **Tested By:** | VY | **Client Sample Desc*:** | Soil, BH 01, Depth 4.50m |
| **Condition of Soil:** | Natural | **Period of Soaking:** | 24 Hrs |
| **Test Location:** | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | TestParameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3 Mechanical Method | Liquid Limit,% | 44 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 22 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 22 | - |

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Kozhikode, Kerala, 673028.

TC-19743

## Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23W-02364A
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| **Client:** | Project Manger, IPE Global |
| **Address:** | 2nd Floor, 1973/3/9 - 3979, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| **Contact:** | - |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Vellaramkunnu, Kalpetta, Wayanad District |
| **Tel / Email:** | - |

ULR-TC743[illegible]

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 08/07/2023 | **Client Sample Ref.*:** | Soil, BH 01, Depth 7.50m |
| **Work Order ID:** | ML23W-02364 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23W-02364/S8 | **Source*:** | BH 01, Depth 7.50m |
| **Date Sampled:** | 30/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2131 - 1981 | **Sample Size(kg):** | 5 Approx |
| **Sample Location*:** | Vellaramkunnu, Kalpetta, Wayanad District | **Date Tested :** | 08/07/2023 - 09/07/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil, BH 01, Depth 7.50m |
| **Tested By:** | MV | **Client Sample Desc*.:** | Soil, BH 01, Depth 7.50m |
| **Condition of Soil:** | Natural | **Period of Soaking:** | 24 Hrs |
| **Test Location:** | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | TestParameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3: Mechanical Method | Liquid Limit,% | 44 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 21 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 23 | - |

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**Comments**

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Kozhikode, Kerala, 673020

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/0-033647
Issue No: 1
Report Date: 18/07/2023

| | |
|---|---|
| **Client:** | Project Manger, IFE Global |
| **Address:** | 2nd Floor, 18/3878 - 3879, Ravanatt Building, Karayanoor Village, Kakkanad, Ernakulam, Kerala 628030 |
| **Contact:** | - |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Vellaramkunnu, Kalpetta, Wayanad District |
| **Tel / Email:** | - |

ULR-TC187423000000495 4F

## Sample Details

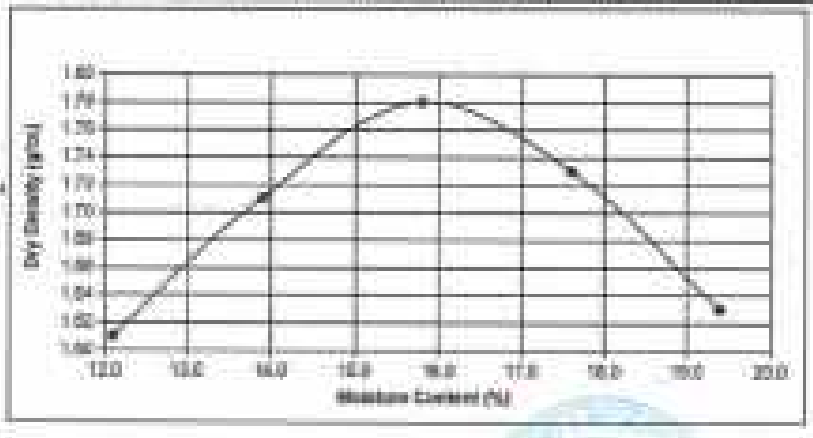
| | | | |
|---|---|---|---|
| **Received Date:** | 06/07/2023 | **Client Sample Ref.*:** | Soil (UDS-1), BH 01, Depth 3.50m |
| **Work Order ID:** | ML23/W-02364 | **Sample Submitted By:*:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02364/02 | **Source*:** | BH 01, Depth 3.50m |
| **Date Sampled:** | 28/06/2023 | **Sampled By*:** | Geotechnical Division |
| **Sampling Method:** | IS: 2132 - 1986 | **Sample Size(kg):** | 5 Approx |
| **Sample Location*:** | Vellaramkunnu, Kalpetta, Wayanad District | **Date Tested :** | 07/07/2023 - 08/07/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil (UDS-1), BH 01, Depth 3.50m |
| **Tested By:** | DK/MV | **Client Sample Desc.:** | Soil (UDS-1), BH 01, Depth 3.50m |
| **Test Location:** | MatterLab - Kozhikode | | |

## Test Results

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ (cm$^3$) | 958 | | | | |
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4053 | | | | |
| Mass of mould + compacted sample | | W (g) | 5859 | 6009 | 6125 | 6089 | 6009 |
| Mass of sample | | | 1798 | 1948 | 2062 | 2026 | 1946 |
| Wet density | $(W-W_m)/V_m$ | $\rho_w$ (Mg/m$^3$) | 1.88 | 1.96 | 2.07 | 2.03 | 1.96 |
| Mass of wet sample | | $W_{ws}$(g) | 477.7 | 488.7 | 498.2 | 477.9 | 526.6 |
| Mass of dry sample | | $W_{ds}$(g) | 426.1 | 411.8 | 430.2 | 426.6 | 440.1 |
| Moisture content | $[(W_{ws}-W_{ds})/W_{ds}]x100$ | m (%) | 12.1 | 13.9 | 15.8 | 17.6 | 19.4 |
| Dry density | $\rho_w/(1+m/100)$ | $\rho_d$ (Mg/m$^3$) | 1.61 | 1.71 | 1.78 | 1.73 | 1.63 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc: | 1.78 |
| Optimum moisture content, % | 16 |
| Material retained on 20mm,% | Nil |
| Sample used | Single |
| Size of mould | 1000cm$^3$ |
| Weight of rammer | 2.6 kg |




For and on behalf of MatterLab

**Comments**

*Information provided by client

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Mini Bypass Road, Thiruvannur Nada (PO) Thiruvannur,
Kozhikode, Kerala, 673025

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/R-02384/B
Issue No: 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 3rd Floor, 18/3878 - 3879, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala 628000 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellaramkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

ULR:TC809423888855F

## Sample Details

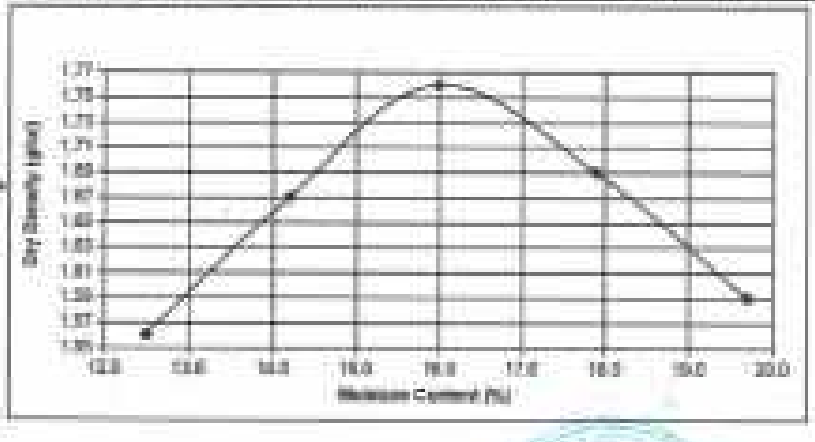
| | | | |
|---|---|---|---|
| Received Date: | 05/07/2023 | Client Sample Ref.*: | Soil (UDS-4), BH 01, Depth 5.50m |
| Work Order ID: | ML23/W-02384 | Sample Submitted By.*: | Geotechnical Division |
| Sample ID: | ML23/W-02384/02 | Source*: | BH 01, Depth 5.50m |
| Date Sampled: | 28/06/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vellaramkunnu, Kalpetta, Wayanad District | Date Tested : | 07/07/2023 - 08/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-4), BH 01, Depth 5.50m |
| Tested By: | DK | Client Sample Desc.: | Soil (UDS-4), BH 01, Depth 5.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ (cm$^3$) | 992 | | | | |
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4003 | | | | |
| Mass of mould + compacted sample | | W (g) | 5819 | 5969 | 6101 | 6049 | 5959 |
| Mass of sample | | | 1799 | 1939 | 2038 | 1986 | 1890 |
| Wet density | $(W-W_m)/V_m$ | $\rho_b$ (Mg/m$^3$) | 1.78 | 1.91 | 2.04 | 1.99 | 1.90 |
| Mass of wet sample | | $W_1$ (g) | 507.2 | 509.2 | 497.8 | 506.0 | 550.7 |
| Mass of dry sample | | $W_2$ (g) | 450.8 | 445.9 | 420.3 | 429.2 | 480.1 |
| Moisture content | $[(W_1-W_2)/W_2]x100$ | m (%) | 12.5 | 14.2 | 18.5 | 17.8 | 19.7 |
| Dry density | $\rho_b/(1+m/100)$ | $\rho_d$ (Mg/m$^3$) | 1.58 | 1.67 | 1.76 | 1.69 | 1.59 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc: | 1.76 |
| Optimum moisture content, % | 18 |
| Material retained on 20mm,% | Nil |
| Sample used | Single |
| Size of mould | 1000cm$^3$ |
| Weight of rammer | 2.6 kg |




For and on behalf of MatterLab

Comments:

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Kozhikode, Kerala, 673028

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/R-023564/B
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 3rd Floor, 3837/8 - 3839, Kaveriath Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala 628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellaramkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

ULR-TC703423000061356F

## Sample Details

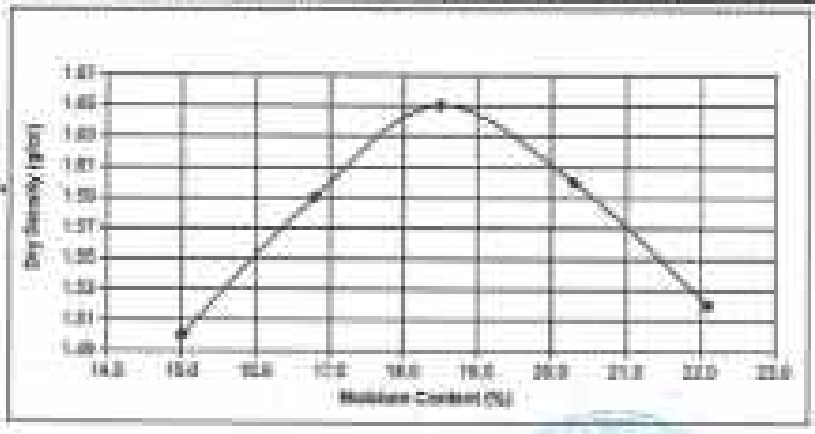
| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS-6), BH 01, Depth 7.00m |
| Work Order ID: | ML23/W-02364 | Sample Submitted By.*: | Geotechnical Division |
| Sample ID: | ML23/W-02364/07 | Source*: | BH 01, Depth 7.00m |
| Date Sampled: | 26/06/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vellaramkunnu, Kalpetta, Wayanad District | Date Tested : | 07/07/2023 - 08/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-6), BH 01, Depth 7.00m |
| Tested By: | DK | Client Sample Desc.: | Soil (UDS-6), BH 01, Depth 7.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould Volume: | | $V_m$ (cm$^3$) | 1000 | | | | |
| Test No: | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould: | | $W_m$ (g) | 4062 | | | | |
| Mass of mould + compacted sample: | | W (g) | 5750 | 5819 | 6009 | 5979 | 5919 |
| Mass of sample | | | 1727 | 1850 | 1948 | 1918 | 1936 |
| Wet density | $(W-W_m)/V_m$ | $\rho_b$ (Mg/m$^3$) | 1.73 | 1.86 | 1.95 | 1.92 | 1.86 |
| Mass of wet sample | | $W_{ws}$ (g) | 532.9 | 503.2 | 537.5 | 495.4 | 500.0 |
| Mass of dry sample | | $W_{ds}$ (g) | 483.4 | 436.8 | 483.8 | 411.8 | 408.6 |
| Moisture content | $[(W_{ws}-W_{ds})/W_{ds}]\times100$ | m (%) | 10.0 | 15.8 | 18.5 | 20.3 | 22.1 |
| Dry density | $\rho_b/(1+m/100)$ | $\rho_d$ (Mg/m$^3$) | 1.50 | 1.59 | 1.65 | 1.60 | 1.52 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc: | 1.65 |
| Optimum moisture content, %: | 19 |
| Material retained on 20mm,%: | Nil |
| Sample used: | Single |
| Size of mould: | 1000cm³ |
| Weight of rammer: | 2.6 kg |




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# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-02384/TR
Issue No : 1
Report Date:19/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 1503/B - 3879, Kavarratt Building, Kanapoor Village, Nakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellarimkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellarimkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 08/07/2023 | Client Sample Ref.*): | Soil (UDS-1), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02384 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02384/08 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 26/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Vellarimkunnu, Kalpetta, Wayanad District | Date Tested : | 09/07/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.50m |
| Tested By: | GK | Client Sample Desc.*) | Soil (UDS-1), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | TestParameters | Result | Specification |
|---|---|---|---|
| IS: 1277( Part 2):1992 | Bulk Density of Soil, g/ml | 2.11 | - |

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**Comments**

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# BULK DENSITY OF SOIL TEST REPORT

Report No: ML2SW-02384/11
Issue No : 1
Report Date:10/07/2023

| | |
|---|---|
| **Client:** | Project Manger, IPE Global |
| **Address:** | 2nd Floor, 1918/B78 - 3879, Kavarati Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-682030 |
| **Contact:** | - |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Vellaramkunnu, Kalpetta, Wayanad District |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 06/07/2023 | **Client Sample Ref.*:** | Soil (UDS-3), BH 01, Depth 5.00m |
| **Work Order ID:** | ML2SW-02384 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML2SW-02384/54 | **Source*:** | BH 01, Depth 5.00m |
| **Date Sampled:** | 26/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2132 - 1986 | **Sample Size(kg):** | 5 Approx. |
| **Sample Location:** | Vellaramkunnu, Kalpetta, Wayanad District | **Date Tested :** | 06/07/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil (UDS-3), BH 01, Depth 5.00m |
| **Tested By:** | GK | **Client Sample Desc.*:** | Soil (UDS-3), BH 01, Depth 5.00m |
| **Test Location:** | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 2.04 | - |

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**Comments**

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# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/W-02364/12
Issue No : 1
Report Date: 10/07/2023

| | |
|---|---|
| Client: | Project Manger, IFE Global |
| Address: | 2nd Floor, 16/3878 - 3879, Kaveriatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-629030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellaramkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS-8), BH 01, Depth 8.50m |
| Work Order ID: | ML23/W-02364 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02364/88 | Source*: | BH 01, Depth 8.50m |
| Date Sampled: | 06/04/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx. |
| Sample Location: | Vellaramkunnu, Kalpetta, Wayanad District | Date Tested : | 06/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-8), BH 01, Depth 8.50m |
| Tested By: | DIVEK | Client Sample Desc.*: | Soil (UDS-8), BH 01, Depth 8.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | TestParameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 2.27 | - |

SREELESH T.V
Chief Technical Officer

For and on behalf of MatterLab

**Comments:**
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## UNCONFINED COMPRESSIVE STRENGTH(UCS) OF SOIL TEST REPORT

Report No: ML23R-0236413
Issue No : 1
Report Date: 09/07/2023

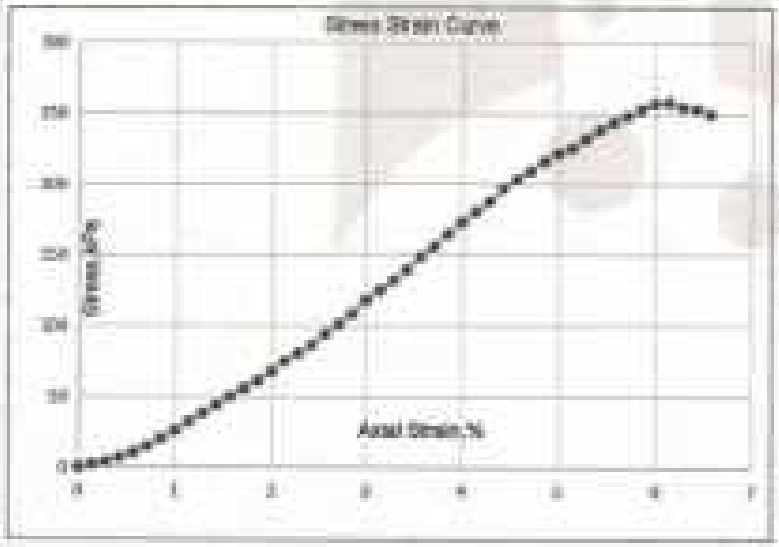
| | |
|---|---|
| Client: | Project Manger, PE Global |
| Address: | 2nd Floor, 18/3878 - 3879, Kavanatt Building, Ramapuram Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Vellarimkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellarimkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*1: | Soil (UCS-1), BH 01, Depth 3.50m |
| Work Order ID: | ML23W-02364 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02364/02 | Source: | BH 01, Depth 3.50m |
| Date Sampled: | 26/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Vellarimkunnu, Kalpetta, Wayanad District | Date Tested : | 06/07/2023 - 07/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Lab Sample Desc.: | Soil (UCS-1), BH 01, Depth 3.50m |
| Tested By: | GK/DK | Client Sample Desc.: | Soil (UCS-1), BH 01, Depth 3.50m |

### Test Results

Method: IS: 2720 (Part 10)-1991 (RA2015)




| | |
|---|---|
| Unconfined Compressive Strength(kPa) | 257 |
| Specimen Height (mm) | 140 |
| Specimen Dia(mm) | 70 |
| Specimen Density(g/cc) | 2.11 |
| Moisture Content(%) | 17 |
| Type of specimen | Undisturbed |
| Specimen Condition | - |

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# UNCONFINED COMPRESSIVE STRENGTH(UCS) OF SOIL TEST REPORT

Report No: ML/SR/22/00474
Issue No : 1
Report Date: 10/07/2023

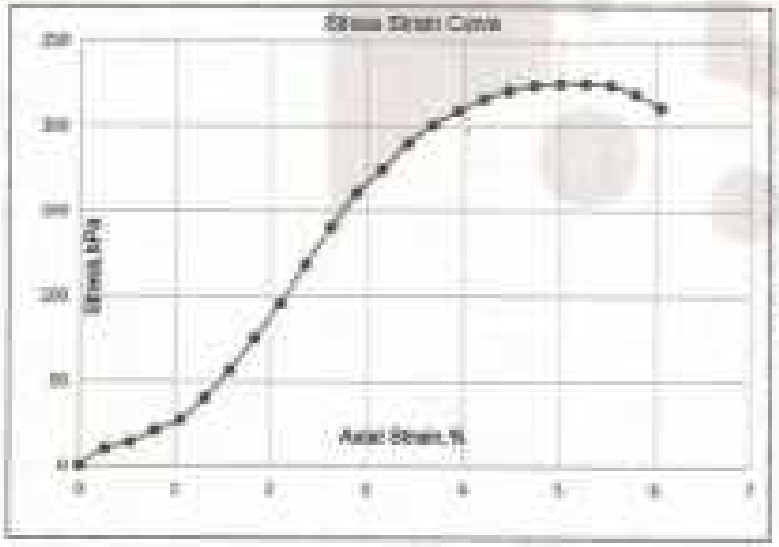
| | |
|---|---|
| Client: | Project Manger, IRE Global |
| Address: | 2nd Floor, 1913/B - 3870, Kawanatt Building, Karapparcoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellaramkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*): | Soil (UCS-3), BH 01, Depth 5.00m |
| Work Order ID: | ML23AN-02364 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23AN-02364/04 | Source: | BH 01, Depth 5.00m |
| Date Sampled: | 26/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Vellaramkunnu, Kalpetta, Wayanad District | Date Tested : | 06/07/2023 - 07/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Lab Sample Desc.: | Soil (UCS-3), BH 01, Depth 5.00m |
| Tested By: | DK/DR | Client Sample Desc.: | Soil (UCS-3), BH 01, Depth 5.00m |

## Test Results

Method: IS: 2720 (Part 10):1991 (R2015)




| | |
|---|---|
| Unconfined Compressive Strength(kPa): | 225 |
| Specimen Height (mm): | 76 |
| Specimen Dia(mm): | 38 |
| Specimen Density(g/cc): | 2.04 |
| Moisture Content(%): | 19 |
| Type of specimen: | Undisturbed |
| Specimen Condition: | - |

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**Comments**

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## UNCONFINED COMPRESSIVE STRENGTH(UCS) OF SOIL TEST REPORT

Report No: ML23/W-0236/R0
Issue No : 1
Report Date: 08/07/2023

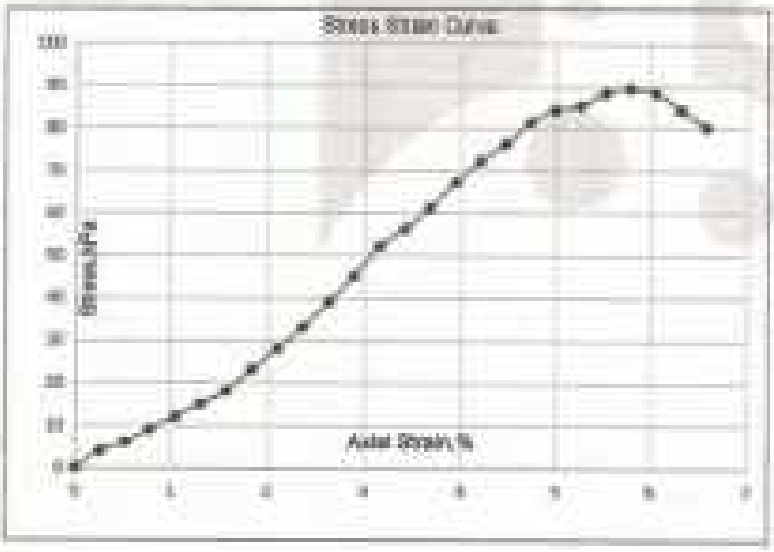
| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 16/3878 - 3879, Kaveratt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellaramkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS-5), BH 01, Depth 6.50m |
| Work Order ID: | ML23/W-0236/ | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-0236/05 | Source: | BH 01, Depth 6.50m |
| Date Sampled: | 28/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Vellaramkunnu, Kalpetta, Wayanad District | Date Tested : | 06/07/2023 - 07/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Lab Sample Desc.: | Soil (UDS-5), BH 01, Depth 6.50m |
| Tested By: | GK/DK | Client Sample Desc.: | Soil (UDS-5), BH 01, Depth 6.50m |

### Test Results

Method: IS: 2720 (Part 10): 1991 (R2015)




| | |
|---|---|
| Unconfined Compressive Strength(kPa) | 89 |
| Specimen Height (mm) | 76 |
| Specimen Dia(mm) | 38 |
| Specimen Density(g/cc) | 2.27 |
| Moisture Content(%) | 19 |
| Type of specimen | Undisturbed |
| Specimen Condition | - |

For and on behalf of Matter Lab

Comments:
*Information provided by client

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Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

# Permeability of Soil Test Report

Report No: ML23/W-02364/12
Issue No : 1
Report Date: 13/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 19/3878 - 3879, Kavanatt Building, Kanapanoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellaramkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02364 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02364/12 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 30/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vellaramkunnu, Kalpetta, Wayanad District | Date Tested : | 06/07/2023 - 10/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.50m |
| Tested By: | DK/GK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 1.73 E-07 | - |

For and on behalf of Matter Lab

**Comments**

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Thiruvambur, Kozhikode, Kerala, 673029

# Permeability of Soil Test Report

Report No: ML23R-02364/P
Issue No : 1
Report Date: 13/07/2023

| | |
|---|---|
| Client: | Project Manger, IRE Global |
| Address: | 2nd Floor, 18/3878 - 3879, Kavanatt Building, Kanarjancor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellarmkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellarmkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 06/07/2023 | Client Sample Ref.*: | Soil (UDS-4), BH 01, Depth 5.50m |
| Work Order ID: | ML23W-02364 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02364/05 | Source*: | BH 01, Depth 5.50m |
| Date Sampled: | 28/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vellarmkunnu, Kalpetta, Wayanad District | Date Tested : | 06/07/2023 - 09/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-4), BH 01, Depth 5.50m |
| Tested By: | DK/GK | Client Sample Desc.*: | Soil (UDS-4), BH 01, Depth 5.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 2.00 E-07 | - |

For and on behalf of Matter Lab

**Comments**

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Thiruvannur, Kozhikode, Kerala, 673029

# Permeability of Soil Test Report

Report No: ML23R-02364/B
Issue No : 1
Report Date: 13/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 18/2878 - 2879, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellaramkunnu, Kalpetta, Wayanad District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/07/2023 | Client Sample Ref.*: | Soil (UDS-6), BH 01, Depth 7.00m |
| Work Order ID: | ML23W-02364 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02364/B7 | Source*: | BH 01, Depth 7.00m |
| Date Sampled: | 28/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 6 Approx |
| Sample Location*: | Vellaramkunnu, Kalpetta, Wayanad District | Date Tested : | 09/07/2023 - 09/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-6), BH 01, Depth 7.00m |
| Tested By: | DK/GK | Client Sample Desc.*: | Soil (UDS-6), BH 01, Depth 7.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 1.55 E-06 | - |

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# Hydrometer Analysis Test Report

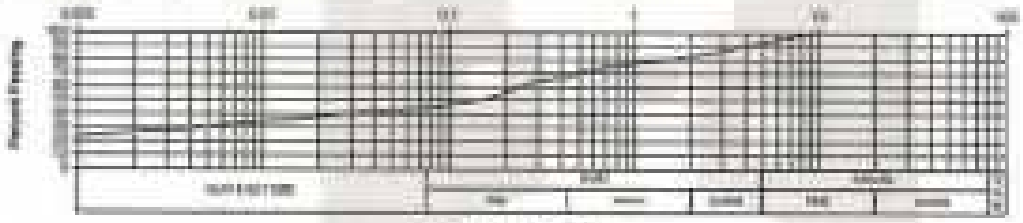
| | | | |
|---|---|---|---|
| Client: | Project Manager, IRE Global | Consultant: | - |
| Address: | 3rd Floor, 16/3679 - 3679, Kavarati Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-682030 | Owner: | KSWAP |
| Contact: | - | Contractor: | - |
| Project No: | - | Project Location: | Vellarimkunnu, Kalpetta, Wayanad District |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellarimkunnu, Kalpetta | Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 08/07/2025 | Client Sample Ref.*): | Soil, BH 01, Depth 4.50m |
| Work Order ID: | ML25/06-02304 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML25/06-02304/03 | Source*): | BH 01, Depth 4.50m |
| Date Sampled: | 30/06/2025 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2131 - 1981 | Sample Size(kg): | 0.4gms |
| Sample Location*): | Vellarimkunnu, Kalpetta, Wayanad District | Date Tested: | 08/07/2025 - 08/07/2025 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 4.50m |
| Tested By: | RH | Client Sample Desc.*): | Soil, BH 01, Depth 4.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution

Method: IS: 2720 (Part 4)-1985, Cl.9.5



Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 97 |
| 2.000 | 93 |
| 0.850 | 78 |
| 0.600 | 73 |
| 0.425 | 67 |
| 0.300 | 54 |
| 0.150 | 50 |
| 0.075 | 44 |
| 0.052 | 42 |
| 0.037 | 41 |
| 0.026 | 39 |
| 0.019 | 37 |
| 0.014 | 35 |
| 0.010 | 34 |
| 0.007 | 32 |
| 0.005 | 30 |
| 0.003 | 28 |
| 0.002 | 26 |
| 0.001 | 23 |

| | |
|---|---|
| Gravel % | 6 |
| Sand % | 49 |
| Silt % | 16 |
| Clay % | 29 |

For and on behalf of MatterLab

Comments:
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Thiruvennur, Kozhikode, Kerala, 673020

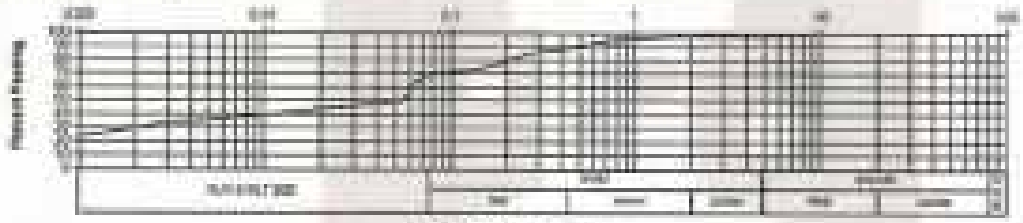
# Hydrometer Analysis Test Report

| | | | |
|---|---|---|---|
| Client: | Project Manager, SFE Global | Consultant: | - |
| Address: | 2nd Floor, 16/3878 - 3879, Kawasaki Building, Kaniyampuzha Village, Kakkanad, Ernakulam, Kerala-682030 | Owner: | KSWMP |
| Contact: | - | Contractor: | - |
| Project No: | - | Project Location: | Vellaramkunnu, Kalpetta, Wayanad District |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellaramkunnu, Kalpetta | Test Issued to: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 08/07/2022 | Client Sample Ref.*: | Bulk, BH 01, Depth 7.45m |
| Work Order ID: | ML23/W-02364 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02364/08 | Source*: | BH 01, Depth 7.90m |
| Date Sampled: | 30/06/2022 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(Kg): | 6 Approx |
| Sample Location*: | Vellaramkunnu, Kalpetta, Wayanad District | Date Tested: | 08/07/2022 - 09/07/2022 |
| Sample Cont. No: | - | Test Method Variation: | Nil |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Bulk, BH 01, Depth 7.45m |
| Tested By: | PH | Client Sample Desc.*: | Bulk, BH 01, Depth 7.45m |
| Test Location: | MatterLab - Kozhikode | | |

**Particle Size Distribution** (Method: IS: 2720 (Part 4)-1985, Cl.9.4)



Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 4.750 | 100 |
| 2.000 | 98 |
| 1.000 | 90 |
| 0.600 | 83 |
| 0.425 | 81 |
| 0.300 | 80 |
| 0.150 | 74 |
| 0.075 | 68 |
| 0.052 | 49 |
| 0.037 | 47 |
| 0.026 | 46 |
| 0.019 | 43 |
| 0.014 | 41 |
| 0.010 | 39 |
| 0.007 | 37 |
| 0.005 | 36 |
| 0.003 | 35 |
| 0.002 | 28 |
| 0.001 | 25 |

| | |
|---|---|
| Gravel,% | 2 |
| Sand,% | 30 |
| Silt,% | 39 |
| Clay,% | 29 |

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# Annexure B

# Environmental Test Reports

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Phone: 0484-2544030, 6282953322, 9747400585, 9747400686, www.poluchem.com, poluchem@gmail.com


## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/152/2023 (ULR NO TC868703000000111F) |
|---|---|---|
| M/s.Program Manager IPE Global Ltd Kavanatt,Building Kalkanad Ernakulam (TSC Package D, KSWMP ) | Date of issue | 24/06/2023 |
| | Date of monitoring | 14/06/2023 |
| | Date of sample received | 16/06/2023 |
| | Date of analysis Started | 16/06/2023 |
| | Sample Code | G/F/152/2023 |
| | Sample description | Ambient air –Kalgetta-Vellarmkunnu |
| | Sample Location | Gps Reading : N- 11 °35'24.276" E -76°02'19.277" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 68.3 $\mu g/m^3$ | 100 $\mu g/m^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 34.5$\mu g/m^3$ | 60 $\mu g/m^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 8.7 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 12.6 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 1.1 $mg/m^3$ | 4 $mg/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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For and on behalf of
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SREEJA RAMESH
AUTHORIZED SIGNATORY

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5255/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kaveri,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 24/06/2023 |
| | Date of monitoring | 14/06/2023 |
| | Date of sample received | 16/06/2023 |
| | Date of analysis Started | 16/06/2023 |
| | Sample Code | G/F/5255/2023 |
| | Sample description | Ambient air -Kalpetta - Vellaramkunnu |
| | Sample Location | Gps Reading : N- 11°35'24.276" E -76°03'19.277" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 $\mu g/m^3$ | 400 $\mu g/m^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 $\mu g/m^3$ | 1 $\mu g/m^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 6 $ng/m^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 20 $ng/m^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 $\mu g/m^3$ | 180 $\mu g/m^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 $\mu g/m^3$ | 5 $\mu g/m^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 $ng/m^3$ | 1 $ng/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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Phone: 0484-2544010, 09810082222, 9747400686, 9747400690, www.poluchem.com, poluchem@gmail.com


## TEST REPORT



| Client Name & Address | Certificate No. | PL/AMB/RT/153/2023 (ULR NO:TC038823000000001153F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 24/06/2023 |
| | Date of monitoring | 14/06/2023 |
| | Date of sample received | 16/06/2023 |
| | Date of analysis Started | 16/06/2023 |
| | Sample Code | G/F/153/2023 |
| | Sample description | Ambient air –Kalpetta-Vellaramkunnu |
| | Sample Location | Gps Reading : N- 11°35'25.777" E -76°05'19.007" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 42.3µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 22.4 µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 6.7 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 8.7 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | <1 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5256/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 24/06/2023 |
| | Date of monitoring | 14/06/2023 |
| | Date of sample received | 16/06/2023 |
| | Date of analysis Started | 16/06/2023 |
| | Sample Code | G/F/5256/2023 |
| | Sample description | Ambient air –Kalpetta-Vellaramkunnu |
| | Sample Locatim | Gps Reading : N- 11 °35'25.777" E -76°03'19.007" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 $\mu g/m^3$ | 400 $\mu g/m^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 $\mu g/m^3$ | 1 $\mu g/m^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 6 $ng/m^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 20 $ng/m^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 $\mu g/m^3$ | 180 $\mu g/m^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 $\mu g/m^3$ | 5 $\mu g/m^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 $ng/m^3$ | 1 $ng/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
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Phone: 0484-2544000, 8281382323, 9747400091, 9747400099, www.poluchem.com, poluchem@gmail.com


**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/SD/9287/2023(ULR NO TC698923000000257F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 24/06/2023 |
| | Date of monitoring | 14/06/2023 |
| | Monitoring Location | Kalpetta- Vellaramkunnu<br>GPS Reading : N- 11°35'25.308"<br>E -76°03'20.171" |
| | Sample Description | Ambient Sound Level |

| HOURLY INTERVAL | | RESULT | HOURLY INTERVAL | RESULT |
|---|---|---|---|---|
| 14.06.2023 | 14.00 Hrs | 56.4 dB (A) | 07.00 Hrs | 57.4 dB (A) |
| 15.00 Hrs | | 62.0 dB (A) | 08.00 Hrs | 59.8 dB (A) |
| 16.00 Hrs | | 58.5 dB (A) | 09.00 Hrs | 58.6dB (A) |
| 17.00 Hrs | | 63.7 dB (A) | 10.00 Hrs | 57.4 dB (A) |
| 18.00 Hrs | | 51.0 dB (A) | 11.00 Hrs | 62.7 dB (A) |
| 19.00 Hrs | | 50.9 dB (A) | 12.00 Hrs | 59.6 dB (A) |
| 20.00 Hrs | | 53.7dB (A) | 13.00 Hrs | 61.7 dB (A) |
| 21.00 Hrs | | 55.2dB (A) | | |
| 22.00 Hrs | | 54.7 dB (A) | | |
| 23.00 Hrs | | 56.7 dB (A) | | |
| 15.06.2023 | 00.00 Hrs | 52.3 dB (A) | | |
| 01.00 Hrs | | 49.8 dB (A) | | |
| 02.00 Hrs | | 51.2 dB (A) | | |
| 03.00 Hrs | | 49.6 dB (A) | | |
| 04.00 Hrs | | 52.4 dB (A) | | |
| 05.00 Hrs | | 50.2 dB (A) | LeqDay | 57.0 dB (A) |
| 06.00 Hrs | | 54.6 dB (A) | LeqNight | 53.7 dB (A) |

Limits: Industrial area Day Time-75dB(A),Night Time- 70dB(A),Commercial area Day Time -65 dB(A),Night Time65dB(A), Residential area Day Time -55 dB(A),Night Time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am

*End of the Report *

For Poluchem Laboratories (P) Ltd.

SREEJA PRAKASH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

# POLUCHEM LABORATORIES (P) LTD.

CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

PALLATH BUILDING, N. KALAMASSERY P. O., ERNAKULAM - 683104

Phone: 0484-2544735, 3201882322, 9747486085, 9747486086, www.poluchem.com, poluchem@gmail.com


## TEST REPORT



**Ref.No: PL/RT/GW/1448/2023** **Date of Issue: 24/06/2023**

(ULR NO:TC638923880000104487)

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kuvanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Kalpetta-Vellarmkunnu
Gps Reading : N- 11°35'28.428"
E -76°03'18.347"

Sample code : P/1448/2023
Date of Sample Collected : 14/06/2023
Date of receipt of sample : 16/06/2023
Date of analysis started : 16/06/2023
Date of completion of analysis : 24/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.89 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | >500 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 341.5 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 420 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 296 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 85 mg/l | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 148 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 76 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 66.5 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 3.47 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 29.14 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.1 mg/l | 1.0 mg/l |

Contd...

BREESH RAMESH
QUALITY MANAGER

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Continuation of Test Certificate No: 1448/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 110 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
MICROBIOLOGIST

*End of the report*

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## TEST REPORT



Ref.No: PL/RT/GW/5258/2023

Date of Issue: 24/06/2023

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavumatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Kulpetta- Vellarumkunnu
Gps Reading : N- 11 °35'28.428"
E -76°03'18.347"

Sample code : F/5258/2023
Date of Sample Collected : 14/06/2023
Date of receipt of sample : 16/06/2023
Date of analysis started : 16/06/2023
Date of completion of analysis : 24/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41 – 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | 0.24 mg/l | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 18 mg/l | — |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | — |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 3.4 mg/l | — |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Contd

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Continuation of Test Certificate No: 525/2023

## RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS :- 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Fthion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorised Signatory

BREEJA RAMESH
QUALITY MANAGER

*End of the report*

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## TEST REPORT



**Ref.No; PL/RT/GW/1449/2023** **Date of Issue: 24/06/2023**

(ULR NO:TC659236000001449F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanutt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Polychem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-2
Sample Location : Kalpetta -Vellarumkunnu
Gps Reading : N- 11 °35'33.228"
E -76°03'29.7"

Sample code : F/1449/2023
Date of Sample Collected : 14/06/2023
Date of receipt of sample : 16/06/2023
Date of analysis started : 16/06/2023
Date of completion of analysis : 24/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.63 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 80 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 91 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 140 µS/cm | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 91 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 64 mg/l | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 44 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 48 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 11.4 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 2.41 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 4.85 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.16 mg/l | 1.0 mg/l |

Contd...

SREEJA RAMESH
QUALITY MANAGER

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Continuation of Test Certificate No: 1449/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 130 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | Shall not be detectable in any 100 ml sample |

For Polychem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Polychem Laboratories (P) Ltd

*End of the report*

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ANALYSIS OF AMBIENT AIR, STACK

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## TEST REPORT



Ref.No: PL/RT/GW/5259/2023 — Date of Issue: 24/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Polychem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-2
Sample Location : Kalpettu- Vellarumkunnu
Gps Reading : N- 11 °35'33.228"
E -76°03'29.7"

Sample code : P/5259/2023
Date of Sample Collected : 14/06/2023
Date of receipt of sample : 16/06/2023
Date of analysis started : 16/06/2023
Date of completion of analysis : 24/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 14 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 2.2 mg/l | --- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level, MDL- Minimum Detection Level

Contd..

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Continuation of Test Certificate No: 525/2023

## RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorised Signatory

SREEJA
QUALITY MANAGER

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/1450/2023** **Date of Issue: 24/06/2023**

(ULR NO:TC048230000001490F)

Name & address of customer : M/S. Program Manager
IPE Global Ltd
Kavanatt,Building,Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : Kalpetta- Vellarmkunnu
Gps Reading : N- 11 °35'38.31"
E -76°03'32.099"

Sample code : P/1450/2023
Date of Sample Collected : 14/06/2023
Date of receipt of sample : 16/06/2023
Date of analysis started : 16/06/2023
Date of completion of analysis : 24/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.99 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 6 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 1.4 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 90 µS/cm | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 58.5 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1 mg/l) | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 28 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 26 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 13.3 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 2.14 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL-0.05mg/l) | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 6.4 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.29 mg/l | 1.0 mg/l |

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SREEJA RAMESH
QUALITY MANAGER

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Continuation of Test Certificate No: I450/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 130 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



Ref.No: PL/RT/GW/5260/2023 Date of Issue: 24/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Polachem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : Kalpetta- Vellaramkunnu
Gps Reading : N- 11 °35'38.31"
E -76°03'32.099"

Sample code : F/5260/2023
Date of Sample Collected : 14/06/2023
Date of receipt of sample : 16/06/2023
Date of analysis started : 16/06/2023
Date of completion of analysis : 24/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Munganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 14 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 3.2 mg/l | --- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

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Continuation of Test Certificate No: 3260/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chlorpyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER

*End of the report*

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**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

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Phone : 0484-2544030, 8281982322, 9747400085.www.poluchem.com, poluchem@gmail.com

**ACCREDITED BY KSPCB AS "A" GRADE LABORATORY**


## TEST REPORT



**Ref.No: PL/RT/5262/2023** **Date of Issue: 24/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Leachate
Sample Location : Kalpetta- Vellaramkunnu
Gps Reading : N-11 °35 '23.91"
E -76°03'19.098"

Sample code : F/5262/2023
Date of sample collected : 14/06/2023
Date of receipt of sample : 16/05/2023
Date of analysis started : 16/06/2023
Date of completion of analysis : 24/06/2023

| Parameters tested | Test method | Results |
|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 7.61 |
| Total Dissolved Solids(Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 845 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 180 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 394.2 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 210 mg/l |
| B O D (3 days at $27^O$ C) | IS 3025 (P) 44 – 1993RA 2014 | 80 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 18.7 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 5.89 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 0.65 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.8 mg/l |
| Cyanide as $CN^-$ | IS 3025 (P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 0.87 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 3.6 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5263/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 24/06/2023 |
| | Date of monitoring | 14/06/2023 |
| | Date of sample received: | 16/06/2023 |
| | Date of analysis | 16/06/2023 |
| | Sample Description | Waste Analysis-Kalpetta- Vellaramkunnu |
| | Sample Location | Gps Reading : N- 11 °35'24.126"<br>E -76°03'20.07" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 25.0 |
| 02 | Bulk Density | | | USEPA | kg/m$^3$ | 763 |
| 03 | Density | | | USEPA | g/cm$^3$ | 0.731 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 1264 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 75 | -- | | | 0 |
| | | 40 | -- | | | 0 |
| | | 20 | -- | | | 28.8 |
| | | 8 | -- | | | 35 |
| | | 4.75 | 4 | | | 16.4 |
| | | 2.36 | 8 | | | 9.6 |
| | | 1.18 | 16 | | | 10.2 |
| | | 0.6 | 30 | | | 0 |

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QUALITY MANAGER

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5264/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanar,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP) | Date of issue: | 24/06/2023 |
| | Date of monitoring | 14/06/2023 |
| | Date of sample received: | 16/06/2023 |
| | Date of analysis | 16/06/2023 |
| | Sample Description | Waste Analysis –Kalpetta- Vellarmkunnu |
| | Sample Location | Gps Reading : N- 11°35'25.372"<br>E-76°05'18.707" |

| PHYSICAL PARAMETERS | | | | | | |
|---|---|---|---|---|---|---|
| Sl. NO | Parameters tested | | | Test Method | Unit | Result |
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 32.4 |
| 02 | Bulk Density | | | USEPA | kg/m³ | 821 |
| 03 | Density | | | USEPA | g/cm³ | 0.785 |
| 04 | Calorific Value | | | ASTM D 5865 | K cal/kg | 1547 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 75 | -- | | | 2.5 |
| | | 40 | -- | | | 35.4 |
| | | 20 | -- | | | 24.8 |
| | | 8 | -- | | | 8.9 |
| | | 4.75 | 4 | | | 2.3 |
| | | 2.36 | 8 | | | 14.2 |
| | | 1.18 | 16 | | | 7.5 |
| | | 0.6 | 30 | | | 4.8 |
| | | 0.3 | 50 | | | 0 |

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For and on behalf of
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SENIOR AUTHORIZED SIGNATORY

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## TEST REPORT



**Ref.No: PL/RT/SW/1451/2023**
(ULR NO: TC659123000001451IF)

**Date of Issue: 24/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kevanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water
Sample Location : Kalpetta- Vellaramkunnu
Gps Reading : N- 11 °35'25.876"
E -76°03'16.589"

Sample code : F/1451/2023
Date of Sample Collected :14/06/2023
Date of receipt of sample :16/06/2023
Date of analysis started :16/06/2023
Date of completion of analysis :24/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 –1983RA2017 | 5.91 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 –1983RA2017 | >500 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 327 NTU | — | — |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 240 µS/cm | — | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 156 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 54 mg/l | — | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 52 mg/l | 200 mg/l | — |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 28 mg/l | — | — |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 49.4 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 30.63 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 –1989RA2014 | 3.2 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 37.08 mg/l | 0.3 mg/l | 0.3 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.5 mg/l | 1.5 mg/l |

Contd...

SREEJA RAMESH
QUALITY MANAGER

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Continuation of Test Certificate No: 1451/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 330 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | --- | --- |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

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## TEST REPORT



Ref.No: PL/RT/SW/5261/2023 Date of Issue: 24/06/2023

Name & address of customer :M/s. Program Manager
IPE Global Ltd
Kavanatt,Building,Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water
Sample Location : Kalpetta- Vellaramkunnu
Gps Reading : N- 11 °35'25.876"
E -76°03'16.589"

Sample code : F/5261/2023
Date of Sample Collected :14/06/2023
Date of receipt of sample :16 /06/2023
Date of analysis started :16/06/2023
Date of completion of analysis :24/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54- 2003RA2014 | BDL(MDL- 0.01mg/l) | – | – |
| Cadmium as Cd | IS 3025(P) 41- 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47- 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42- 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59- 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | — |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | — |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | 0.63 mg/l | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27° C ) | IS 3025 (P) 44 -1993RA2014 | 4.8 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 14 mg/l | — | — |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | — | — |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 5.4 mg/l | — | — |
| Total Chromium as Cr | IS 3025 (P)52 - 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37- 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

For Polachem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAJ
QUALITY MANAGER

"End of the report"

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5265/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 24/06/2023 |
| | Date of monitoring | 14/06/2023 |
| | Date of sample received: | 16/06/2023 |
| | Date of analysis | 16/06/2023 |
| | Sample Description | Waste Analysis –Kalpetta- Vellarankunnu |
| | Sample Location | Gps Reading : N- 11°35'24.126"<br>E -76°03'20.07" |

### CHEMICAL PARAMETERS

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | – | 7.43 |
| 02 | Biodegradable Factor | USEPA | % | 4.1 |
| 03 | Total carbon | USEPA 9060A | % | 3.8 |
| 04 | Phosphorus(P) | USEPA | % | 0.017 |
| 05 | Nitrogen(N) | USEPA | % | 0.28 |
| 07 | Potassium(K) | USEPA | % | 0.023 |
| 08 | C/N Ratio | USEPA | .. | 13.5:1 |
| 09 | Calorific Value | ASTM D 5865 | K.cal/kg | 1165 |

Conti.....

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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5265/2023 |
|---|---|---|
| M/s. IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 24/06/2023 |
| | Date of monitoring | 14/06/2023 |
| | Date of sample received: | 16/06/2023 |
| | Date of analysis | 16/06/2023 |
| | Sample Description | Waste Analysis –Kalpetta- Vellaramkunnu |
| | Sample Location | Gps Reading : N- 11°35'24.126"<br>E -76°03'20.07" |

**TOXICITY ANALYSIS- HEAVY METALS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 10 | Iron (Fe) | USEPA 3050 | % | 3.1 |
| 11 | Arsenic(As) | USEPA 3050 | mg/kg | <0.1 |
| 12 | Selenium(Se) | USEPA 3050 | mg/kg | <0.1 |
| 13 | Nickel(Ni) | USEPA 3050 | mg/kg | 15.4 |
| 14 | Zinc (Zn) | USEPA 3050 | mg/kg | 35.7 |
| 15 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 |
| 16 | Copper (Cu) | USEPA 3050 | mg/kg | 30.2 |
| 17 | Chromium(Cr) | USEPA 3050 | mg/kg | 12.4 |
| 18 | Lead(Pb) | USEPA 3050 | mg/kg | 24.3 |
| 19 | Mercury(Hg) | USEPA 3050 | mg/kg | <0.1 |
| 20 | Manganese(Mn) | USEPA 3050 | mg/kg | 97.2 |

* End of the Report*


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SREEJA RANGAN
AUTHORIZED SIGNATORY

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## TEST REPORT



| Client Name & Address | | |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanart,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Certificate No: | PL/RT/5635/2023 |
| | Date of issue: | 24/06/2023 |
| | Date of sample collection | 14/06/2023 |
| | Date of sample received: | 16/06/2023 |
| | Date of analysis | 16/06/2023 |
| | Sample Received From | Kalpetta-Vellaramkunnu |
| | Sample description | Waste Segregation |
| | Sample Location | Gps Reading : N- 11°35'25.372"<br>E -76°03'18.707" |

| PHYSICAL COMPOSITION | | | | |
|---|---|---|---|---|
| SL NO | Parameters | | Result | |
| | | | Weight | Percentage |
| 01 | BioEarth | (-4.75mm) | 8.35 | 33 |
| | | (+4.75 to 8 mm) | 4 | 16 |
| 02 | C&D | C&D (+8mm) | 6 | 24 |
| 03 | Plastics | Plastics | 4.5 | 18 |
| 04 | MLP/SUP | MLP/SUP | 0.5 | 2 |
| 05 | Cloths | Cloths/ Rags | 0.9 | 3.6 |
| 06 | Glass | Glass | 0.35 | 1.4 |
| 07 | Metals | Metals | 0.48 | 1.9 |
| 08 | Rubber | Rubber | 0.025 | 0.1 |
| 09 | E-Waste | E-waste | 0.0025 | 0.01 |
| 10 | Leather | Leather | 0.0025 | 0.01 |
| Total Weight Of sample -25 g | | | | |

* End of the Report*

The results are related only to the sample collected for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory

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POLUCHEM LABORATORIES (P) LTD.

SREEJA R NAIR
AUTHORIZED SIGNATORY
QUALITY MANAGER

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## TEST REPORT



| | | |
|---|---|---|
| Client Name & Address | Certificate No: | PL/RT/5626/2023 |
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 24/06/2023 |
| | Date of sample collection | 14/06/2023 |
| | Date of sample received: | 16/06/2023 |
| | Date of analysis | 16/06/2023 |
| | Sample Received From | Kalpetta-Vellaramkunnu |
| | Sample description | Waste Segregation |
| | Sample Location | Gps Reading : N- 11°35'24.126"<br>E -76°03'20.07" |

| PHYSICAL COMPOSITION | | | | |
|---|---|---|---|---|
| SL NO | Parameters | | Result | |
| | | | Weight | Percentage |
| 01 | BioEarth | (-4.75mm) | 8.25 | 33 |
| | | (+4.75 to 8 mm) | 4.5 | 18 |
| 02 | C&D | C&D (+8mm) | 5.5 | 22 |
| 03 | Plastics | Plastics | 4 | 16 |
| 04 | MLP/SUP | MLP/SUP | 0.75 | 3 |
| 05 | Cloths | Cloths/ Rags | 1 | 4 |
| 06 | Glass | Glass | 0.45 | 1.8 |
| 07 | Metals | Metals | 0.5 | 2 |
| 08 | Rubber | Rubber | 0.04 | 0.17 |
| 09 | E-Waste | E-waste | 0.0025 | 0.01 |
| 10 | Leather | Leather | 0.005 | 0.02 |
| Total Weight Of sample -25 g | | | | |

* End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD.

SREEJA RAJEEV
QUALITY MANAGER
AUTHORIZED SIGNATORY

# Annexure C

## Sampling Photographs





*Figure SEQ Figure * ARABIC 15*









# Annexure D

# Volumetric Analysis

| NAME OF WORK : | [illegible] |
|---|---|
| Quantification of waste | |

| Chainage | Survey EX Area (sqm) | Average Area (sqm) | Interval of Sections (m) | Survey Volume (cum) |
|---|---|---|---|---|
| | | [illegible] | | |
| 0+00 | 0 | 0 | | 0 |
| 0+05.000 | 49.67 | [illegible] | 5 | [illegible] |
| 0+10.000 | 76.7 | [illegible] | 5 | [illegible] |
| 0+15.000 | 95 | [illegible] | 5 | [illegible] |
| 0+20.000 | 98.82 | [illegible] | 5 | [illegible] |
| 0+25.000 | 98.91 | [illegible] | 5 | [illegible] |
| 0+30.000 | 118.69 | [illegible] | 5 | [illegible] |
| 0+35.000 | 104.37 | [illegible] | 5 | [illegible] |
| 0+40.000 | 132.8 | [illegible] | 5 | [illegible] |
| 0+45.000 | 197.49 | [illegible] | 5 | [illegible] |
| 0+50.000 | 199.15 | [illegible] | 5 | [illegible] |
| 0+55.000 | 208.13 | [illegible] | 5 | [illegible] |
| 0+60.000 | 208.25 | [illegible] | 5 | [illegible] |
| 0+65.000 | 164.98 | [illegible] | 5 | [illegible] |
| 0+70.000 | 92.38 | [illegible] | 5 | [illegible] |
| 0+75.000 | 57.67 | [illegible] | 5 | [illegible] |
| 0+80.000 | 12.23 | [illegible] | 5 | [illegible] |
| 0+85.000 | 14.86 | [illegible] | 5 | [illegible] |
| 0+90.000 | 6.45 | [illegible] | 5 | [illegible] |
| Total Volume of Waste | | | | [illegible] |

Total Volume of Waste = 5885.37 cum

# Annexure E

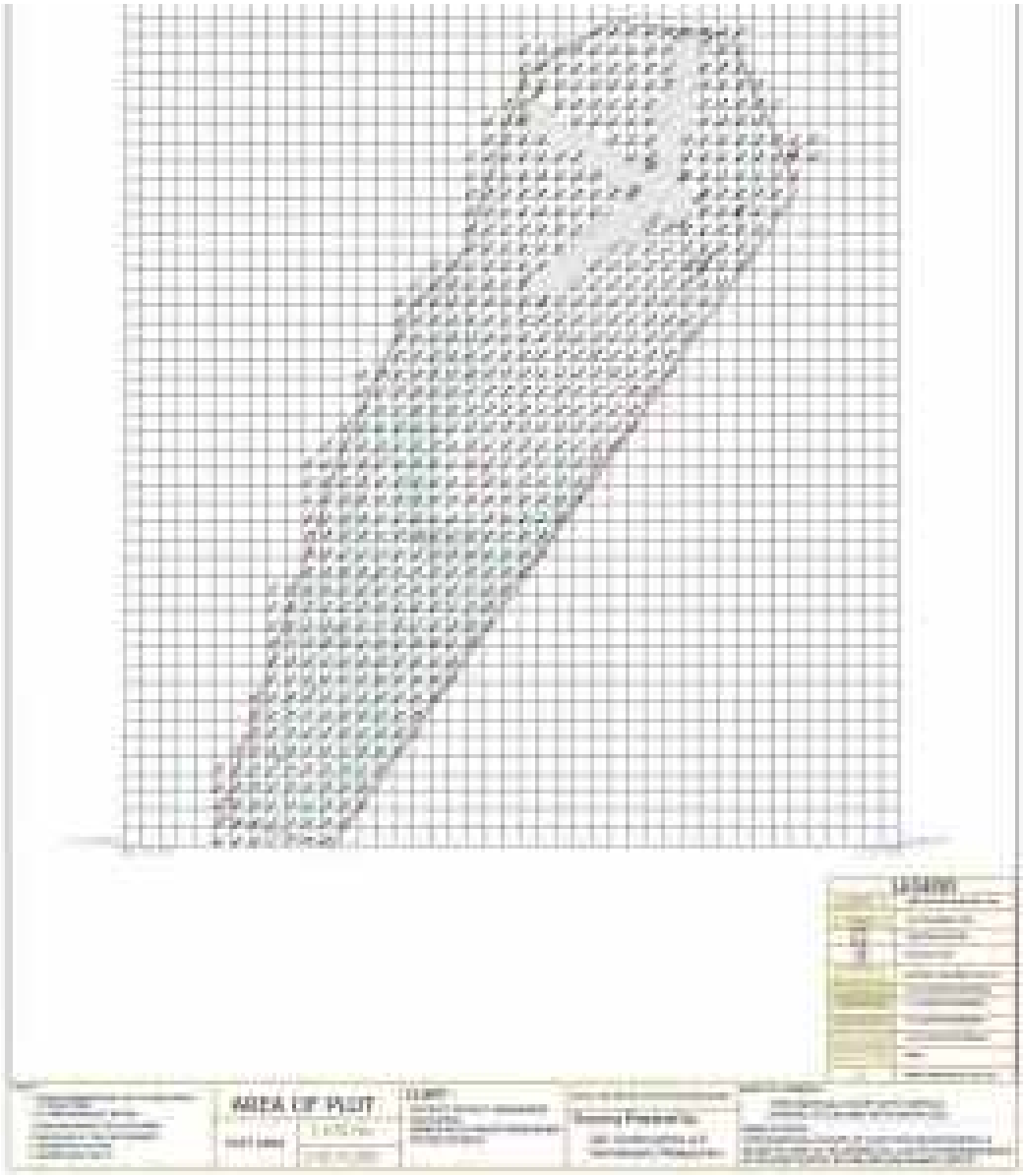
## Site Plan

# SITE MANAGEMENT PLAN KALPETTA



# Annexure F

## Survey Contour Plan



AREA OF PLOT

Annexure-G

# REQUIREMENT OF VEHICLE & MACHINERY

*Table 35 Details Analysis*

| S.No | Machinery & Vehicles | Qty | Units |
|---|---|---|---|
| 1 | Excavation Process | | |
| | Design capacity | 300 | TPD |
| | Required Material to be Excavated per hour | 50 | TPH |
| | Capacity of front-end loader with backhoe per hour | 40 | TPH |
| | No of front-end loader with backhoe required | 3 | Nos |
| 2 | Vehicles Needed for Site movement | | |
| | Tipper capacity per Trip | 4 | Tons |
| | No of trips Per hour | 3 | |
| | No of tippers required | 3 | |
| 3 | No of Tipper required for transporting Byproducts of Biomining ( Earth,RDF, Inerts & Recyclables) | 3 | |
| 3 | Windrow formation and turning | | |
| | Front end loader required for formation of Windrow from the material dropped by the tipper trucks and for turning of waste | 2 | Nos |
| 4 | Feeding to sieving and baling operations | | |
| | Quantity of waste to be fed to sieving machines | 300 | TPD |
| | Quantity of RDF material to be fed to baling machine | 50 | TPD |
| | Capacity of front-end loader to feed in a day to feeders (20 TPH X 10 hours) | 50 | TPD |
| | No of front-end loaders required for feeding sieving and baling machines | 1 | Nos |
| 5 | Water Tanker | 1 | Nos |
| 6 | Tractor | 1 | Nos |
| 7 | Backhoe Loader | 2 | Nos |

# Annexure H

## Specifications of Machineries & Vehicles

*Table 36 Machineries Details*

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| 1 | Mobile Trommel | 1 | Model – Kleemann Scalper MSS 802 |
| | | | Crawler Chassis = Chassis B3HD |
| | | | Drive = KYB MAG 85 NP, Speed 0.98 km/h |
| | | | Fuel Tank holding Capacity = 330 litres |
| | | | Feed Capacity (up to approx.) = 500 t/h |
| | | | Screen Size (W*L) = 1,550 *4,880 mm |
| | | | Machine Weight = 30,000 - 36,000 Kg |
| | | | Drive Output = 99 kW at 1800 rpm |
| | | | Screen Slope = 15.4 - 20 Degree |
| | | | Screen Slpoe Conveyor = 12.5 Degree |
| | | | Fine-grain Conveyor Belt Width = 1200 mm |
| | | | Hopper Discharge Capacity = 9.1 cum |
| | | | Screen Pore Size – Less than 900 * 7760 mm |
| | | | Between 900*7760 mm and 1550*4880 mm |
| | | | Greater Than 1550*4880 mm |
| | | | Warranty = 12 months, however max. 2,000 operation hours from setting into operation, however 15 months after the reported date of readiness for shipment resp. |
| 2 | Baling Machine | 1 | Model – FLT-BMPO 25MT |
| | | | Capacity = 25 Tonnes |
| | | | Cylinder = Single Cylinder (140mm*80mm@3000psi) |
| | | | Oil Tank Capacity = 250 Literes Lifetime Oil |

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| | | | Bale Size = 600*600*600 - 900mm |
| | | | Bale Weight = 50-75 Kg |
| | | | Cycle Time = 15-20mm per Bale |
| | | | Power = 7.5 HP |
| | | | Production Capacity = 1000-1500 Kg/Shr Shift |
| | | | Feed Type = PET, HDPE, MLP, PAPER, CLOTHS, BAGS, CHAPPAL |
| 3 | Weighing bridge | 1 | Model = Modular U Shape Weighbridge, Load Capacity: 10t To 150 |
| | | | Capacity = 30 Tonne (10-150 Tonnes) |
| | | | Size = 5 to 10 m |
| | | | Power Supply 90V to 270V |
| | | | Shape = S Shape |
| | | | Accuracy = 5 Kg |
| 4 | Ballistic Separator | 1 | Drive Power (15 HP) – 1 No.<br>Blower- 1 No.<br>Screen Size - 70*70 MM<br>Material of Construction – IS:2062 ( MS )<br>Throughput Capacity - 30 TPH<br>Output Material - 3 Fraction ( RDF , Inert, Compost)<br>Automatic Feeding Conveyor<br>Drive Power (7.5HP)<br>Feeding Conveyor Inclined<br>Drive Power (7.5HP)<br>Inert Conveyor<br>Drive Power (3.0HP)<br>RDF Conveyor |

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| | | | Drive Power (3.0HP)<br>Compost Conveyor<br>Drive Power (3.0HP)<br>Material of Construction – IS:2062 ( MS )<br>Electrical Control Panel Complete With Wiring |

*Table 37 Vehicle Details*

| II | Vehicle | Nos | Technical Specification |
|---|---|---|---|
| 1 | Back Hoe Loader | 2 | Type = BS 6<br>Bucket min. Capacity = 0.6 cum<br>Gross Power = 84 HP<br>Fully power shift transmission source from the internationally renowned ZF, with heavy duty cluth packs for smooth and easy click of the knob gear shift as per approved design standard |
| 2 | Tipper | 5 | Type = BS 6<br>Hydraulic Lifting Capacity = 10 cum single stock front end hydraulic system<br>Wheel consist of heavy duty steel radials with spare wheel along with 6 cylinder engine, inter cooled as per approved design standard with current pollution |
| 3 | Tractor (separately) | 2 | Mahindra 275 Eco Tractor (BS-6)<br>Fuel Tank Capacity = 45L<br>Brake Type = Oil Brakes<br>Engine Rated RPM = 1900 r/min<br>Main Cluth Type = Single Clutch Heavy Duty Diaphragm type<br>Tyre = 13.6 * 28 / 12.4 *28 (Front / Rear) |
| 4 | Trolley for tractor (separately) | 1 | Janta Enterprise Trolley Making<br>Material = MS |

| B | Vehicle | Nos | Technical Specification |
|---|---|---|---|
| | | | Size of Trolley = 1700*825*1200 |
| | | | Capacity = 7 Tonne |
| | | | Weight = 900 Kg |
| 5 | Water Tanker for tractor (separately) | 1 | Brand = QEE |
| | | | Capacity = 500-10000 Litres |
| | | | Materials = MS |
| 6 | Front End Loader | 1 | Types = BS 6 |
| | | | Minimum Capacity = 1 cum |
| | | | Gross Power = 125 HP |
| | | | Fully power shift transmission source from the internationally renowned ZF, with heavy duty clutch packs for smooth and easy click of the knob gear shift. |

*Table 38 Equipment Details*

| C | Equipment | No.S | Technical Specification |
|---|---|---|---|
| 1 | CCTV | 5 | 4 MP IP Bullet Colour Camera with Mic EA4IL2C-GP (Nos. -4) |
| | | | 4CH NVR 104-FI |
| | | | 1 TB HDD |
| | | | 4+2POE Switvh CP-DNW- GPU4G2-48 |
| | | | 6U Rack 600Depth |
| | | | 2.2 KV UPS |
| | | | RJ45 Connector |
| | | | CDBOX |
| | | | CAT6 Cable |
| | | | Monitor Cell 22"inch |
| 2 | GPS System For Vehicle | 5 | Vehicle Type = truck, Bus, Ship, Generator |
| | | | Model Name = RT wireless Fuel sensor |
| | | | Available Accessories = Wires |

# Annexure I

# Proposed Operational Plan

## Proposed Operational Plan

The project of the Bio-mining with 100% land recovery will be implemented through 100% outsourcing model. The detailed operations of 100% land recovery is provided below:

1. **Project Kick-off**

   The existing legacy waste dumpsite should be visited jointly by representative of implementation agency, officials ULB and experts of PMU/PMC & TSC for the following

   - ✓ For assessment of ***As –Is Situation*** of local settings viz., human settlement & environmental settings etc.,
   - ✓ For validation of profile, quantity & physical characterization of legacy waste.
   - ✓ Available services viz., electrical power, source of water and access road etc.,
   - ✓ For ground truthing the sampling locations of baseline environmental parameter, locations where monitoring will conduct during operation phase and post reclamation phase
   - ✓ For sensitizing/awareness of the upcoming the project activity to the stakeholders within the vicinity of the dumpsite.
   - ✓ For understanding the sensitive of environmental & social aspects/social considerations viz., educational institutions, religious places and settlements settings.
   - ✓ For ensuring that the implementation agency understands and to complies with all local and national regulations related to project activities.

2. **Site Management Plan**

   The position of the machineries and other auxiliary machineries/equipment's in-line with the defined process of bio-mining with 100% land recovery play imperative role in effective implementation of the project activities.

   A detailed site management plan is prepared including the details of excavation & pre stabilization area in phases (1 to 4), machineries, weigh bridge, area allocation for by-products storage, vehicle parking area and position of CCTV cameras. The detailed site Management plan is provided below:




3. **Site Preparation**

The portion of the legacy waste dumpsite will be clear vegetation and levelling the area to create a stable & level platform for positioning of bio-mining machineries/equipment's and for processing of legacy waste.

4. **Procurement of Machinery & Vehicles and Equipment's**

An indicative list of Machineries &Vehicles and equipment's are proposed to for effective processing the quantity of existing legacy waste in-tune to the timeline of NGT orders. The indicative list of the Machinery & Vehicles and equipment's are provided in the Section 8.3.2

5. **Mobilization of Manpower**

For effective management of the project activities, an indicative list Manpower provided in the Section 8.4.1 shall be mobilize required.

## 6. Statutory Approvals

The implementation agency is responsible for obtaining the all required permission/consent/approvals from the competent authorities. The ULB/DPMU/DPMC will only facilitates implementation agency in obtaining the approvals etc. The indicative list of statutory approvals required for the project is provided below.

a. Site Authorization from KSPCB in conforming to SWM Rules 2016 and Consent to Establish/Operate KSPCB.
b. Dept. of mining and geology
c. Necessary permission for storage of process materials and chemicals
d. NOC from Dept. of Fire and Rescue
e. Segregated Hazardous waste disposal arrangement (eg: KEIL Ambalmedu, Kochi)
f. NOC from Heritage/Archeology, if the site is in regulated zone of heritage/protected building
g. Any other statutory approvals/ permissions

## 7. Establishment of forward linkages

The By-products from the bio-mining process/operations viz., Bio earth/ C&D waste (Inert), RDF and Recyclables will be stored in the designated place (as indicated in the site management plan) within the dumpsite. The implementation is responsible for management/establishment of forward linkages. Utilization of Bio earth/C&D (inert) may be finalized in consultation with ULB. The ULB/DPMU/DPMC only will facilitates in forward linkage establishment. An indicative forward linkage is provided in the Section 9.1 List of Cement industries are provided in the Annexure K and list authorized recyclers are provided in the Annexure L

### Bio-mining operations

#### Step-1 – Waste Stabilization

The initial step involves the use of a front-end loader to excavate the legacy waste, allowing for the leachate to dry out through exposure to solar radiation and for the removal of trapped methane from the heap. To ensure the decomposition of biodegradable waste such as discarded food, fruits, flowers, and garden waste, proper aeration is necessary to prevent the generation of leachate and odors. The top layer of the legacy waste, approximately 150 mm in depth, is repeatedly loosened using the front-end loader. Additionally, the waste is lightly mist-sprayed with bio-cultures to manage odors and disperse decomposing microbes throughout the waste. The loosened legacy waste forms windrows.

#### Step-2 – Windrow Formation

The second step involves creating windrows of the legacy waste using backhoe. Composting bio-cultures are added to accelerate decomposition and generate biological heat within the waste, aiding in drying it out and reducing its volume. These windrows are turned every 3 days to ensure proper biological treatment and moisture loss. After 1-2weeks, when the heaps have reached a suitable consistency for screening, the material is weighed and transferred to a Mobile Trommel, which consists of rotating cylinders with different-sized perforations.

Step-3 – Sorting and Segregation by Mobile Trommel

The third step is to move stabilized waste to mobile trommel to get 3 different sizes of fractions

- ✓ Fraction 1 – (minus 30 mm) – Bio Soil/earth -Used for filling low lying areas.
- ✓ Fraction 2 – (30-80) mm – Mixed fraction – Plastics with C&D (send to Ballistic Separator)
- ✓ Fraction 3 – (80 +) mm – Mixed fraction – (send to Ballistic Separator)

The Fraction-2 & Fraction-3 (30-80) mm & (80 +) mm is required to move for further separation process through ballistic separator.

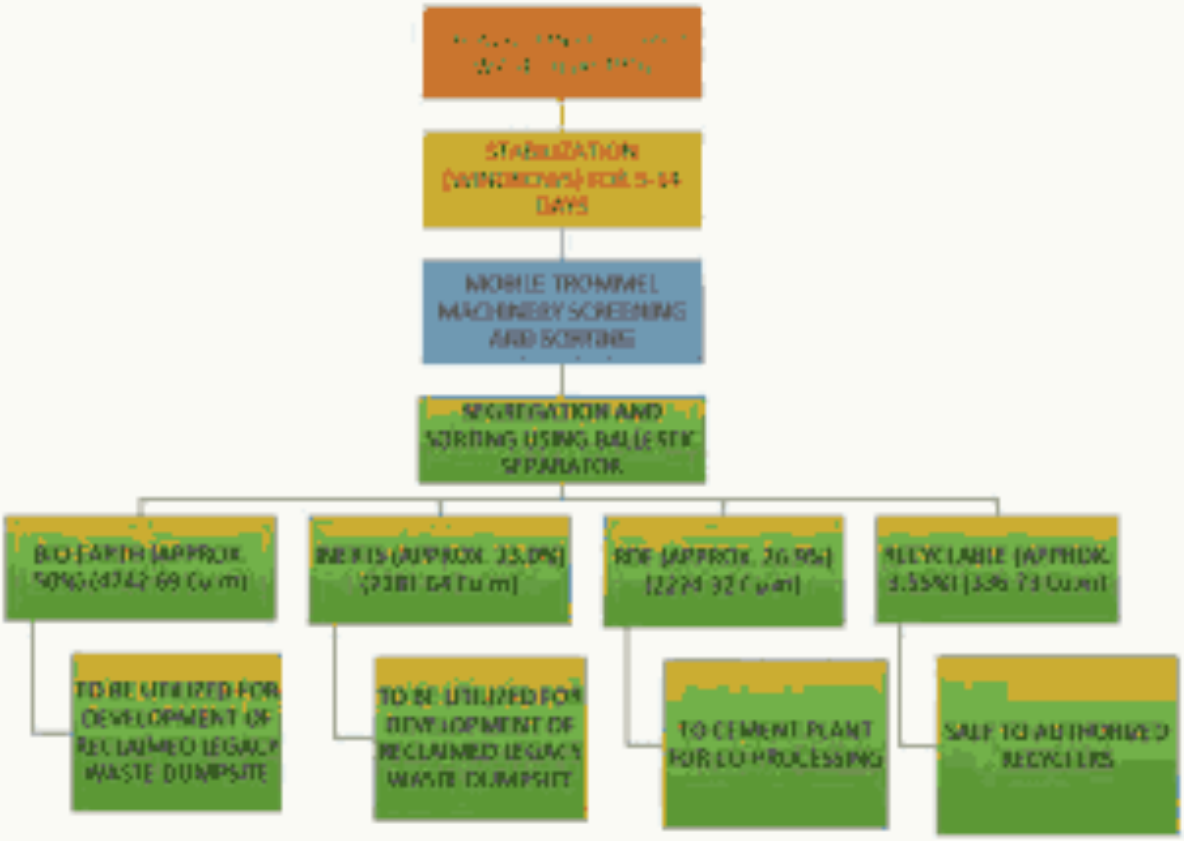


Step-4 – By - products – C&D materials

In the fourth step, the fraction-2 and fraction-3 are sorted into three types based on their shape and weight: heavy and rolling fraction (referred to as 3D) - C&D Material, light fraction (referred to as 2D) - RDF, and the sieved fraction (or under-screen fine fraction) - Plastic.

Step-5 - Byproducts – RDF

In the fifth step, the RDF sorted by the ballistic separator (30TPH) is moved to the baling machine (50TPD) for packaging the RDF fractions. The baled RDF is then transported to Cement plants via a weigh bridge (30Ton), where a co-processing facility is available.




## 8. Monitoring & Supervising Mechanism

Supervision and monitoring during dumpsite remediation by TSC/PIU/DPMU

## 9. Record keeping and Reporting

i. The Implementation agency shall maintain a record of the daily processed legacy waste and also keep proper record of all the recovered and disposed of materials.

ii. The Implementation agency shall maintain authorized weigh bridge records at the point of receipt by end designated agency. A consolidated weigh bridge records certified by the Plant Manager/competent authority of the authorized Cement plant/ WtE or such units certifying the total RDF received from the Project is a valid proof of compliance.

iii. The Implementation agency shall maintain all the statutory records, as per SWM Rules, 2016, and also conditions stipulated in Site Authorization/Consent to Establish/Operate

by KSPCB if any, KSWMP/WB requirements and other project relevance statutory requirements.

iv. The site shall be operated in CCTV surveillance with data storage of entire contract period. For CCTV surveillance High-Definition IP based cameras in adequate numbers. As per the requirement of the ULB/KSWMP link with mobile compatibility may be provided for online monitoring of the project activities.

v. The vehicles engaged for the project activities shall be equipped with Vehicles Tracking System (VTS) by equipping with GPS and online monitoring system.

## 10. Land recovery/project closure

Land shall be reclaimed i.e. all the legacy waste will be removed till it reaches the surface of the earth/ soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the bidder to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to bi-weekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site.

Annexure-J

# LSGD GUIDELINES FOR REMEDIATION OF LEGACY WASTE DUMPSITES THROUGH BIOREMEDIATION

# GOVERNMENT OF KERALA

## Abstract

Local Self Government Department - Guidelines for Remediation of Legacy Waste Dumpsites through Bio Remediation - orders issued.

## DEPARTMENT

G.O.(Rt)No.2629/2022/LSGD Dated,Thiruvananthapuram, 29-10-2022

Read 1 Letter No. 2683/C2/2022/SM dated 16.09.2022 from Executive Director Suchitwa Mission.

## ORDER

As per the letter read above, Executive Director, Suchitwa Mission had submitted draft guidelines for implementation of project for remediation of Legacy Waste Dumpsites through Bio Remediation.

2) Government have examined the matter in detail and are pleased to approve the guidelines enclosed herewith for implementation of project for reclamation of legacy waste dumpsites through bio remediation.

(By order of the Governor)
SHIBI ABRAHAM
DEPUTY SECRETARY

To:

Principal Director Local Self Government Department

Director Local Self Government(Urban) Department

Director, Local Self Government (Rural) Department

Executive Director, Suchitwa Mission

Principal Accountant General (A&E/Audit-I/Audit-II)Kerala, Thiruvananthapuram.

Executive Director, Information Kerala Mission.

The Information Officer (Web & New Media ) I&PRD

Stock File / Office Copy

G.O.(Rt)No.2629/2022/LSGD

Forwarded /By order

Signed by Prasanth C
Date: 29-10-2022 14:53:04

Section Officer

**Copy to:- PS to Minister LSGD**

**PA to ACS LSGD**

**CA to SS LSGD**

I/5470223/2022

**ബയോ**റെമഡിയേഷൻ വഴി തദ്ദേ**ശ** സ്വ**യംഭരണ** സ്ഥാപന**ങ്ങ**ളിലെ ലെഗ**സി മാ**ലിന്യ **നിക്ഷേപ** സൈ**റ്റുകൾ/ഭൂമികൾ** വീ**ണ്ടെടു**ക്കുന്നതി**ലേ**ക്കുള്ള പദ്ധതികൾ **ന**ടപ്പിലാ**ക്കുന്ന**തിന**ുള്ള** മാർഗ്ഗനിർദ്ദേശങ്ങൾ

ഖരമാലിന്യ സംസ്കരണ ചട്ടങ്ങൾ 2016-ലെ വ്യവസ്ഥകൾ അനുസരിച്ച കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ പുറപ്പെടുവിച്ച മാർഗ്ഗനിർദ്ദേശങ്ങളുടെ അടിസ്ഥാനത്തിൽ ലെഗസി മാലിന്യങ്ങൾ നിർമ്മാർജ്ജനം ചെയ്യുന്നതിനും അത്തരം ഭൂമി വീണ്ടെടുക്കുന്നതിനും തദ്ദേശ സ്ഥാപനങ്ങളെ ചുമതലപ്പെടുത്തിയിട്ടുണ്ട. ടി മാനദണ്ഡങ്ങൾ പ്രകാരം നിർമ്മാർജ്ജനം ചെയ്യേണ്ട മാലിന്യത്തിന്റെ സ്വഭാവവും അളവും വിലയിരുത്തൽ, ലെഗസി മാലിന്യ നിക്ഷേപങ്ങൾ ഉറക്കുന്നതിനുള്ള ഉത്ഖനന പ്രവർത്തനങ്ങൾ, മാലിന്യം തരംതിരിക്കുന്നതിനായി സ്ക്രീനിംഗ് സോർട്ടിംഗ്, വീണ്ടെടുക്കപ്പെട്ട വസ്തുക്കളുടെ പുനരുപയോഗം, വിൽപ്പന/വിപണനം, തിരസ്കൃത വസ്തുക്കളുടെ ശാസ്ത്രീയ നിർമ്മാർജനം എന്നിങ്ങനെ വിവിധ പ്രവർത്തനങ്ങൾ ആയതിൽ ഉൾപ്പെടുന്നു. കൂടാതെ ഇത്തരം സൈറ്റുകൾ/ഭൂമികൾ വീണ്ടെടുക്കേണ്ടതിന്റെ ആവശ്യകത 17.07.2019 ലെ OA 519/2019-ലെ ഉത്തരവിൽ ബഹു: ദേശീയ ഹരിത ട്രൈബ്യൂണൽ നിർദ്ദേശിച്ചിട്ടുണ്ട. ഇതിനെത്തുടർന്ന, പ്രവർത്തനങ്ങൾ വേഗത്തിലാക്കുന്നതിനായി 22.03.2020 ലെ സ.ഉ (സാധാ) നം 702/2020/തസ്വഭവ പ്രകാരം ബയോമൈനിംഗ വഴി ലെഗസി മാലിന്യ നിക്ഷേപ ഭൂമികൾ വീണ്ടെടുക്കുന്നതിന വിവിധ സ്റ്റേക്ക ഹോൾഡർമാരുടെ ഉത്തരവാദിത്തം ഉൾപ്പെടെയുള്ള നിർവ്വഹണ സ്ട്രാറ്റജി അംഗീകരിച്ച ഉത്തരവായിരുന്നു. എന്നാൽ, നാളിതുവരെ ഇത്തരം പദ്ധതികളുടെ നിർവ്വഹണത്തിൽ ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ പുരോഗതി കൈവരിച്ചിട്ടില്ലാത്തതാണ. ലെഗസി മാലിന്യ നിർമ്മാർജ്ജന പദ്ധതികൾക്ക പ്രോജക്ടിന്റെ അംഗീകാരം മുതൽ നടപ്പിലാക്കുന്ന രീതി (വീണ്ടെടുത്ത വസ്തുക്കളുടെ വിൽപ്പനയും സംസ്കരണവും ഉൾപ്പെടെ) വരെയുള്ള നടപടിക്രമങ്ങളിൽ വ്യക്തതയില്ലാത്തതാണ ഒരു പ്രധാന കാരണമായി കണക്കാക്കുന്നത. ഇത്തരം പദ്ധതികൾ പൊതു നിർമ്മാണ/സിവിൽ പ്രവൃത്തികൾക്ക സമാനമല്ലാത്തതിനാലും, നിലവിലുള്ള ഒരു ലെഗസി ഡംപസൈറ്റിൽ നിന്ന വീണ്ടെടുക്കാൻ കഴിയുന്ന വസ്തുക്കളുടെ സ്വഭാവം, ഗുണമേന്മ, അളവ എന്നിവ അത്തരം ഡംപസൈറ്റുകൾ ഉറക്കാതെ കൃത്യമായി മുൻകൂട്ടി നിർണ്ണയിക്കാൻ കഴിയാത്തതിനാലും, മറ്റ പൊതുമരാമത്ത പ്രവർത്തികൾ പോലെ ഇത്തരം പ്രവൃത്തികൾക്ക എസ്റ്റിമേറ്റ തയ്യാറാക്കുന്നത പ്രായോഗികമല്ല. ഈ പ്രശനങ്ങൾ പരിഹരിക്കുന്നതിനായി, സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-നും സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന "അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ (Adv sory on Landf Rec amat on)" പുറപ്പെടുവിച്ചിട്ടുള്ളതാണ. ആയതിലെ അനുയോജ്യമായ വ്യവസ്ഥകൾ കേരളത്തിൽ ഇത്തരം പദ്ധതികൾ നടപ്പിലാക്കുന്നതിന സ്വീകരിക്കാവുന്നതാണ. മേൽ സാഹചര്യത്തിൽ, സർക്കാർ ഇക്കാര്യം വിശദമായി പരിശോധിക്കുകയും തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ മുഖേന ലെഗസി മാലിന്യ നിർമ്മാർജ്ജന പദ്ധതികൾ നടപ്പിലാക്കുന്നതിന ഇനിപ്പറയുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങൾ പുറപ്പെടുവിക്കുന്നു.

പാ**ലി**ക്കേണ്ട **മാന**ദ**ണ്ഡ**ങ്ങളും **മാർ**ഗ്ഗനി**ർദ്ദേശ**ങ്ങ**ളും**

- കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ 2019-ൽ പുറത്തിറക്കിയ "ഗൈഡലൈൻസ ഫോർ ഡിസ്പോസൽ ഓഫ ലെഗസി വേസ്റ്റ (ഓൾഡ മുനിസിപ്പൽ സോളിഡ വേസ്റ്റ)"

- കേന്ദ്ര പാർപ്പിട-നഗരകാര്യ മന്ത്രാലയവും (MoHUA) സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന 2020 ൽ പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ (SBM U - Adv sory on Landf Rec amat on)"

- പ്രസ്തുത വിഷയവുമായി ബന്ധപ്പെട്ട കാലാകാലങ്ങളിൽ കേരള സർക്കാർ പുറപ്പെടുവിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങൾ

**തദ്ദേശ** സ്വയം**ഭരണ** സ്ഥാപനങ്ങ**ൾ** മു**ഖേ**ന **ലെഗ**സി **മാ**ലിന്യ **നി**ർമ്മാർജന പദ്ധതികൾ നടപ്പി**ലാ**ക്കുന്നതിനുള്ള **മാതൃകക**ൾ

- 100% ഔട്ടസോഴസ ചെയത മോഡൽ (MoHUA-യും CPHEEO-യും പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഫിൽ റിക്ലമേഷൻ" പ്രകാരം)

**ലെഗസി മാ**ലിന്യ **നിർമ്മാർ**ജന പദ്ധതികളു**ടെ നിർവ്വഹ**ണ ഉദ്യോഗ**സ്ഥ**ൻ

- ലെഗസി മാലിന്യ നിർമാർജന പദ്ധതികളുടെ നിർവ്വഹണ ഉദ്യോഗസ്ഥൻ തദ്ദേശ സ്വയംഭരണ സ്ഥാപനത്തിന്റെ എഞ്ചിനീയർ ആയിരിക്കും

നിർമ്മാർജനം ചെയ്യേണ്ട ലെഗസി മാലിന്യ നിക്ഷേപങ്ങളുടെ അളവ തിട്ടപ്പെടുത്തൽ

- പൊതുവായി, നിർമ്മാർജ്ജനം ചെയ്യേണ്ട ലെഗസി മാലിന്യത്തിന്റെ അളവ (ക്യൂബിക മീറ്ററിൽ) ടോട്ടൽ സ്റ്റേഷൻ സർവേയിലൂടെ കണ്ടെത്താവുന്നതാണ. എന്നാൽ ടോട്ടൽ സ്റ്റേഷൻ സർവേ സാധ്യമല്ലാത്ത സാഹചര്യത്തിൽ, ഒരു ലക്ഷം ക്യൂബിക മീറ്റർ വ്യാപ്തിയിൽ കൂടുതലുള്ള വലിയ ഡംപസൈറ്റുകളുടെ കാര്യത്തിൽ ഡ്രോൺ സർവ്വേ രീതി സ്വീകരിക്കാവുന്നതാണ.

- ആവശ്യമുള്ള പക്ഷം, പുറമെയുള്ള സർവേ ഏജൻസികളെ നിശ്ചിത നടപടിക്രമങ്ങൾ പാലിച്ച ഇതിനായി ഏർപ്പെടുത്താവുന്നതും, അതിനുള്ള ചെലവ ലഭ്യമായ ഫണ്ടിൽ നിന്ന തദ്ദേശ സ്വയംഭരണ സ്ഥാപനം വഹിക്കേണ്ടതുമാണ.

- സൈറ്റിന്റെ കോണ്ടൂർ മാപ്പ തയ്യാറാക്കേണ്ടതും ആയത തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ പരിശോധിച്ച അംഗീകരിക്കേണ്ടതുമാണ.

എസ്റ്റിമേറ്റ തയ്യാറാക്കലും പദ്ധതി രൂപീകരണവും

- സൈറ്റിന്റെ നിലവിലെ അവസ്ഥ, മാലിന്യത്തിന്റെ സ്വഭാവം/തരം, മാലിന്യ നിക്ഷേപത്തിന്റെ കാലയളവ, മറ്റ അടിസ്ഥാന വിശദാംശങ്ങൾ എന്നിവയെക്കുറിച്ചുള്ള വിശദമായ റിപ്പോർട്ട അനുബന്ധം- I ൽ നൽകിയിരിക്കുന്ന പ്രൊഫോർമയിൽ തയ്യാറാക്കേണ്ടതാണ

- അനുബന്ധം-II ൽ നൽകിയിരിക്കുന്ന സ്പെസിഫിക്കേഷനും ഡാറ്റയും അനുസരിച്ച ബയോമൈനിംഗ മുഖേന പ്രവൃത്തി നടപ്പിലാക്കുന്നതിന എസ്റ്റിമേറ്റ തയ്യാറാക്കേണ്ടതാണ.

- പ്രൊപ്പോസൽ തയ്യാറാക്കുന്നതിന്റെ ഭാഗമായി പ്രസ്തുത പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള എല്ലാത്തരം ചെലവുകളും പരിഗണിക്കേണ്ടതാണ.

- വാർഷിക പദ്ധതിയുടെ ഭാഗമായി പ്രോജക്ട ഏറ്റെടുക്കേണ്ടതും ലഭ്യമായ സ്രോതസ്സുകളിൽ നിന്നും ഫണ്ട വകയിരുത്തേണ്ടതുമാണ.

സാങ്കേതിക അനുമതി

നിലവിലുള്ള സാമ്പത്തിക അധികാരങ്ങൾ അനുസരിച്ച തദ്ദേശ സ്വയംഭരണ വകുപ്പ(ലോക്കൽ ഇൻഫ്രാസ്ട്രക്ച്ചർ & എഞ്ചിനീയറിംഗ വിങ) ലെ ബന്ധപ്പെട്ട എഞ്ചിനീയർ പ്രോജക്ടിന സാങ്കേതിക അനുമതി നൽകുകയും മാനദണ്ഡങ്ങൾ പാലിക്കുന്നതിനായി ചീഫ ടെക്നിക്കൽ എക്സാമിനർക്ക (ഫിനാൻസ വിംഗ) ആവശ്യമായ റിപ്പോർട്ടിംഗ ഉറപ്പാക്കുകയും ചെയ്യേണ്ടതാണ.

തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ ലെഗസി മാലിന്യ നിക്ഷേപ സൈറ്റുകൾ/ഭൂമികൾ വീണ്ടെക്കുന്നതിനുള്ള പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള നടപടി ക്രമങ്ങൾ

ടെൻഡറിംഗ

- ലെഗസി മാലിന്യ നിക്ഷേപ സൈറ്റുകൾ വീണ്ടെടുക്കുന്നതിനുള്ള പ്രവൃത്തിയുടെ വിശദമായ സ്കോപ്പ ഓഫ വർക്ക, നിബന്ധനകളും വ്യവസ്ഥകളും മുതലായവ വ്യക്തമായി പരാമർശിക്കുന്ന 'ടു കവർ ബിഡ്സ താല്പര്യപത്രം'(Request for Proposa - wo Cover Bd) തയ്യാറാക്കേണ്ടതും ആയത നടപടിക്രമങ്ങൾ പാലിച്ച പ്രസിദ്ധീകരിക്കുകയും ചെയ്യേണ്ടതാണ.

- കേന്ദ്ര പാർപ്പിട-നഗരകാര്യ മന്ത്രാലയവും (MoHUA) സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ" ൽ നൽകിയിരിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങളെ

അടിസ്ഥാനമാക്കി RFP-യിലെ വ്യവസ്ഥകൾ/യോഗ്യതാ മാനദണ്ഡങ്ങൾ നിശ്ചയിക്കാവുന്നതാണ.

- കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ പുറപ്പെടുവിച്ച "ഗൈഡലൈൻസ ഫോർ ഡിസ്പോസൽ ഓഫ ലെഗസി വേസ്റ്റ (ഓൾഡ മുനിസിപ്പൽ സോളിഡ വേസ്റ്റ) " പ്രകാരം ലെഗസി മാലിന്യ നിക്ഷേപങ്ങൾ നിർമ്മാർജ്ജനം ചെയ്യേണ്ടതാണെന്ന നിബന്ധന പ്രവൃത്തിയുടെ 'സ്കോപ്പ ഓഫ വർക്കിൽ' ഉൾപ്പെടുത്തുന്നുണ്ടെന്ന ഉറപ്പ വരുത്തേണ്ടതാണ.

- ലഭ്യമാകുന്ന ടെക്നിക്കൽ ബിഡ്സുകൾ പരിശോധിച്ച വിലയിരുത്തേണ്ടതും സാങ്കേതിക യോഗ്യത നേടുന്ന ബിഡ്ഡർമാരെ ബിഡ/ടെൻഡർ അംഗീകാരത്തിന്റെ തുടർ ഘട്ടത്തിനായി ഷോർട്ടലിസ്റ്റ ചെയ്യേണ്ടതുമാണ. ടെക്നിക്കൽ ബിഡ്സുകളുടെ മൂല്യനിർണ്ണയം നടത്തുന്നതിനായി താഴെപ്പറയുന്ന അംഗങ്ങളെ ഉൾപ്പെടുത്തി തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ സാങ്കേതിക സമിതി രൂപീകരിക്കേണ്ടതാണ;

    - സെക്രട്ടറി
    - LSGD (LID & EW) എഞ്ചിനീയർ
    - ഹെൽത്ത വിഭാഗം ഉദ്യോഗസ്ഥൻ (നഗര തദ്ദേശ സ്ഥാപനങ്ങളുടെ കാര്യത്തിൽ)
    - ജില്ലാ ശുചിത്വ മിഷനിൽ നിന്നുള്ള സാങ്കേതിക വിദഗ്ധൻ
    - ജില്ലാ മലിനീകരണ നിയന്ത്രണ ബോർഡിന്റെ പ്രതിനിധി
    - അക്കാദമിക സ്ഥാപനങ്ങളിൽ നിന്നുള്ള മറ്റ വിദഗ്ധർ

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ സാങ്കേതികമായി ഷോർട്ടലിസ്റ്റ ചെയ്ത ബിഡഡർമാരുടെ ഫിനാൻഷ്യൽ ബിഡ്സുകൾ തുറക്കേണ്ടതും നടപടിക്രമങ്ങളും മാനദണ്ഡങ്ങളും പാലിച്ച അംഗീകരിക്കേണ്ടതുമാണ.

- തിരഞ്ഞെടുത്ത കരാറുകാരന/ഏജൻസിക്ക ലെറ്റർ ഓഫ അവാർഡ (L O A) നൽകുകയും കരാറിൽ ഏർപ്പെടേണ്ടതുമാണ.

നിർവ്വഹണം, മേൽനോട്ടം, ബില്ലുകൾ തയ്യാറാക്കൽ

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയറും മാലിന്യ പരിപാലന പ്രവർത്തനങ്ങളുടെ നിരീക്ഷണ ചുമതലയുള്ള ഉദ്യോഗസ്ഥനും അടങ്ങുന്ന ഒരു മേൽനോട്ട സമിതി (Superv s on Commttee) രൂപീകരിക്കേണ്ടതാണ

- R F P ഡോകുമെന്റിലും കരാറിലും ഉൾപ്പെടുത്തിയിട്ടുള്ള 'സ്കോപ്പ ഓഫ വർക്ക' കരാറുകാരൻ കൃത്യമായി പാലിക്കുന്നുണ്ടോ എന്ന നിരീക്ഷിക്കുന്നതിനായി തദ്ദേശ സ്വയംഭരണ സ്ഥാപനം മേൽനോട്ട സമിതിയെ ചുമതലപ്പെടുത്തേണ്ടതാണ.

- പ്രസ്തുത പ്രവൃത്തി 'സ്കോപ്പ ഓഫ വർക്കിൽ' നിഷ്കർഷിക്കുന്ന പ്രകാരമാണോ നടപ്പിലാക്കുന്നതെന്ന മേൽനോട്ട സമിതി കൃത്യമായും പരിശോധിക്കുകയും നിരീക്ഷിക്കുകയും ചെയ്യേണ്ടതാണ.

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ കരാറുകാരന/ ഏജൻസിയ്ക്ക സൈറ്റ ഹാൻഡ ഓവർ ചെയ്ത നൽകേണ്ടതും പ്രവൃത്തി നടപ്പിലാക്കുന്നതിനുള്ള/ നിർവഹിക്കുന്നതിനുള്ള പിന്തുണ നൽകുകയും ചെയ്യേണ്ടതാണ.

- മാലിന്യ പരിപാലന പ്രവർത്തനങ്ങൾ നിരീക്ഷിക്കുന്നതിന്റെ ചുമതലയുള്ള ഉദ്യോഗസ്ഥൻ പ്രസ്തുത പ്രവൃത്തിയിൽ ഉൾപ്പെടുന്ന മാലിന്യ പരിപാലനവുമായി ബന്ധപ്പെട്ട പ്രവർത്തനങ്ങളായ വിൻട്രോ ഫോർമേഷൻ, മാലിന്യം

തരംതിരിക്കൽ, മലിനീകരണ നിയന്ത്രണ മുൻകരുതലുകളും ആരോഗ്യപരമായ കാര്യങ്ങളും ഉറപ്പുവരുത്തൽ എന്നിവയ്ക്ക മേൽനോട്ടം വഹിക്കേണ്ടതും കരാറുകാരന/ഏജൻസിക്ക മേൽനോട്ട സമിതി മുഖേന ആവശ്യമായ നിർദ്ദേശങ്ങൾ നൽകേണ്ടതുമാണ.

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ എംബുക്കിൽ 'ഇനിഷ്യൽ', 'ഇന്റർമീഡിയറ്റ്', 'ഫൈനൽ' ലെവലുകൾ എന്നിവ എടുത്ത അളവുകൾ രേഖപ്പെടുത്തേണ്ടതും, തദ്ദേശ സ്വയംഭരണ വകുപ്പിന ബാധകമായ അധികാരമനുസരിച്ച ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ വകുപ്പ (എൽ.ഐ.ഡി & ഇ.ഡബ്ല്യു) എഞ്ചിനീയർ ചെക്ക മെഷർമെൻറ നടത്തുകയും ചെയ്യേണ്ടതാണ.

- കരാറിൽ വിശദമാക്കിയിട്ടുള്ള ജോലിയുടെ വിവിധ ഘട്ടങ്ങൾ പൂർത്തിയാക്കിയ ശേഷം കരാറുകാരൻ/ഏജൻസി ക്ലെയിം ചെയ്യുന്ന പ്രവൃത്തിയുടെ വർക്ക ബില്ലുകൾ തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ തയ്യാറാക്കേണ്ടതും തദ്ദേശ സ്വയംഭരണ സ്വയംഭരണ വകുപ്പിന ബാധകമായ അധികാരമനുസരിച്ച ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ വകുപ്പ (എൽ.ഐ.ഡി & ഇ.ഡബ്ല്യു) എഞ്ചിനീയർ ചെക്ക മെഷർമെൻറ നടത്തുകയും ചെയ്യേണ്ടതാണ.

- <u>GUIDELINES FOR IMPLEMENTATION OF PROJECTS FOR RECLAMATION OF LEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION (BIO MINING AND MANAGEMENT OF RECOVERABLES AND REJECTS)</u>

As per the provisions of Solid Waste Management Rules 2016, local bodies are mandated to remediate legacy waste dumpsites and reclaim the land based on the guidelines issued by CPCB. Remediation of legacy dumpsites involves various activities such as assessment of the nature and quantity of waste to be remediated, excavation works to open the dumps, screening and sorting to segregate the waste fractions, reuse and sale/marketing of recovered materials, scientific disposal of rejects as per the norms. The remediation of dumpsites is further directed by Honorable NGT in its order on OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. However, the progress of implementation of such projects has not been satisfactory so far. One of the main reasons is that there is a lack of clarity in the procedures to be followed for legacy waste remediation projects right from the approval of the project to the mode of execution (including sale and disposal of recovered materials) by LSGIs since the nature of such projects is not similar to the general public construction/civil works. Also, the nature, quality and quantity of material that can be recovered from an existing legacy dumpsite cannot be accurately predetermined without opening up such dumpsites and hence it is not practical to prepare a workable estimate for the same like other public works . In order to tackle these issues, Swachh Bharat Mission(Urban) and CPHEEO have issued an "Advisory on Landfill reclamation", and suitable provisions of this advisory can be adopted for the State of Kerala. In these circumstances, the Government has examined this matter in detail, and the following guidelines are issued for the implementation of projects for remediation of legacy dumpsites by Local Self Government Institutions.

**<u>Standards, guidelines and advisories to be followed</u>**

- "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" issued by Central Pollution Control Board
- "SBM-U Advisory on Landfill Reclamation" published by MoHUA and

CPHEEO

- Guidelines issued by Government of Kerala in this regard from time to time

**Models for implementing legacy waste dumpsite remediation by LSGI's**

- 100% outsourced model (As per "SBM -U Advisory on Landfill Reclamation" published byMoHUA and CPHEEO)

**Implementing officer for legacy waste dumpsite remediation projects**

The implementing officer for legacy waste remediation shall be the Engineer of the LSGI

**Quantification of legacy waste to be remediated**

- The volume of legacy waste (in m3) to be remediated shall be generally assessed through Total Station Survey. If a total station survey is not feasible, a drone survey may be adopted for large dumpsites having a volume of more than 1 (One) Lakh m3.
- If required, external survey agencies may be engaged following laid down procedures and the cost for the same shall be met by LSGI from available funds.
- Contour mapping of the site shall be prepared and approved by the Engineer of the LSG

**Project Cost Estimation and Formulation by LSGI**

- Detailed report regarding the site conditions, nature of dump, history of dumping and other basic details shall be prepared in the format given in **Annexure - I**
- The estimate for biomining shall be prepared as per the specification and data given in
  - **Annexure -II**
- The overall cost for the implementation of the project shall be considered as part of the proposal.
- Project shall be taken up as per annual projects and funds from available sources shall be ear marked

**Technical Sanction**

- Technical sanction for the project shall be issued by the concerned Engineer in LSGD (LID & EW) as per the existing financial powers and necessary reporting to the Chief Technical Examiner (Finance Wing) may be ensured for compliance as per norms

**Implementation steps for remediation of legacy waste dumpsites by LSGIs**

**Tendering**

- Request for Proposals (RFPs-Two cover bid) clearly mentioning the scope of work, terms and conditions for reclamation of legacy waste dump sites shall be prepared and published as per laid down procedures.
- Conditions/eligibility criteria in the RFP shall be fixed based on the guidelines given in"**SBM-U Advisory on Landfill Reclamation"** published by MoHUA and CPHEEO
- It shall be ensured to mention in the scope of work that remediation of legacy waste dumpsites shall be undertaken as per the **"Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)"** issued by Central Pollution Control Board.
- The technical proposals received should be evaluated and technically qualified bidders shortlisted for further stage of bid approval. A Technical committee shall be formed at LSGI level for evaluation of the technical bids with the following members;
    - Secretary
    - LSGD (LID & EW) Engineer
    - Health Official (in the case of Urban local bodies)
    - Technical expert from District Suchitwa Mission
    - Representative from District Pollution Control Board
    - Other experts from academic institutions if any
- Financial bids of the technically shortlisted firms should be opened at LSGI level and approved as per procedures and norms
- Letter of Award (LoA) is to be issued to the selected contractor agency and agreement executed

**Execution, Supervision and preparation of bills**

- LSGI shall constitute a supervision committee consisting of LSGI Engineer and the officer in charge of monitoring waste management activity
    - LSGI shall authorise the supervision committee to monitor that the contractor correctly follows the scope of work included in the RFP document and agreement
- The supervision committee shall inspect and monitor that the work is being carried out as per the scope defined.
- LSGI Engineer shall hand over the site and provide support for execution of work at the site by the contractor/agency
- The officer in charge of monitoring waste management shall oversee the waste management related activities such as formation of windrows, segregation of waste into various streams,ensuring pollution control measures and health matters involved in the project and shall give direction to the contractor/agency through the supervision committee.

- LSGI Engineer shall measure, record quantities by taking initial, intermediate and final levels in M-book and Check measurements shall be done by the officials of LSGD (LID & EW) as per the powers vested with in the Local Self Government Department.
- LSGI Engineer shall prepare the work bills claimed by the contractor/agency after completing stages of work detailed in the agreement and check measurement shall be made by the officials of LSGD (LID & EW) as per the powers vested within Local Self Government Department.

അനുബന്ധം - I

PROPOSAL FOR BIO MINING / BIO REMEDIATION OF LEGACY WASTE DUMPSITE AT ..... CORPORATION /MUNICIPALITY/ GRAMA PANCHAYAT

BASIC DETAILS OF DUMPSITE

| | | |
|---|---|---|
| Name of LSGI | : | |
| Name of location of legacy dumpsite | : | |
| Extend of land (Acres) | : | |
| Survey No | : | |
| Land owned by | : | |
| Volume of waste (m3) | : | |
| Maximum depth below ground level (m) | : | |
| Maximum height above ground level (m) | : | |
| Approx. level of water table (m) | : | |
| GPS location (Co-ordinates & link to google map) | : | |
| Period from which dumping is done (in Years) | : | |
| Whether waste is still dumped at the site (Yes/No) | : | |
| Availability of water source for remediation process (Yes/No) | : | |
| Availability of electricity (Yes/No | | |

I/5470223/2022

DE AILED REPOR

- Introduct on (Br ef about the s te nc udng s te photograph)
- Survey deta s (Methodo ogy adopted, Deta s of eve measurements and quant ty ca cu at on)
- Cost est mate
    - Abstract est mate
    - Deta ed est mate
    - Data

S gnat**ure**

Des**g**nat on **o**f E**ng**neer n **c**harg**e**

Nam**e o**f LSG**I**

അനുബന്ധം - II

SPECIFICA ION & OBSERVED DA A FOR RECLAMA ION OF LEGACY DUMPSI E HROUGH BIO R M DIA ION ( o m g, man gng ecove abe and eje t

Bo remedat on (Bo mnng, managng recoverab e and rejects) by

**a.** Excavat ng the ex st ng mxed compacted garbage wh ch underwent b o og ca degradat on n the and port on a ocated and spray ng w th m croba nocuum for san t s ng and stab s ng the excavated mass, s ev ng them us ng Mechan ca s ev ng mach ne or any other equ pment,

**b.** Contro of ma odour us ng deodor z ng agent and stab z ng the waste us ng Bo Cu ture for aerob c ompo t g

**c** o f e dy d o po t g po e o de to ed e t e mp t of d mp g te t e dj e t e

**d** eg eg te t e e v ted g b ge t e d po to e m ked, to m y k d d tego e poss b e by mechan ca means nc udng the cost of any power or fue consumpt on.

**e.** Creat on and mantenance of nfrastructure, fac t es and amen t es for s ev ng, the excavated garbage, stor ng the segregated mater a s.

**f.** Dep oyment of necessary manpower, mater a s, equ pment, too s and creat on of fac t es for hand ng, separat ng, segregat ng and stor ng for the operat on of the p ant.

**g.** Leve ng the earth's surface by bu -dosser or any other earth mov ng equ pment

h. Provding security arrangements for the plan project site, machineries, equipment etc.

DSR 2018 Cost Index- 1.00 (For reference)

| Code | Description of Items | Unit | Quantity | Rate | Amount |
|---|---|---|---|---|---|
| | *Details of cost for 50 m3/day* | | | | |
| | LABOUR | | | | |
| 115 | Cooli | day | 20.00 | 558.00 | 11160.00 |
| | MACHINERY | | | | |
| MR | Double stage screener with conveyor | day | 1.000 | 7200.00 | 7200.00 |
| MR | Magnetic separator- capacity 5HP | day | 1.000 | 600.00 | 600.00 |
| MR | Dust screenning remover | day | 1.000 | 900.00 | 900.00 |
| MR | Baling press | day | 1.000 | 450.00 | 450.00 |
| 17 | Hire and running charges of tipper 5 m3 | day | 2.000 | 1700.00 | 3400.00 |
| 20 | Hydraulic excavator 3D with driver and fuel | day | 1.000 | 7000.00 | 7000.00 |
| 18 | Hire and running charges of loader | day | 1.000 | 5000.00 | 5000.00 |
| 9999 | Deodorizer & Inoculum | L.S | 124.860 | 2.00 | 249.72 |
| | Total | | | | 35959.72 |
| | Market Rate cost | | | | 9150.00 |
| | Add water charges 1% on MR | | | | 91.50 |
| | Net Total ( A) | | | | 9241.50 |
| | Total excluding Market rate | | | | 26809.72 |
| | Add water charges 1% on this | | | | 268.10 |
| | Net Total (B) | | | | 27077.82 |
| | Total A + Cost Index B | | | | 36319.32 |
| | Add CPOH 15% | | | | 5447.90 |
| | Total for 50 m3 | | | | 41767.22 |
| | Hence for 1 m3 | | | | 835.34 |

NB:- **Rates shall be prepared based on the cost index applicable to each locality*

# Thank you!

Local Self Government Department, Upper Ground Floor, Thara Towers,
Vazhuthacaud, Thiruvananthapuram - 695 014

91-471-2333911 www.kswmp.org



# PART B

# SOCIAL IMPACT ASSESSMENT

## VELLARAMKUNNU DUMPSITE IN KALPETTA MUNICIPALITY

**SOCIAL SAFEGUARDS**

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## 1. Introduction

Social safeguard aspects during dump site remediation mainly focusing on meaningful stakeholder engagement, understanding stakeholder's risk perception and restoring them to a safe and environmentally sustainable state. It involves a series of systematic social actions which include social inclusion, effective labor management, and prevention of gender violence during the process, successive rehabilitation of the affected people and reduction of health risk of the host community. The bio mining process of Kalpetta municipal dumpsite has been included in the World Bank supported KSWMP project.

### 1.1 Profile of the ULB

The Kalpetta municipality is an Urban Local Body (ULB) of the Wayanad district of Kerala, covering an area of 40.74 square kilometers and it's divided into 28 administrative divisions. This municipality generates 13.82 tons per day (TPD) of solid waste. However, Kalpetta ULB do not possess adequate solid waste treatment and disposal facilities as mandated by the Solid Waste Management (SWM) rules, 2016. Consequently, unsegregated waste was disposed of in an unscientific manner; essentially dumped at the ULBs trenching ground (where feces/night soil used to be dumped from pit latrines) at Adlayed in ward 23. In order to promote a healthy and sustainable environment, it is imperative to undertake the remediation of the existing dumpsite. The socio-economic profile of Kalpetta is presented below table.

| Socio Economic Profile | |
|---|---|
| District Name | Wayanad |
| ULB | Kalpetta |
| Total Population of the ULB | 31,580 |
| Total Projected Population of the ULB (2023) | 37,997 |
| Total Male Population of the ULB | 15,401 |
| Total Female Population of the ULB | 16,179 |
| Total Scheduled Castes Population of the ULB | 2200 |
| Total Scheduled Castes Male Population of the ULB | 1125 |
| Total Scheduled Castes Female Population of the ULB | 1075 |
| Total Scheduled Tribes Population of the ULB | 3228 |

Table 2 Socio Economic Profile Data *Source: Census Data, 2011*

### 1.2 Profile of the Dumpsite

The Biomining and Bioremediation at the Kalpetta ULB dumpsite are proposed as part of the Kerala Solid Waste Management Project (KSWMP) with support from the World Bank and the Asian Infrastructure Investment Bank. The dumpsite in Ward 23, Adlayed spans an area of 1.12

acres and has accumulated waste for about 20 years since its establishment in 2000. The quantity of legacy waste slated for removal is approximately 9485.37 cubic meters. This site falls within an 8.5-acre land owned by the ULB, specifically designated for waste management. Within this area, a windrow composting unit, FSTP, and an RRF operate, maintaining a safe distance of 25 meters from the dumpsite. Importantly, the remediation process is planned to safeguard the physical assets of the waste management facility, ensuring no disruption to its operations.

### 1.3 Socio economic baseline of host community

Within a 200-meter radius from the dumpsite, there are no households, settlements, or establishments present. The RRF unit at the dumpsite engages six HKS workers, while the windrow composting unit employs nine workers. Access to the dumpsite is limited to a 3-meter road. Importantly, nearby public properties and commercial establishments will remain unaffected without any disruptions. There are no scheduled tribes, rag pickers, or other vulnerable communities residing in close proximity to the dumpsite. Approximately 700 meters away from the site, both a school and a college are operational. Throughout the dumpsite remediation process, waste transportation will utilize the road passing by these educational institutions.

### 1.4 Vulnerability mapping of Host community

The Vellaramkunnu dumpsite is situated within an isolated, hilly terrain spanning 8.5 acres, owned by the ULB. There are no vulnerable communities residing within a 200-meter radius of the dumpsite.

## 2. Output of the Social screening

### 2.1 Social Screening Checklist

The social screening has been conducted with a social screening checklist to assess potential social risks associated with the dumpsite remediation, yielding key findings:

- The dumpsite is inside the ULB's existing waste management facility, accommodating a windrow composting unit, RRF, and an FSTP, with approximately 16 workers employed across these units.
- No households are situated within a 200-meter radius of the dumpsite, and the project poses no threat to the religious or customary practices of any community members. Scheduled tribes or rag pickers do not reside nearby.
- In the Year-2 projects, the municipality plans to construct a new Material Collection Facility (MCF) within the same compound.
- Presently, no waste dumping occurs at the site. Bio waste is managed at the windrow unit, while non-bio waste is handled at the RRF facility.
- There are no expected adverse social impacts on dwellings, land, labor, livelihoods, or community resources of the host communities, and land acquisition or loss is irrelevant for project execution.
- Within a 700-meter radius, both a school and a college are located. Waste transportation during the remediation process will utilize the road passing these educational institutions.
- Given the low risk concerning the social and economic conditions of the host communities, the dumpsite falls into the "Moderate Risk" category.

### 2.2 Transect walk

On June 1, 2023, a transect walk was carried out as an integral component of the dumpsite bioremediation process. The primary objective was to evaluate the site, collect data on its positioning, potential social risks, existing infrastructure, and the effects on neighboring communities. The team engaged in observing, inquiring, listening, and visually documenting a transect diagram to investigate environmental and social resources, conditions, and systems.

### 2.3 Key Informant Interview

The Stakeholder meeting are required for understanding and addressing community concerns crucial for the success of projects like solid waste management. At the Vellaramkunnu dumpsite in Kalpetta, initial assessments conducted through social screening and transect walks revealed the absence of a host community within 200 meters, ensuring minimal impact on livelihoods or practices. However, a school and college within 700 meters were identified as the host community, as their students and staff use the same road for their transportation. Consequently, during the dumpsite remediation process, there might be a need for traffic control measures to ensure minimal disruption or inconvenience to the students.

On June 5, 2023, a stakeholder meeting was organised for the Vellaramkunnu dumpsite's remediation marked a crucial step in the project. Its primary aim was to engage the nearby community and open discussions about the remediation process going to start under the Kerala Solid Waste Management Project (KSWMP), backed by World Bank funding.

Notable attendees included the ward councillor, elected representatives, ULB officials HKS workers, representatives from Kristuraja school, NMSM College, TSC, and DPMU staff. The meeting focused on raising awareness about the dumpsite's challenges, addressing legacy waste issues, and discussing environmental concerns.

A detailed presentation showcased the proposed remediation process, outlining the required efforts from workers, ULB, contractors, and stakeholders, clarifying anticipated outcomes. Engaged participants raised queries about the process, which were addressed by TSC and DPMU experts.

This meeting proved vital in fostering community engagement, offering transparent communication about the remediation's particulars. It effectively disseminated essential information, addressed concerns, and garnered active participation from stakeholders. Such proactive engagement promises a smoother, more comprehensive implementation of the remediation efforts.

### 2.4 Stakeholder Consultation Meeting

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### 2.5 Findings of Social Screening

- The dumpsite's remote location suggests moderate associated risks.
- Throughout the dumpsite remediation, potential issues may arise concerning labor, gender-related matters, heavy noise, foul odors, dust emissions, and leachate affecting the wider region.
- Absence of rag pickers linked to the dumpsite implies no livelihood risks for them in this context.
- No necessity for government, forest, or private land acquisition is identified for the remediation project.
- Despite a total scheduled tribal population of 3228 within the ULB, no scheduled tribes reside near the dumpsite, with no observed impact on their land, customary rights, or livelihoods.
- Waste dumping at the site commenced in 2000 following a previous practice of depositing all waste from the Kalpetta ULB near the national highway opposite the Vellaramkunnu bus stop. Due to many protests, the ULB identified the present location and started to dump all the wastes. A significant amount of waste was deposited at the site following the 2018 flood.
- Despite its distance from settlements, there have been no reported protests at the current site.
- As part of this assessment, a social map was collaboratively created with local input, including that of the ward councillor.

### 2.6 Group discussions

A group discussion was organized at the ULB engaging various stakeholders, including people representative, Kudumbashree members, HKS, sanitation workers, and other stakeholder groups, to identify fundamental aspects of SIA with regard to the remediation process. This helped in understanding their perspectives, concerns, and aspirations related to the activity.

### 2.7 Key informants Interviews

As part of the assessment, DPMU and TSC conducted key informants' interviews (KIIs) among the nearby communities and gathered data on socio-economic conditions, waste management practices, and opinion on the proposed remediation project to develop suitable and adequate mitigation plans. The interviewer gathered information and concerns over the dumpsite from the interviewees. The present ward councillor, ex- ward councillor and a political party leader were interviewed as part of KIIs

### 2.8 Expected positive impacts on host community after remediation

#### 2.8.1 Waste free ULB

Creating a municipality free of waste is the major goal of addressing the dumpsite issue. The Vellaramkunnu dumpsite holds waste accumulated over two decades. Presently, due to the area's geography, this old waste isn't causing immediate problems for the community. However, it's crucial to acknowledge that potential future issues cannot be dismissed. Therefore, remediating the dumpsite serves as a proactive measure to prevent future complications arising from inadequate waste management.

#### 2.8.2 Enhanced quality of life

The remediation can restore the aesthetics of the area, reducing visual blights, foul odour and improving air and water quality. Also it results to a clean and hygienic work environment for the workers engaged in Windrow unit and the RRF.

#### 2.8.3 Economic opportunities

After remediating the site, the Municipality can plan for more solid waste management facilities such as enhancing the capacity of the MCF and RRF to process more non bio degradable waste and to set up a centralized waste management unit to process the bio degradable waste. These projects will create more job opportunities to the people who are looking for employment in waste management sector. The cleaned-up land can potentially be used for new construction, commercial development, or recreational activities.

#### 2.8.4 Land availability

The removal of the legacy wastes can improve the aesthetics of the area, reduce odour and noise pollution, and increase property values for surrounding residents.

## 3. Stakeholder Analysis

The significant stakeholders in the ULB with regard to the dumpsite remediation are as follows in the table:-

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| Service Providers | | |
| 1 | ULB Council | Providing ground support to the remediation process |
| 2 | Govt. institutions like PCB,KSEB, KWA, Kerala Fire & Rescue Services, DDMA etc | To deliver necessary approvals and provide necessary services for remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | DPMU | Monitoring and Evaluation |
| 5 | TSC/PMC | Technical support and consultation |
| 6 | Contractor | Execution of the Remediation process |
| 7 | Service providers/ HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| Community | | |
| 8 | 16 Workers in the RRF and the windrow compost unit | Support and cooperation for the remediation process |
| 9 | School and college in between 500-700 mtr distance | Support and cooperation for awareness generation activities regarding the remediation |
| 11 | Labours of contractor/ Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |
| 12 | Rag Pickers | Participation in informal collection to strengthen the collection process to prevent further dumping |
| 12 | Waste Generator in Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |
| 13 | Owner of the Workshop and Grocery shop | Cooperating with the remediation process |

| SL. No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| 14 | Scrap dealers | Informal participation in NBD waste management to prevent further dumping after remediation |
| 15 | End recyclers | Process the inert and legacy waste safely after remediation |

*Table 4 Stakeholder Details*

# 4. Required Action plans

All the social risks were identified through the social screening and Transect walk conducted at site. Since there are families and institutions in the proximity of the dumpsite, below shown action plans have been formulated to be followed at site

### 4.1 Labour Management Plan

Approximately 30 labors are expected to be engaged in remediation process at a time.

A detailed labour Management plan has been prepared and attached as Annexure.

### 4.2 Labour Influx Management Plan

Anticipated labour influx to the site is approximately 20 laborers. Considering the potential risk due to the influx, a detailed labour Influx Management plan has been prepared and attached as Annexure.

### 4.3 Preventive GBV Action plan

Since an RRF and Bio waste processing units are functioning inside the dumpsite location there is chance of occurrence GBV incidents. A detailed GBV action plan has been prepared and attached as Annexure.

### 4.4 Citizen Engagement Plan

A Citizen Engagement Plan is crucial for addressing social issues during dumpsite remediation. It acts as a bridge between the project implementers and the affected community, for fostering collaboration, understanding, and collective action towards mitigating social issues during dumpsite remediation. A detailed citizen engagement plan has been prepared and attached as Annexure.

The assessment of potential social risk during the remediation process and the identification from social screening with screening checklist, transect walk and focus group discussion indicates that there will not be any impact on the livelihood of the community and service providers.

It is identified that land acquisition is not required as sufficient land is available.

**Annexure 1: Labour Management Plan**

### 4.1.1. Introduction

Project Tittle: Project for the Dumpsite biomining and bioremediation, Adlayed, Kalpetta Municipality

Project area: The Dumpsite of Kalpetta Municipality is situated in ward 23 of the municipality, covering an area of 1.12 acres.

### 4.1.2. Scope and structure of the labour management plan

The scope of the LMP shall be as outlined in the World Bank's ESMF. The engagement will be planned as an integral part of the project's social assessment and project design and implementation. This document has 10 chapters. This chapter viz., chapter 1 served as introduction. Scope and structure of LMP is provided in chapter 2. An overview of labour use in the project is presented in chapter 3. Key potential labour risks are listed in chapter 4. Legislative framework governing labour employment in India/Kerala is discussed in chapter 5. Implementation Arrangements, policies and procedures follow in the subsequent chapter. Grievance redressal mechanism, contractor management are presented in the last chapters.

### 4.1.3. Details of Labours

The proposed remediation process requires following category and number labors

| S. No | Manpower | Nos |
|---|---|---|
| 1 | Site In-charge/Head | 1 |
| 2 | Environmental Health & Safety Engineer | 3 |
| 3 | Security (3 X 8 Hrs) | 2 |
| 4 | Operations Supervisor & Accountant | 2 |
| 5 | Machine Operator, Mechanic & Electrician | 2 |
| 6 | Labors for stone removal | 2 |
| 7 | Labors for spraying Bio culture | 4 |
| 8 | Labors near Screening machinery | 2 |
| 9 | Labors at Baling facility | 11 |
| 10 | Drivers for tipper trucks, excavators, backhoe loaders and tractors | 1 |
| | **Total** | **30** |

### 4.1.4. Assessment of key potential labour risks

**Project Activities:**

The bioremediation of the dumpsite includes the following activities.

- Mobilization of plant and machinery for bio-mining
- waste excavation and forming of windrow
- Spraying with inoculum and waste stabilization
- Waste segregation and refinement
- sorting materials into recyclable, RDF, compost and inert
- Transport to the authorized recyclers and end users

**Key Labour Risks**

It is assessed that key labour risks would be associated with health and safety risks related to the construction activities such as exposure to physical hazards during construction activities such as: use of heavy equipment, exposure to noise and dust, falling objects, exposure to hazardous materials and exposure to electrical hazards from the use of tools and machinery, lack of proper sanitation facilities, availability of separate toilet for women workers. As the construction activities will involve hazardous work, persons under the age of 18 will not be employed by the Project. Many workers will be exposed to occupational health and safety hazards, primarily including but not limited to:

- Injuries/accidents/ fatalities leading to even death, while at work.
- Inadequate accommodation facilities at work force camps, including inadequate sanitation and health facilities.
- Non-payment of wages by Employer.
- Non-payment of benefits (compensation, bonus, maternity benefits etc.) by Employer
- Discrimination in Employment (e.g., abrupt termination from employment, working conditions, wages or benefits etc.)
- Engagement of child labour.
- Sexual harassment at work sites.
- Forced labour or trafficking.
- Security of women workforce.

- Inadequate facilities for pregnant women and lactating mothers.
- Inadequate facilities for the children of the workforce at workforce camp sites
- Possibility of Gender based violence as the work is mostly carried out within the premises of the existing facilities like MCFs/ RRFs etc where female SWM workers are engaged.
- Absence or inadequate or in accessible emergency response system for rescue of labour/workforce.
- Health risks of labour relating to HIV/AIDS and other sexually transmitted diseases.
- Unclear terms and conditions of employment.
- Discrimination and denial of equal opportunity in hiring and promotions/incentives/training opportunities.
- Denial for workers' rights to form workers organizations, etc.
- Absence of a grievance redressal mechanism for labour to seek redressal of their grievances/issues.

### 4.1.5. Brief overview of labour legislation: Terms and conditions

| Sl No | Applicable Acts | Details |
|---|---|---|
| 1. | Employees Compensation Act 1923 | The Act provides for compensation in case of injury, disease or death arising out of and during employment |
| 2. | Contract Labour (Regulation & Abolition) Act 1970 | The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. |
| 3. | Minimum Wages Act 1948: | The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the |

| Sl No | Applicable Acts | Details |
|---|---|---|
| | | Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. |
| 4. | Payment of Wages Act 1936: | It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the workers. |
| 5. | Equal Remuneration Act 1976: | The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training, and promotions etc. |
| 6. | Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: | The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc. |
| 7. | Child Labour (Prohibition & Regulation) Act 1986: | The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in the Building and Construction Industry. |
| 8. | Employees State Insurance Act 1948: | The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the Central Government. The |

| Sl No | Applicable Acts | Details |
|---|---|---|
| | | Act also provides for benefits to dependents of insured persons in case of death because of an employment injury. |
| 9. | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: | This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee |
| 10. | Industrial Disputes Act 1947: | The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing the establishment. |
| 11. | Trade Unions Act 1926: | The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. |

#### 4.1.6. Responsibility Mapping

The ULB (Urban Local Body) will award the proposed work to the contractor through competitive bids. The contractor will be responsible for hiring labourers for both civil and skilled work. In the recruitment process, the contractor is obligated to provide opportunities to members of the host community who possess the necessary skills and willingness to engage in the activities available at the dumpsite for remediation.

The contractor is required to adhere to existing labour laws in the state of Kerala while employing labourers, ensuring compliance with all applicable welfare measures mandated by the relevant labour legislation and rules. Additionally, the contractor is responsible for implementing measures to protect and assist vulnerable groups of workers, including individuals with disabilities, migrant workers, and women workers. These protective measures should be explicitly outlined in the work agreement.

Furthermore, the contractor must prioritize occupational health and safety measures for the labourers. The ULB will actively monitor the contractor's compliance with legal and welfare

requirements. The ULB will also organize training sessions for the workers and establish a forum at the ULB level to address any grievances raised by the workers.

It is a prerequisite for the contractor to possess a valid Labor License, and all laborers working on the site must be registered with the appropriate authorities. This comprehensive approach ensures the well-being and fair treatment of workers throughout the remediation project.

### 4.1.7. Code of conduct

A code of conduct needs to be incorporated with the contract under the project. The contractor should conduct continuous awareness generation and training activities to ensure that the workers abide by the code of conduct. While preparing the code of conduct, following aspects should be ensured.

- Compliance with applicable laws, rules, and regulations of the jurisdiction
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment (PPE), preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment)
- The use of illegal substances
- Non-Discrimination (for example based on family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction)
- Interactions with community members (for example to convey an attitude of respect and non-discrimination)
- Sexual harassment (for example to prohibit use of language or behavior, towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate)
- Violence or exploitation (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favors or other forms of humiliating, degrading or exploitative behavior)
- Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behavior with children, limiting interactions with children, and ensuring their safety in project areas)
- Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by their employer and not open areas)

- Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favors, are not provided to any person with whom there is a financial, family, or personal connection)
- Respecting reasonable work instructions (including regarding environmental and social norms)
- Protection and proper use of property (for example, to prohibit theft, carelessness, or waste)
- Duty to report violations of this Code
- No retaliation against workers who report violations of the Code, if that report is made in good faith.

### 4.1.8. Systematizing the code of conduct

Awareness raising: The Contractor is required to conduct ongoing awareness-raising and training activities to ensure that workers consistently adhere to the Code of Conduct. Additionally, the Contractor must take measures to ensure that local communities are well-informed about the Code of Conduct, enabling them to report any concerns or instances of non-compliance. This proactive approach aims to foster a shared understanding of ethical standards and accountability within both the workforce and the surrounding communities.

### 4.1.9. Transparency in contract specific terms and conditions

**All contracts must contain**

- Wages: Specific wages and payment modality, timeline
- Working Hours: hours of work, maximum number of hours that can be worked on the project, overtime, compensation
- Leaves: rest per week, annual leave, maternity leave, sick leave
- Benefits: medical treatments in case of accidents or otherwise
- Notice of termination of employment and details of severance payments in a timely manner
- Collective agreements that apply to the project, other specific terms, and conditions
- Details of the grievance redressal mechanism

**4.1.10. Labour management plan matrix**

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To complete the registration by the Principal Employer, the ULB, as per the provisions of the Contract Labour (Regulation & Abolition) Act 1970 (CL Act), Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979 (ISML Act) and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 (BOCW Act) and procure certificate to that effect. | 3 Registration Certificates to be procured by the ULB under CL Act, ISML Act and BOCW Act respectively. | Before Awarding works | Registration Certificate issued by District Labour Officer under CL Act, ISML Act and BOCW Act | ULB |
| To Procure license under CL Act, ISML Act and registration under BOCW Act by the contractor | 2 Licenses and One registration under CL Act, ISML Act and BOCW Act respectively. | Before commencing the work at site | License and registration certificate issued by the competent Authority. | Contractor |
| To procure Workmen Compensation insurance policy proportionate to the number of labour force deployed. (By the Contractor) | One insurance policy. | Before commencing work at site | Copy of insurance policy | Contractor |
| To display a copy of the certificate of registration at the conspicuous place at the premises where the building and other construction work is being | One notice board | As soon as the work is started. | Photographs of the notice board where the license is | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| carried on.<br><br>To establish a labour information signboard at camp site by including following details like, date of payment of wages, working hours, holidays, wages rates for different categories of labours and name and contact details of local labour inspector and his/ her office and emergency contact numbers. | One notice board | Do | displayed.<br><br>do | |
| To conduct pre- employment medical examination (as per the provisions of BOCW Act)- to ensure medical fitness of the employee. | All workers must be examined | No of workers employed by the contractor | Pre-Medical Examination certificate issues as per Rule 223(C) of BOCW Act (Form No. IX) by the Registered Medical Practitioner. | Contractor |
| To conduct Periodical Medical Check-ups (once in every six months) | All workers must be examined. | No of workers employed by the contractor | Medical Examination certificate issued by a | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| | | | registered medical practitioner. | |
| To provide safe drinking water- the contractor must provide safe drinking water at worksite as well as camp site* (Guideline is provided along with this document) | As per requirement | During the entire contact period | Photographs of supply of potable water, Bill of water purchase. | Contractor |
| To arrange first Aid facility at work site as well as camp site (Specifications and items to be maintained in the box is mentioned in this document) | As per requirement | During the entire contract period | First Aid Register, Bill of purchase, photographs of First Aid kit | Contractor |
| To arrange separate First Aid room at work site | Allot one specified room | To be made available during the construction period | Photographs of the facility | Contractor |
| To provide first Aid training to selected labours or staff members through an authorised agency. | One training with authorized agency | Within one month of commencement of the work | Training records & Photographs | Contractor |
| To establish linkage with local hospitals/ health care institutions for emergency medical assistance | Tie up with at least one hospital | Within one month of the | Letters issued by the hospital | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| | | commencement of the work | or correspondence and agreement with the hospital. | |
| To establish rest room at work site or camp site | | Before the commencement of the work | Photographs of the rest room | Contractor |
| To establish Canteen facility for labours if the contractor engages more than 250 labours | | Before the commencement of the work | Photographs of the facility, canteen register etc | Contractor |
| To maintain essential registers and records like Form A (Registration of employees), Attendance Register, Wages Register, and other registers like incidents registers including Accident register, Harassment complaints, recovery register, Maternity leave, Termination etc | | As and when the work starts | Copy of registers. | Contractor |
| Constitute GRC for labours (maximum members to be six. Number of members from employer and employee to be equal. Female members should be minimum 50%. ) | | As and when work starts | Copy of register and minutes of meeting. Complaint box | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| | | | etc | |
| Constitution of ICC (minimum members to be four. The presiding member should be a senior female employee) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| To publish the abstract of labour laws within the premises of the labour camp.<br>1. The Payment of Wages Act<br>2. The Employee compensation Act<br>3. The Building and Other Construction Workers (RECS) Act<br>4. The Contract Labour (A&R) Act<br>5. The Child and Adolescent Labour (P&R) Act<br>6. The Maternity Benefit Act | Abstract of Six acts | As and when the camp is established | Photos of the notices published. | Contractor |
| To establish code of conduct and provide induction trainings | | As and when new employees are joined | Training reports and other documents | Contractor |
| Conduct HIV/AIDS awareness programmes | As per requirement | Once in six months | Reports, photographs etc | Contractor |
| All the Drivers should possess effective and valid | Drivers should be selected after | As and when drivers are | Photocopy of license ids to be | PIU |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| Driving Licence | verification of DL | appointed | collected | |
| All the vehicles involved in the project shall be insured to cover the third-party risk | Vehicle must be allowed to be plied in the project only after procurement of third-party insurance to the vehicle | As and when vehicles are plied in the project | Photocopy of insurance is to be collected | PIU |

**Budget for LMP**

| S.No | Item | Cost |
|---|---|---|
| 1 | Labour compliance as per LMP | [redacted] |

**Annexure 2: Preventive Gender based violence Action Plan**

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| Formation of internal complaints committee | • ULB level ICC will be constituted | Before implementation | ULB | • Minutes and Reports | TSC |
| Map GBV issues | Ensure justice, safety and protection, reasonable wages, care and support, adequate Work space, Avoid Gender discrimination<br>Physical,<br>Sexual ,<br>Psycological and socio<br>Economic violence. stress, emotion, conflict, abuse, | During implementation | Contractor/ULB | Issue tracking system in place<br>Feedback report (monthly) | TSC |

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| | threatens | | | | |
| Map GBV service providers and quality assessment of services | • NGOs<br>• Police Station KELSA<br>• Women protection officer<br>• List of Nongovernment and private agencies providing GBV support<br>• Map local informal grassroot level organizations<br>• Review the quality of services in terms of prevention, protection, rescue, rehabilitation, restoration, | Before implementation | TSC | • Directory of service providers<br>• List of key partners<br>• Mapping of roles and responsibilities<br>• Monthly report on quality Assessment | TSC |

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| | reintegration, research, and documentation | | | | |
| Facilitate GBV awareness and sensitization programs | • Organize sensitization activities<br>• Display sign boards around the project site | During implementation | Contractor/ICC | • Detailed activity plan<br>• Progress reports<br>• Completion report | TSC |
| Create a GBV response and support mechanism | SOP for the actions be followed in terms of any incidents related to GBV will be formed along with ICC. The SOP will detailed the identification of support mechanism and terms of conditions for comply with existing rules and regulations and operational strategy. | During implementation | ULB/ICC | • SOP for prevention, protection, and rehabilitation | TSC |

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| Reporting, monitoring and review | • Create GBV data fields<br>• Quarterly reports<br>• Conduct review | During implementation | Contractor/ TSC | • Progress reports (Monthly, quarterly)<br>• CB report<br>• Monthly complaint status and action taken report<br>• Establishment of Feedback system | TSC |

**Budget for Preventive GBV action Plan**

| S.No | Item | Cost |
|---|---|---|
| 1 | Activities as per GBV plan | [redacted] |

## Annexure 3: CITIZEN ENGAGEMENT PLAN

### 4.3.1. Stakeholder identification

Host community: Close to the Vellaramkunnu Dumpsite, there are no residences or communities within a 200-meter radius. However, within 1 KM distance, both a school and colleges are in operation. The students of these institutions should be considered as the host community. The students of these institutions utilize the same road for their transportation. Consequently, during the dumpsite remediation process, there might be a need for traffic control measures to ensure minimal disruption or inconvenience to the students.

Waste Generators: The identified service providers of the dumpsite are as follows:

| Sl.No | Waste Generators | Nos |
|---|---|---|
| 1 | General Households | 100 |
| 2 | Shops | 3 |
| 3 | Institutions | 7 |

Service Providers: The identified service providers of the dumpsite are as follows:

| Sl. No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| Service Providers | | |
| 1 | ULB Council | Providing ground support to the remediation process |
| 2 | Govt institutions like District administration and line departments, PCB,KSEB,KWA, Fire&Safety, Police and Geology Dept. | To deliver necessary approvals and provide necessary services. |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | Contractor | Execution of the Remediation process |
| 5 | Service providers/HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| 6 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |

### 4.3.2. Need of the plan

Creating a Citizen Engagement Plan for dumpsite remediation is crucial for involving and addressing the concerns of the community. Ultimately, the primary objective is to create a

collaborative and inclusive environment that empowers the community, ensures their concerns are heard and addressed, and leads to a successful and mutually beneficial dumpsite remediation project. Citizen engagement as part of the proposed bioremediation of dumpsite in Kalpetta municipality aims to facilitate two-way communication between the project and its stakeholders to make better informed decisions. Such an engagement will certainly pave the way for better implementation of the project, and it will ensure public participation in trouble shooting at all the stages of the implementation of the project.

### 4.3.3. Objective of the plan

The citizen engagement plan for the proposed dump site remediation is prepared with following objectives.

- To build and maintain trust between the project implementers and the affected community by fostering open communication, addressing concerns, and demonstrating a commitment to community welfare.
- To actively involve the community in the decision-making processes related to the remediation, allowing them to voice concerns, provide feedback, and contribute ideas
- To empower community members by providing them with the necessary information, skills, and opportunities to actively participate in and potentially benefit from the remediation project.
- To suggest appropriate activities with a monitoring plan and an expected budget for engaging the stakeholders with the motive of enhancing their ownership in the project through increased participation
- To ensure that the engagement plan contributes to sustainable outcomes by fostering community support, minimizing social disruptions, and maximizing the positive social, economic, and environmental impacts of the remediation effort.

### 4.3.4. Stakeholder concerns

#### 4.1 **Waste Generators**

There are no host community within 200-meter distance. Within a 700-meter radius, both a school and a college are located. Waste transportation during the remediation process will utilize the road passing these educational institutions. Thus, these two institutions can be considered as the host community. Major concerns of the host community can be understood as: -

1. Concerns about air pollution during the remediation process.
2. Worries about disruptions to daily life due to noise, increased traffic, temporary road closures, or alterations in access to local amenities.

Addressing these concerns through transparent communication, community engagement, robust safety measures, and considering the community's input in the remediation process is crucial to gaining their trust and support for the project.

1. **Service Providers**

Major concerns of the service providers which has to be addressed by the citizen's engagement plan can be summarized as follows;

- The Kalpetta Municipality authorities are unaware about the urgency and importance of remediating the dumpsite. Their improved involvement through proper sensitization is essential to the effective implementation.
- SWM related Service providers/HKS of Municipality should be trained and motivated for proper timely collection, segregation and transportation of waste to appropriate processing units to prevent the formation of such dumping yards in the future
- Compliance with Regulations: Ensuring that the remediation process complies with local, regional, and national environmental, labour regulations and standards to avoid legal repercussions.
- Health and Safety: Prioritizing the health and safety of workers and the environment during the remediation process to mitigate potential risks or hazards.
- Community Relations: Managing community relations and concerns by maintaining open communication, addressing grievances, and ensuring community involvement in decision-making processes.
- Long-term Sustainability: Ensuring that the remediation efforts result in a sustainable and long-term solution at the site.
- Monitoring and Maintenance: Establishing post-remediation monitoring and maintenance plans to ensure the continued effectiveness of the cleanup efforts and prevent future recontamination.

Addressing these concerns involves careful planning, adherence to regulations, effective resource management, community engagement, and a commitment to long-term sustainability to ensure successful dumpsite remediation.

### 4.3.5. Activities proposed

5.1 **Community/citizen Awareness**

- Awareness programs focused to the students of the nearby schools.
- Organize exposure visit for the identified members from host community and council members
- Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency.
- Sensitization programs to nearby vendors

**Awareness to Service providers**

1. **Training and Workshops**: Providing comprehensive training sessions or workshops to service providers, including contractors, waste management personnel, and other relevant parties. These sessions could cover safety protocols, handling of hazardous materials, proper waste disposal techniques, and adherence to project timelines.
2. **Information Dissemination**: Distributing detailed information packets, manuals, or guides outlining the remediation plan, activities, and protocols to service providers. This ensures everyone involved understands their roles, responsibilities, and the overall objectives of the project.
3. **Continuous Updates**: Providing regular updates and progress reports to service providers to keep them informed about any changes, challenges, or developments in the project. This enables them to adapt and align their activities accordingly.
4. **Risk Mitigation Strategies**: Educating service providers about potential risks associated with the remediation process and implementing strategies to mitigate these risks. This could include safety measures, emergency response protocols, and environmental protection procedures.
5. **Collaborative Engagement**: Encouraging open communication and collaboration among service providers, fostering a team approach to problem-solving and ensuring a cohesive effort toward achieving the project goals.

By raising awareness and providing comprehensive information and guidance to service providers, the remediation project can be executed more effectively, ensuring adherence to standards, safety, and the overall success of the dumpsite remediation initiative.

### 4.3.6. Citizen Engagement Plan

| S. No | Engagement Challenge | Impacts on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| 1 | Limited Awareness and Information | • Misleading information on the project<br>• Lack of understanding on the scientific information about the project | Consultation meeting in the school, college and the ULB level<br>Awareness campaign | Contractor |
| 2 | Communication Barriers | Lack of effective communication channels, or difficulties in reaching all community members, lack of apt communication strategies/ materials can hinder engagement efforts | Location specific communication strategies are to be designed and developed | Contractor |
| 3 | Delay in decision making and timely support from the ULB | The community people will lose the hope about the project | Sensitization on bioremediation activities for the Kalpetta Municipality council and staff before the commencement of the remediation | ULB |
| 4 | GRM committee | If proper GRM system is not in place, it will affect the project's goodwill.<br>And there are possibilities of emergence of issues from the community people. | Constitution of a project level GRM Committee to take-up any social issues raised at site level | ULB/ Contractor |
| 5 | Time and | Engaging the community | Proper planning | Contractor |

| S. No | Engagement Challenge | Impacts on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| | Resource Constraints | requires time, resources, and sustained effort. Communities might have limited time or resources to dedicate to engagement activities. | for the activities based on the host community's convenience. | |
| 6 | Complexity of Information | Dumpsite remediation processes can be complex, involving technical or scientific information that might be challenging for the community to understand, hindering meaningful engagement | Circulation of communication materials in simple local language with attractive pictorial representation | Contractor |

**4.3.7. Monitoring Plan**

| S. No | Activity | Means of Communications | Monitoring Indicator | Monitoring Responsibility |
|---|---|---|---|---|
| 1 | Sensitization on the bio-remediation activities for the Municipal Council and officials | Presentation and group discussion | No of councilors and officials attended | DPMU/DPMC/ TSC |
| 2 | Sensitization meeting to host community | Presentation and group discussion | No of persons attended. | DPMU/DPMC/ TSC |
| 3 | Formation of GRM committee | Meeting and presentation | Office order/ proceedings | DPMU/DPMC/ TSC |
| 4 | One to one meeting district administration, | Presentation | No of one-to-one meeting | DPMU/DPMC/ TSC |

| S. No | Activity | Means of Communications | Monitoring Indicator | Monitoring Responsibility |
|---|---|---|---|---|
| | line departments, PCB, KSEB, KWA, Fire & Safety and Police | | conducted / no of officials attended | |
| 5 | Organize exposure visit incorporating the GRM members and council members | meeting | No of person gone for exposure | DPMU/ TSC/DPMC |
| | IEC display board | IEC boards | No of IEC developed and displayed | DPMU/DPMC/ TSC |
| 6 | Orientation to the Service providers/HKS of Municipality | Presentation / meeting | No of HKS attended the orientation | DPMU/DPMC/ TSC |
| 7 | Issue based one to one meeting with Govt institutions like PCB,KSEB,KWA, Health Department | Presentation / meeting | No of officials attended the meeting | DPMU/DPMC/ TSC |

**4.3.8. Budget**

| S. No | Activity | Specification | Quantity | Cost |
|---|---|---|---|---|
| 1 | Sensitization on the bio-remediation activity is to be conducted for the Municipal Council and officials prior to the commencement of the actual bio-remediation process | Half day Program for Councilors and Health Staff | 1 | [redacted] |
| 2 | Sensitization meeting to | Half day Program by | 2 | [redacted] |

| S. No | Activity | Specification | Quantity | Cost |
|---|---|---|---|---|
| | host community | incorporating all host community members | | |
| 3 | Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency. | Committee formation | 1 | [redacted] |
| 4 | Meeting with Contractor to understand their plan of operations/No labors involvement/timeline etc. | One to one interaction | As required | [redacted] |
| 5 | Organize exposure visit incorporating the GRM members and council members | Exposure visit to Alappuzha | 15 participants-1programme | [redacted] |
| 6 | Orientation to the Service providers/HKS of Municipality | Half day programme | 2 | [redacted] |
| 7 | Issue based one to one meeting with Govt institutions like PCB,KSEB,KWA, Health Department and police | One to one | As required | [redacted] |
| **Total** | | | | [redacted] |

**Annexure 4: LABOUR INFLUX MANAGMENT PLAN**

| Risk | Mitigation measures | Implementation responsibility | Monitoring indicators | Monitoring responsibility |
|---|---|---|---|---|
| Social and Community wellbeing | Joint Meeting with the community by ULB officials and Elected members | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Economic and Livelihood Issues | Skilled /Unskilled jobs for the Community members in the sub-project | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Accommodation /labour camp | 1. Ensure basic amenities are provided to the laborers ( Toilets, Water ,Kitchen facilities etc)<br>2. Daily briefing to the labourers | Contractor | • Risk identification report<br>• Proposed action/mitigation plan<br>• List of facilities in labour camp<br>• Details of labours | TSC/DPMU |

| Risk | Mitigation measures | Implementation responsibility | Monitoring indicators | Monitoring responsibility |
|---|---|---|---|---|
| Communicable Diseases | Access to Medical Check-up<br><br>Aaresness to the laboures | Contractor | • SOP for prevention of communicable disease and health wellbeing on worksite and labour camp<br>• Report on medical check-up | TSC/DPMU |
| Crimes | Intimation to the Local police about the camp | Contractor | Work site complaint register<br><br>Number of cases reported, and action taken | TSC/DPMU |
| Child Labour | Ensure Adhar card of all labourers at the site | Contractor & TSC | • Number of child labour issues reported<br>• Data of labours | ULB/DPMU |
| Gender-based violence, including sexual harassment child abuse and exploitation | 1.Gender sensitization briefing to the laborers | Contractor/TSC | • Number of cases reported<br>• Action taken report<br>• Number of cases resolved<br>• Time taken for resolving complaints | ULB/DPMU |

| Risk | Mitigation measures | Implementation responsibility | Monitoring indicators | Monitoring responsibility |
|---|---|---|---|---|
| Labour license | | Contractor/PIU | Number of labours having license | DPMU |

**Summary of SMP budget**

| S.No | SMP Activity | Cost |
|---|---|---|
| 1 | Labour Management Plan | [redacted] |
| 2 | Labour Influx Management Plan | [redacted] |
| 3 | Preventive GBV action plan | [redacted] |
| 4 | Citizen Engagement Plan | [redacted] |
| Total | | [redacted] |

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR DUMPSITE BIOMINING AND BIOREMEDIATION, THALIPADUPPU, KASARAGOD MUNICIPALITY




Submitted By:

**Kerala Solid Waste Management Project**

# PART A

# ENVIRONMENTAL IMPACT ASSESSMENT

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## Summary

### Introduction

The Kasaragod municipality is an Urban Local Body (ULB) of in the Kasaragod district of Kerala, covering an area of 16.7 square kilometers (sq.m) and divided into 38 administrative wards. This municipality generates 35.60 tons per day (TPD) of solid waste. However, Kasaragod ULB does not possess an adequate solid waste treatment and disposal facilities as mandated by the Solid Waste Management (SWM) Rules of 2016. Consequently, un-segregated waste was disposed of in an unscientific manner; essentially dumped at the ULBs trenching ground (where feceas/night soil used to be dumped from pit latrines) at Thalipaduppu in ward 4. Over the years of past 50 years, Thalipaduppu dumpsite saw various types of wastes dumped there. In order to promote a healthy and sustainable environment, it is imperative to undertake the remediation of the dumpsite

### Subproject Description

The Biomining and Bioremediation at the Kasaragod ULB dumpsite is proposed as part of the Kerala Solid Waste Management Project (KSWMP) in collaboration with funding from the World Bank and the Asian Infrastructure Investment Bank. The dumpsite situated in Ward 4, Kasaragod, covers a total area of 1.1 acres and contains a legacy waste quantity of 16,736 tons. The waste at the site is approximately 50 years old, with dumping activities started in 1970 and stopped in 2010. Initially, the dumpsite served as a trenching ground for the disposal of sewage from pit latrines. The total volume of waste accumulated is approximately 20,115 cubic meters, and the dumpsite spans across an area of 1.1 acres.

i. **Status of Subproject Development at the time of EIA**

   Currently, the dumping has stopped at site and solid waste of the ULB is treated and disposed at multiple decentralized facilities across the city. The entry to the dumpsite is facilitated by a 4-meter-wide approach road in good condition, located in Adkathbail - Kasaragod.

ii. **Technical Aspects**

Following a comprehensive evaluation, the method or technique of Bio-mining with a goal of achieving 100% land reclamation and recovery is found to be the most suitable remediation approach, ensuring long-term sustainability and environmentally responsible treatment of legacy waste, leading to the complete remediation of the dumpsite. Based on the Feasibility and site conditions, Mobile Trommel machinery would be the most suitable option for the small site at Thalipaduppu Kasaragod. The optimal time frame for conducting the Bio mining Process would be from December to April Months, a period characterized by lower rainfall levels as per climate data.

**Application of Regulatory and Guidance Framework**

In accordance with the SWM Rules of 2016, the selection of an appropriate method or technique for remediating a dumpsite should be determined through a feasibility study that considers technical, financial and Environmental aspects complying with regulatory requirements (CPCB, KSPCB and NGT). The formulation of the subproject adhered to the State/National and World Bank safeguards policies, both in its planning phase and will continue to do so during the implementation and monitoring stages. This commitment to compliance will be upheld by the ULB the project period.

**Baseline Environmental Scenario**

A detailed environmental baseline study was conducted for analyzing quality of air, groundwater, surface water, noise levels, and leachate characteristics. The preliminary Environmental Screening [Annexure -1] and the detailed assessment showed that this sub project falls under “E2” category.(Please note that suggestive environmental categorization of dumpsite bio mining/ bioremediation as per EMF for KSWMP is E1.However,considering the very small extent of the dumpsite, absence of any sensitive environmental feature in or around the site , short bio mining period, and the overall positive impacts of the proposed development post mitigation measures; this is categorized as E2. At this stage, locations for disposal of bio mined wastes is unknown, the subproject would be re categorized if the

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locations are near any sensitive areas. In case the bio mining is clubbed with other multiple sites also, the overall categorization would be reconsidered)

An analysis has been conducted at the site to review and comprehend the physiography, climate, soil, cultural heritage, ecology, and biodiversity of the dumpsite. This assessment aims to identify potential impacts on the environment, human health, and biodiversity. Additionally, a traffic assessment has been performed to analyze traffic patterns and movements during the project's implementation phase

**Terrestrial Ecology:**

The nearest Forest/Protected Area, known as Parappa Forest, is located approximately 26 kilometers away from the site. Various indigenous flora and fauna species commonly inhabit the vicinity of the site.

*Tinospora cordifolia. Miers (Amruthu or Chittamruthu), Strobilanthes heyneanus. Nees (karikurunhi), Vitex negundo L (Karinotchi), Strychnos nux-vomica (kanjira maram), Haliaeetus leucogaster (white bellied sea eagle), Ailanthus sp. (Tree), Areca catechu (Tree), Cyathula prostrate (Herb) Aporosa cardiosperma (Shrub).* Among the reptile population, the Indian rat snake *(Ptyas mucosa) has been noted.* Additionally, several plant species, including *Macaranga peltata, Bauhinia sp., Ficus sp. (Banyan), and Ficus hispida (Parakam),* are also present. The species listed were not classified as Critically Endangered by International Union for Conservation of Nature (IUCN)

**Air Quality:**

Air monitoring was conducted continuously for a 24-hour duration at all sites, and the obtained results were meticulously analyzed against the National Ambient Air Quality Standards (NAAQS) of 2009. It is noteworthy that all measured pollutants' concentrations were found to be well within the permissible limits. Furthermore, no presence of hazardous or toxic gases was detected during the monitoring process.

**Water Quality:**

The monitoring of water quality was carried out at 3 locations for Ground water & 1 Location for Surface Water.

Groundwater samples were collected from three distinct locations, each within a radius of 200 m from the site. The analysis of these samples revealed that all parameters examined fall within acceptable limits, with the exception of Iron, Color and turbidity. Surface water

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assessment indicates that the Madhuvahini River is located approximately 4.5 kilometers from the site. Additionally, there is a nearby drain that transports surface runoff, wastewater from the surrounding area, as well as leachate and drainage from the site. A Surface water sample was obtained from a specific location known as Shankarankuzhi thodu, which is at an aerial distance of 300 meters from the site. Upon analysis, it was determined that all examined parameters are within acceptable limits, with the exception of Biological Oxygen Demand (BoD).

**Noise Level:**

Sample for noise level monitoring were collected within the dumpsite to assess the current ambient noise levels. The results indicate that the noise levels observed are comfortably within the permissible limits. However, it shall be noted that there is no activity currently on site. And noise levels are expected to increase with bio mining activity.

**Assessment of Risks/Impacts and Proposed Mitigation measures and Monitoring**

The anticipated impacts of the interventions proposed have been analyzed in detail and mitigation measures proposed. The Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) documents, which assess the potential environmental and social impacts of the proposed sub project, serve to identify potential risks, formulate mitigation measures and ensure compliance with environmental and social standards regulations. This dumpsite remediation project comprises an overview of the current environmental conditions within the project area. Furthermore, the report delineates the environmental baseline data, Disaster Management Plan, identification of sensitive receptors and a Fire Risk Assessment. key environmental risks include leachate and storm water from the site impacting the nearby areas, odor (including gas), visual blight ,flies& pests, storage and disposal of retrieved materials, fire, accident& other disasters, and health and safety of workers. Possible future dumping of wastes after bio mining is also a concern. Mitigation and management measures for these in line with mitigation hierarchy are included in the EMP.

Proposed mitigation measures are designed to address environmental and social impacts effectively, with the goal of minimizing negative consequences while maximizing positive outcomes. Additionally, this report encompasses an Environmental Management Plan


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(EMP) and a Social Management Plan (SMP), providing detailed strategies for the management of the project's environmental and social facets.

In addition, a detailed Environment Monitoring Plan and Social Monitoring Plan will outline the monitoring procedures to assess the efficiency of mitigation measures and guarantee adherence to environmental and social standards. To ensure seamless and timely execution, the dumpsite remediation subproject report also includes an Environmental and Social Budget. This ensures a sustainable and responsible bio-mining process that prioritizes the protection of the environment and the well-being of nearby communities throughout the waste remediation process.

**Implementation Mechanism & Budget**

The Bio-mining project, with the objective of achieving 100% land recovery, will be carried out exclusively through an outsourcing model. The bio mining process will be conducted separately at each ULB. If the land is found to be contaminated with hazardous wastes, the subproject shall be excluded. For solid waste/leachate contamination on site proper remedial measures will be followed before utilizing for future facilities. Retrieved materials and recyclables may be handed over to the authorized recyclers and the usage of these retrieved fractions is unknown today as it would be as per the contractors proposal /plan. However, such reuse/recycling/disposal would be in line with National/State regulations which are stringent. The land will be restored to its pre-waste dumping condition, necessitating the complete removal of all legacy waste until it reaches the original land surface. Following the completion of the bio-mining process, the machinery and vehicles belonging to the implementing agency must be vacated within 7 days. No waste material shall remain on site after contract period. The reclaimed land, free of any encumbrances, will then be transferred to the Urban Local Body (ULB).

The total budget proposed for Environmental Management and monitoring Budget is [redacted] /- including social budget.

**Consultation &Disclosure**

A transect walk was also carried out to assess the socio-environmental characteristics in the vicinity of the dumpsite. To understand the social dynamics, demographic profile,

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livelihood patterns, social dynamics of the community and to understand the needs, concerns, and aspirations of the community, a transect walk was carried out on 30.05.2023, (Attendees – 17 no.s) which was crucial for developing effective dumpsite remediation strategies that align with their priorities. The findings and recommendation of the transect walk is shown in the following table.

| S.No | Social risks | Findings and Recommendations |
|---|---|---|
| 1 | Presence of 100 families, institutions, shops, establishments, and other public utilities near (200m) the dumpsite. | • Free movement of the residents needs to be ensured<br>• The livelihoods of the workers attached to these facilities should not be affected if the working hours of public utilities including shops and establishments are restricted, at any cost |
| 2 | Sound pollution, health issues and foul smell most affects 6 families residing very close to the site (50m). | SIA and SMP will consider the detailed impact and proper mitigation measures |
| 3 | Health risk of vulnerable groups residing near to the site (especially 6 families) which includes patients with breathing issues, pregnant women, PWDs, cancer patients, children below the age of two and elderly above the age of seventy-five. | Health issues may aggregate during work operations.<br>These factors should strongly be considered especially for all vulnerable groups |

***Note: All the references to Social Impact Assessment and Social Management Plan may be referred to Part B- Social Impact Assessment which is a separate document attached along with this document.***

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## Summary [Malayalam]

[redacted]

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# 1. INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-Financing Framework agreement and as agreed Project Co-lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake biomining of multiple Legacy Waste Dumpsites in various districts.

## 1.2 The rationale for the Proposed Sub-Project

Thalipaduppu (Kelugudde) dumpsite in Kasargod ULB at ward no.4 has a total waste quantity of 16,736 Tons, spreading over 1.1 acres. The site is located between Lat-12°30'59.0"N and Long - 74°59'20.7"E and has an elevation of MSL +27 (m), with a gentle slope towards the North-eastern part. During monsoon season, due to geography of the site waste flows downhill towards residential areas located at northern side of the site. Kasaragod ULB proposes biomining and bioremediation of the Thalipaduppu legacy waste dumpsite site under KSWMP supported by the World Bank and Feasibility Report has been prepared for this subproject. Considering the environmental and social impacts associated with legacy dumpsite biomining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

## 1.3 Objectives and scope of Environmental & Social Impact Assessment

***Environmental Categorisation and Assessment:***

As per indicative categorization for dumpsite biomining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation waste spread (1.1acres) and absence of environmentally sensitive features around, this subproject is individually considered as E2, and EIA is prepared accordingly. Required monitoring and analysis are carried out considering the possible impacts.

***Social Impact Assessment***

Under this category social impact assessment is also a key factor to be considered. Accordingly, detailed assessment of the environmental and social impacts was carried out.

**1.4 Proposed sub project details**

*Table 1Proposed sub project details*

| Description | Details |
|---|---|
| Name of ULB | Kasaragod |
| District | Kasaragod |
| Taluk | Kasaragod |
| Total present population in the ULB | 57,005 |
| Name of the sub-project | Dumpsite Remediation at Thalipaduppu |
| Location of the sub-project | (Kehugudde) Thalipaduppu at ward no 4 |
| Total dumpsite area (in acres) | 1.1 |
| Total waste accumulated area (in acres) | 1.1 |
| GPS Co-ordinate of the Site | Latitude: 12°30'59.0"N,<br>Longitude 74°59'1037"E |
| Legacy waste quantity | 16,736 tons |


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*Figure 1Legacy Waste Dumpsite at Thalipadappu*

The technology proposed is Bio mining and bio remediation in line with CPCB's Legacy Waste Bio mining Guidelines, 2019. The various phases in the biomining process (as per Legacy Waste biomining Guidelines of CPCB) are shown below.


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*Table 2 Phases of Biomining*

| Phases of Bio-mining | |
|---|---|
| **Phase 1: Stabilization** | The legacy waste is formed into equal-sized windrows and which are turned frequently, bio-culture is added and de-odor izer (an odor-controlling agent) sprayed. This phase removes stench, reduces moisture and eliminates pathogens. |
| **Phase 2: Sorting & Segregation** | In this phase, stabilized legacy waste is sorted/segregated into bio earth, recyclables, refused derived fuel (RDF) and C&D through series of various sizes of Trommel/circular rotator sieves and manpower. |
| **Phase 3: Disposal & Utilization** | In this phase, the non-combustible fractions such as soil and stones are disposed of for further processing into finer aggregates or for earth filling. The combustible fractions are called refuse-derived fuel (RDF) are sent for co-processing in cement industries. |

**1.5 Site management plan**

The plan aims to minimize potential adverse impacts on sensitive receptors while maximizing the recovery of valuable resources and promoting site restoration.

Mobile machineries will be used for biomining of the small Thalipaduppu, Kasaragod dumpsite, and they do not require a separate area for erection. The waste will be excavated and directly fed into mobile screeners for processing. This approach minimizes the need for additional infrastructure and optimizes the efficiency for the biomining process. The proposed plan is as follows


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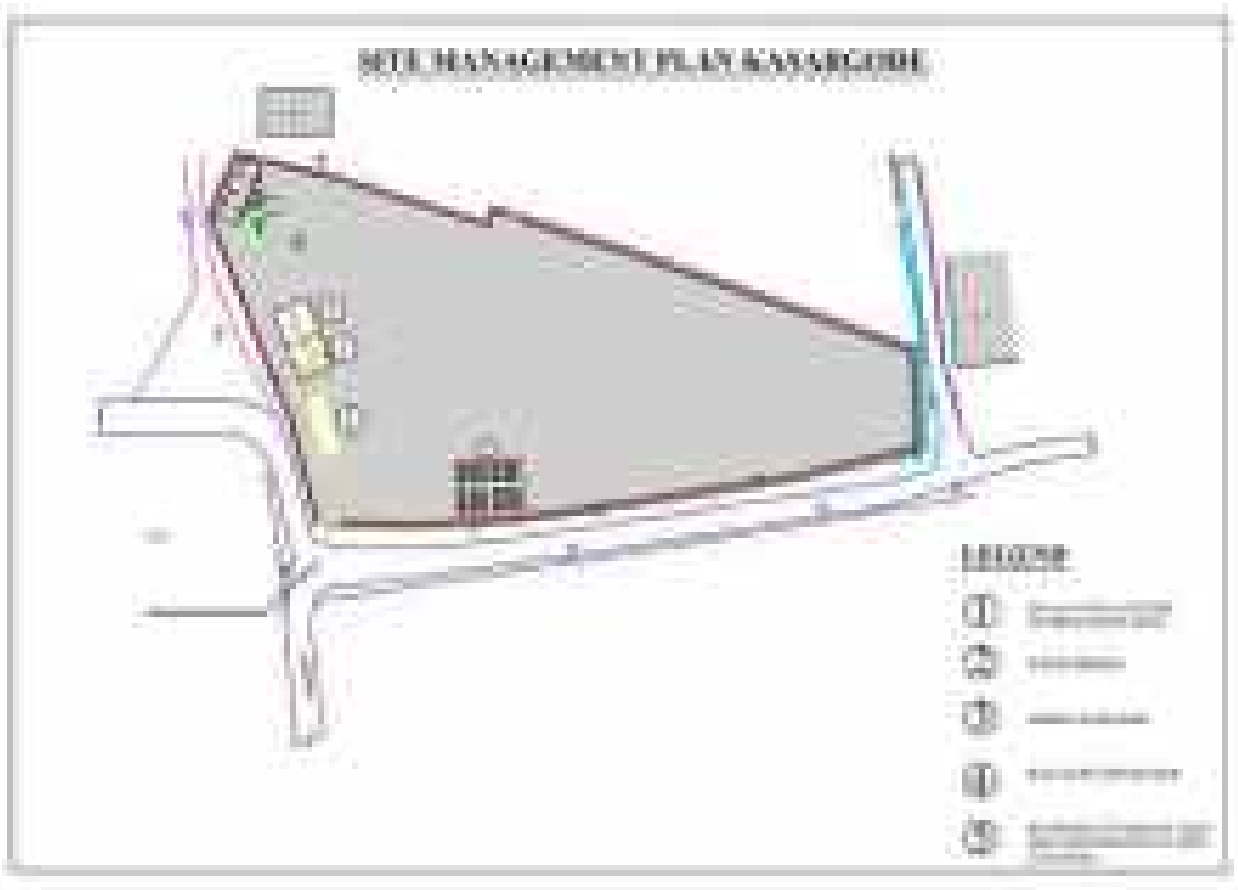



*Figure 2 Site Management Plan (Drawing attached as Annexure - E)*

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## 1.6 Structure of the report

*Table 3 Structure of the report*

| Chapter | Structure |
|---|---|
| 1 | Introduction |
| 2 | Policy and Regulatory Framework |
| 3 | Environment and Social baseline |
| 4 | Analysis of Alternatives |
| 5 | Assessment of Environmental and Social Risks and Impacts |
| 6 | Environmental and Social Management and Monitoring Plan |
| 7 | Institutional Arrangements |
| 8 | Public consultation and Information Disclosure |


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## 2. POLICY AND REGULATORY FRAMEWORK

### 2.1 National, State Legislations and Technical Guidelines related to environmental and social aspects of dumpsite remediation

*Table 4 Applicable rules and regulations for Thalipadappu dumpsite remediation*

| S. No | Rules and Regulations | Relevance |
|---|---|---|
| 1 | The Motor Vehicle Act, 1988 | All vehicles used for installation and operation will need to comply with the provisions of this act and should have valid Pollution Under Control Certificate. |
| 2 | Authorization from PCB for storing Hazardous material like diesel for DG sets as per Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016 | Hazardous waste (used oil from DG Sets) is likely to be generated during the erection and operation stage. Hence, authorization under the purview of the rule shall be requiring. |
| 3 | Labour Act | Occupational safety and health administration. |
| 4 | Solid Waste Management Rules, 2016 (MSW Rules) | To operate the mobile Bio mining plant, it is necessary to follow the existing MSW rules. |
| 5 | The Water (Prevention and Control of Pollution) Act, 1974 | Consent to Establish and Consent to Operate to be obtained during the construction phase and operation of waste recycling/disposal facilities |
| 6 | The Air (Prevention and Control of Pollution) Act, 1981 | Consent to Establish and Consent to Operate to be obtained during the construction phase and operation of waste recycling/disposal facilities |
| 7 | safety of the workers as per the ILO Convention No. 62 | Safety aspects |
| 8 | NOC from fire department | Safety aspects |
| 9 | Tree felling permission:<br>If felling of trees as defined in Kerala Preservation of Trees Act, 1986 | If any tree needs to be cut or replanted concerned permission is required from Forest Dept. Government of Kerala. The ULB will take the necessary permission. |
| 10 | NGT guidelines upto date | Relevant to the subproject to be considered for the successful implementation of the project. |


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| S. No | Rules and Regulations | Relevance |
|---|---|---|
| 11 | Building and Other Construction Workers (Welfare Cess Act) 1996, | Discusses Health and Safety and environmental aspects associated with construction and allied works |
| **Other Applicable Rules** | | |
| 12 | Solid Waste Management Rules, 2016 (SWM Rules) | |
| 13 | Plastic waste Management Rules, 2016 | |
| 14 | Construction & Demolition, Waste Management Rules, 2016 | |
| 15 | Batteries (Management and Handling) Rules, 2001 | |
| 16 | E-Waste (Management) Rules, 2016 | |
| 17 | SBM-Urban Advisory on Landfill Reclamation, CPHEEO, June 2020. | |
| 18 | Kerala Municipality Act, 1994 & Rules | |
| 19 | Hazardous & Other Wastes (Management And Transboundary Movement) Rules, 2016 | |
| 20 | The Operational Policies (Safeguards) of the World Bank and the Environmental and Social Management Framework; and the World Bank EHS Guidelines | |


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## 2.2 The World Bank Safeguards Policies

*Table 5World Bank Safeguard Policies*

| S.No. | WB Policy | Safeguard policy applicable | Description |
|---|---|---|---|
| 1 | Environmental Assessment (OP/BP 4.01) | Yes | The project has potential impacts and pose risks to various environmental factors during the implementation phase. Consequently, this policy is triggered, necessitating assessment and management of E&S risks and impacts, and ensuring a structured approach to safeguard management for risk mitigation including (health &safety risks, risks and impacts due to linked activities) in alignment with regulatory requirements, and Environmental and Social Management Framework (ESMF). |
| 2. | Natural Habitats (OP/BP 4.04) | Yes | Though the project will not support any activities that involve conversion or degradation of natural habitats; However, impacts on any flora/fauna on site during the proposed activity is important. |
| 3 | Pest Management (OP 4.09) | Yes | Considering the possible pest related issues as the project deals with wastes and improvements to dump sites. OP 4.09 Pest Management is triggered. As per this policy the banned pesticides/insecticideslisted by the Nation / State and the World Health Organization (WHO) other national/ state bodiesshould not be used in the project, and as much as possible Integrated Pest Management Options shall be followed |
| 4 | Physical Cultural Resources [PCR] (OP 4.11) | Yes | The proposed project will not support any activities that could potentially harm nearby cultural heritage, archaeological sites and physical resources valuable to the community |


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## 3. BASELINE ENVIRONMENTAL SCENARIO

### 3.1 Project location of the site

Thalipaduppu dumpsite in Kasaragod ULB at ward no. 4 is non-operational and dumping of waste stopped due to public protests during the year 2010.The location detailed are described in the previous section of 1.1 and 1.4.

*Table 6Sensitive receptor around the Dumpsite*

| S.No | Sensitive Receptors | Distance |
|---|---|---|
| 1 | Residential buildings | 60 households are located within 200 m radius of the dumpsite |
| 2 | Educational institutions such as Govt. UP school Adkathbail | 750 m |
| 3 | Arabian Sea | 1.86 Km |
| 4 | Nearest Stream (Sankaran Kuzhi thodu) | 300 m |

### 3.2 Methodology for Environmental Baseline studies

Baseline Study in EIA process usually includes data collection and analysis of various aspects in the project area, such as: Physical Environment (e.g., topography, geology, soil, water, air quality, and climate) and Biological Environment (e.g., flora and fauna, Land/Soil, habitat, biodiversity, and ecological processes). The overall methodology of EIA

1) Scoping, Environmental Screening, Exclusion and Categorization
2) Environmental Baseline study like analysis of Air, Water, Soil and Noise/Vibration and impacts on biodiversity, workers and people around
3) Environmental Impact Assessment
4) Avoidance of adverse impacts, minimization, mitigation, and management measures
5) Environmental Management Plan (EMP)
6) Environmental Monitoring Plan (EMoP)
7) Budget for implementation of EMP and EMoP

The below table indicates the environmental attributes and frequency of monitoring


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*Table 7Environmental Attributes*

| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| 1 | Meteorology | Temperature humidity and rainfall | - | Study area | Data collected from IMD |
| 2 | Ambient air quality | $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$, VOCs | A1 - 12°30'59.01"N 74°59'11.099"E<br>A2 - 12°30'59.0"N 74°59'10.9"E | 2 | 24 hourly samples |
| 3 | Noise levels | Noise levels in dB(A) Leq | N1 - 12°30'58.146"N 74°59'10.283"E | 1 | Once |
| 4 | Surface water quality | Physical, chemical and biological paranueters including pH, temperature, turbidity, magnesium hardness, total alkalinity, chlorides, sulphates, fluoride, Copper, DO, BOD, COD, salinity, Zinc, Lead, Arsenic. | S1- 12°31'06.571"N 74°59'12.616"E | 1 | Once |
| 5 | Groundwater quality | Physical, chemical and bacteriological parameters including pH, temperature, turbidity, magnesium | G1- 12°30'55.788"N 74°59'11.213"E | 1 | Once |


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| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| | | hardness, total alkalinity, chlorides, sulphates, fluoride, Copper, DO, BOD, COD, salinity, Zinc, Lead, Arsenic. | G2- 12°31'0.402"N 74°59'12.516"E G-3 12°30'57.964"N 74°59'16.399"E | | |
| 6 | Biological environment | Existing flora and fauna | - | Study Area | Through field visits and substantiated through secondary data sources. |
| 7 | Soil characteristics | Physical, chemical and biological parameters including pH, Total Hardness, Nitrites, Phosphates, Organic matter, Fluorides, Total Iron, Nickel, Copper and Lead, TOC, Permeability. | - | - | Once |
| 8 | Land use/land cover | Land use for different land use Classifications. | - | Study Area | Land use / Land Cover Analysis using satellite imaging and GIS Technique |
| 9 | Leachate | pH, BoD, CoD, TSS, TDS, Fluoride, Cyanide, Nickel, | L-1 12°30'50.110"N | 1 | Once |


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| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| | | Cadmium, Lead, Copper, Mercury, Zinc | 74°59'09.272"E | | |

### 3.3 Existing Facilities on site and its Environmental Audit

The dumpsite is secured by a compound wall that surrounds the entire area, and it is equipped with a gated entrance for access control.

*Table 8Environmental Audit of Dumpsite*

| S. No | Aspects | Remarks |
|---|---|---|
| 1 | Structural Characteristics | Type: Compound Wall<br>Perimeter - 300 m<br>Height of the Compound wall-2 m<br>Floor :Nil<br>Walls: Brick, Good Condition<br>Doors & windows: NIL |
| 2 | Functional Characteristics | Activities in the Dump Site :NIL<br>Activities spilling out onto the dumpsite: NIL<br>Access to the Dump Site: (Single access for Dumpsite. Having a bitumen (asphalt) road adjacent to a dumpsite<br>No. of workers: NIL |
| 3 | Facilities | Parking area-NIL<br>Loading/unloading area-NIL<br>Storage room & area: NIL<br>Worker snack/rest areas: NIL<br>Worker / other washrooms& sewerage: NIL<br>Water supply for Cleaning, Washroom: NIL<br>Greenbelt: NIL |


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### 3.4 Analysis of Environmental Baseline

*Table 9 Environmental Baseline*

<table>
<tr><th>S No</th><th>Environmental Aspect</th><th>Discussion on Baseline Scenario</th><th>Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject</th></tr>
<tr><td>1</td><td>Topography</td><td>The elevation of the Kasaragod site is MSL +27 m, gentle slope towards the northern section from the site. The land area in dumpsite is high land. Soil is predominantly Hard Laterite in nature. kasargod site falls within the tropical to sub- tropical climatic region</td><td>Leachate from the dumpsite drains out to North East side.</td></tr>
<tr><td>2</td><td>Climate</td><td>Kasaragod, the maximum temperature in the region varies almost between 24.4°C to 30.4°C and minimum temperature ranges from 16.7°C to 20.8°C.</td><td>Rains are heavy, and the site is at an elevated draining out of stored waste and leachate during dumpsite biomining & bioremediation works.<br><br>The biomining project has been scheduled during the off-season for rainfall in anticipation of reduced precipitation.</td></tr>
<tr><td>3</td><td>Hydrology/Hydrogeology& Soil</td><td><table><tr><th>Pre-monsoon (m) *</th><th>Post-monsoon (m) *</th><th>Avg. Fluctuation (m)</th></tr><tr><td>7.68</td><td>6.31</td><td>1.37</td></tr></table>Soil is predominantly Hard Laterite in nature</td><td>Lateritic soil is porous and may lead to contamination of nearby wells. Hence, any waste below 10m depth need to be remediated; and adequate measures are necessary to collect and manage leachate during all times</td></tr>
<tr><td>4</td><td>Forests and Ecology</td><td>Site is not located in forest area. Some of the common flora and fauna found near the site.<table><tr><th>Sno</th><th>Scientific name</th><th>Common Name</th><th>Type</th></tr><tr><td>1</td><td>Thespesia populnea Miers</td><td>Amrutha or Chittamrut ha</td><td>Flora [Tree]</td></tr><tr><td>2</td><td>Strobilanthes</td><td>karthevuh</td><td>Flora</td></tr></table></td><td>The species listed were not classified as Critically Endangered by the IUCN. (INTERNATIONAL UNION FOR CONSERVATION OF NATURE)</td></tr>
</table>


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| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | | 3 Anisomeles Wall. i [Tree]<br>4 Pinus sylvestris L Karimanchi Flora [Tree]<br>4 Syzygium cumini Kanjira maram Flora [Tree]<br>5 Haliaeetus leucogaster white bellied sea eagle Fauna [Bird]<br>6 Ailanthus sp Simaroubac eae Flora [Tree] | |
| 5 | Socio Economic Aspects | A detailed transect walk conducted near the Kasaragod dumpsite area. | The dumpsite remediation process is anticipated to pose social risks, including pollution of food and beverages in nearby establishments and potential health issues for local residents, workers, laborers, and students. A Social Management Plan, based on social screening and transect walk findings, is essential to mitigate these risks. Furthermore, the proposed remediation will have a positive impact on nearby residents, as it will lead to the removal of legacy waste, improving both environmental and social conditions. |
| 6 | Land use, Development Pattern and Key Projects | Surrounding land uses are mostly residential. Nearby cultural resources are temples at 280m from the site. Neighbours complain about odor nuisance and leachate from dumping yard affecting the drains. Key development projects in the region are NIL. | Odor, leachate and visual impacts on the surrounding land use (residential, temples). |
| 7 | **Infrastructure and Services** | | |
| 7.1 | Traffic and Transportation | A detailed incremental load by vehicles during the operation phase is assessed and | The implementing agency shall ensure staggering of |


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| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | | given under the traffic assessment reported. Through assessment it is identified additional 3 trucks/day will be the traffic load due to the activity which is as such negligible. The implementing agency shall ensure staggering of the traffic movements from site considering peak hours/school timings. Also, night time vehicular movements can be implemented | the traffic movements from site considering peak hours/school timings. Also, nighttime vehicular movements can be implemented. More accurate information shall be available once Contractor is being on boarded. EIA to be uplated by the contractor based on his work plan |
| 7.2 | Water Supply<br>a) Surface water<br>b) Ground Water | A) Surface water collected from 1 site and results found – all parameters are well within limits except BoD, slightly exceeding.<br><br>B) Ground Water collected from 3 different location and results found – all parameters are well within limits except for color and turbidity.. | Site Drainage & leachate Impacts due to of biomining activity (esp during any seasonal rain) is important with respect to nearby soil & water environment |
| 7.3 | Drainage, Sewerage and Sanitation | Region has an unplanned network of drains. The nearest drainage channel is Shankarankuzhi thodu which is300 m distance from the site.<br>Kasaragod is mainly served with septic tanks for individual premises (No toilets onsite).<br>Leachate samples collected at site, showed BOD value exceeding the limit and all other parameters were within limits | |
| 7.4 | Air Quality | Air Samples collected from 2 locations within the dumpsite and results found to be well within the permissible Limits. | |
| 7.5 | Noise Level | Noise Level monitoring samples collected within the dumpsite in order to identify the present noise level and results found well within permissible limit | Proper remedial measures for increased noise level shall be ensured by the contractor while bio mining activity. |


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### 3.5 Description of Environmental Parameters

Under this baseline environmental attributes are arrived at after analysis of samples taken from the dumpsite and surroundings viz ground water, surface water, Noise level and air.

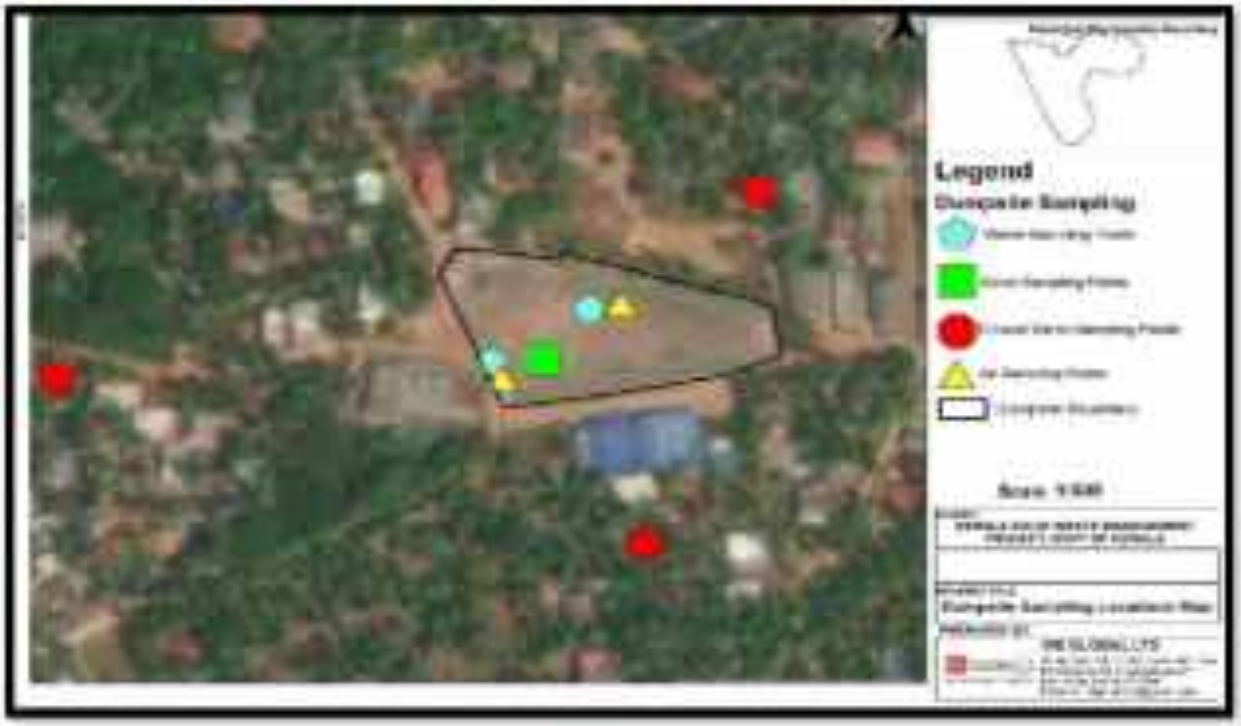



*Figure 3 Distance of the Sampling locations*

The map showing sampling locations and the analysis with observations are given below:

*Table 10 Distance & Direction of Sampling locations*

| S.No. | Description | Direction | From Boundary of the dumpsite (m) |
|---|---|---|---|
| 1 | Surface Water | North East | 300 |
| 2 | Ground water-1 | South West | 65 |
| 3 | Ground water-2 | East | 63 |
| 4 | Ground water-3 | South West | 115 |


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### 3.6 Identification of sampling location:

*Table 11 Identification of sampling location*

| S.No | Description | Place identified | Justification |
|---|---|---|---|
| 1 | Air sampling (2 Locations) | Inside the dumpsite | As per the wind rose diagram, the direction and speed of the wind are determined and based on the existing wind rose data the air sampling location fixed at two locations |
| 2 | Noise (1 Location) | Inside the dumpsite | As per the lab experts' advice the sampling location was identified |
| 3 | Surface water (1 Location) | Surface water near to the dumpsite (stream) | It is important to identify area very near to the dumpsite to asses any contamination due to the project thus location was identified |
| 4 | Ground water (3 Locations) | 3 wells identified near the dumpsite area | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope (NE). The infiltration of leachate which could result in the contamination of ground water.<br>Based on the possible infiltration and slope direction the ground water samples are collected in the West, Northeast and Southeast direction outside of the dumpsite. |

### 3.7 Sampling Methodology

*Table 12Sampling Methodology*

| S.No | Description | Method |
|---|---|---|
| 1 | Air sampling | Calibrated High Volume Sampler, Calibrated rotameter & calibrated Dry gas meters and sampling locations selected based on wind rose and impacts on surrounding land uses. |
| 2 | Noise | Calibrated sound level meter and sampling locations selected based on highest noise level on site and impacts |


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| S.No | Description | Method |
|---|---|---|
| | | on surroundings |
| 3 | Ground water | Water collected in polyethylene and sampling locations selected based on leachate and run off flow and impacts on surroundings |
| 4 | Surface water | Water collected in polyethylene bottles and sampling locations selected based on leachate and run off flow and impacts on surrounding surface water bodies and drains (line sources of pollution) used be communities |
| NOTE: Sampling Photographs added as Annexure C in the FR Report. | | |

### 3.8Site Connectivity

The width of site access road is approximately 5m which is partly concrete and partly bituminized. NH 66 is only about 0.75 kilometers away. NH66 provides access to other major cities in Kerala, such as Kannur and Kozhikode. The industrial and trade city of Mangalore in Karnataka also is connected through this NH66. This highway provides access to other parts of Kasaragod city.




*Figure 4 Access Roads for the Site*


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### 3.9 Traffic Assessment

Traffic assessment refers to the process of evaluating and analyzing the flow of vehicles, pedestrians, and other modes of transportation on roadways, intersections, or specific areas. This assessment helps in understanding current traffic conditions, identifying potential issues, and developing appropriate strategies to improve traffic flow, safety, and efficiency.

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**Traffic load:**

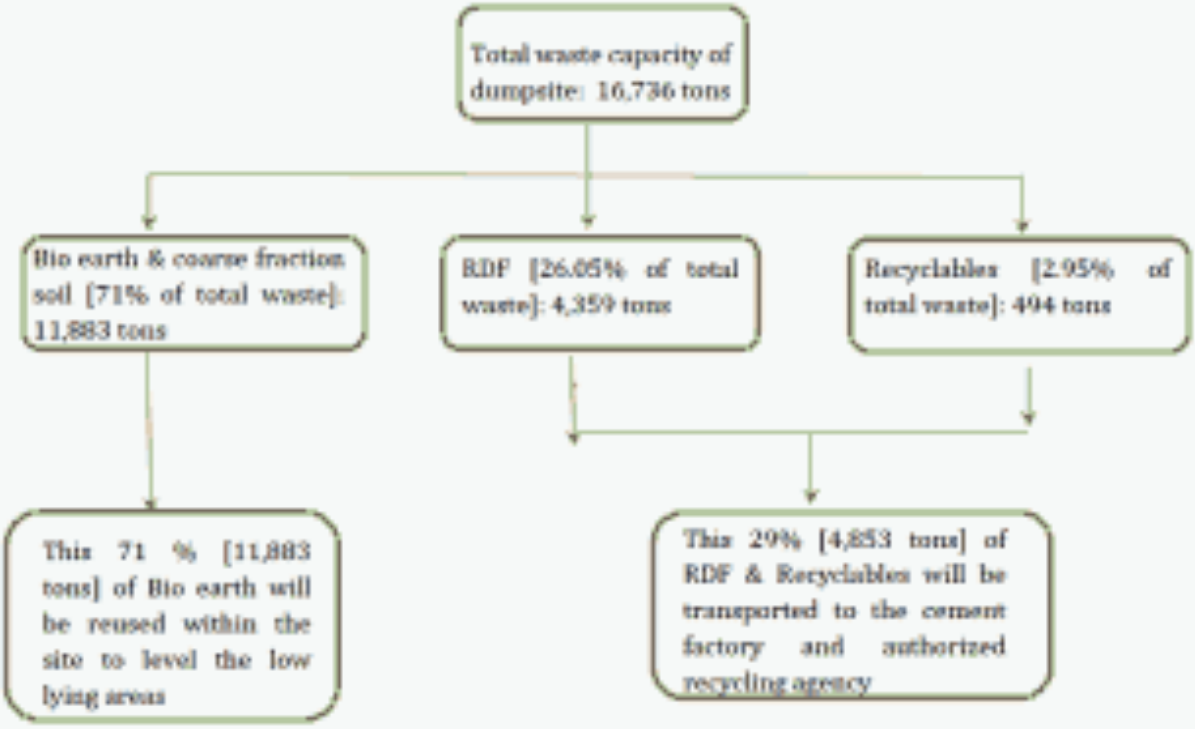



*Figure 5 Traffic load*

Access road is of 5m wide of partly concrete and partly bituminized. The road starts from NH66 at Adkathbail which is 720m to the site. The road is Thalipaduppu cross road. Considering 90 days of operation phase the trips are planned and the inward & outward of the vehicle to be made during off peak hours.

To promote safety and avoid traffic congestion, it is recommended to impose restrictions on the movement of vehicles used for the Bio mining process. These restrictions should be applied one hour before the start of school timings and one hour after school closing time.


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*Table 13 Required Truck capacity & trips*

| S.No | Materials | % of Materials | Weight of each materials(t) | Vehicle Type | Max Capacity of load carrying Truck (t) | No. of Trips |
|---|---|---|---|---|---|---|
| 1 | RDF | 26.05 | 4359 | 12 Wheeler Dumper | 18 | 242 |
| 2 | Glass | 1.6 | 268 | 12 Wheeler Dumper | 25 | 11 |
| 3 | Metals | 1.35 | 226 | Goods Track | 2 | 113 |
| 30% of Total Weight | | | 4853 | Total No. of Trips | | 366 |

*Table 14 Total Trips planned*

| S.No. | Materials | Total Trip | Total Days for Disposal | Trip/Day | Remarks |
|---|---|---|---|---|---|
| 1 | RDF | 242 | 90 | 3 | Three Trips per day |
| 2 | GLASS | 11 | 90 | 0.1 | Ten days once one trip |
| 3 | Metals | 113 | 90 | 2 | Two Trip Per day |

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## 4. ANALYSIS OF ALTERNATIVES

### 4.1 Alternative 1: No project (without project scenario)

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevent further contamination of the site.

If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows.

1. Foul Odor Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.
2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.
3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.
4. Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the surrounding environment, disrupting natural habitats and causing long-term ecological imbalances.
5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

### 4.2 Alternative 2: Mode of execution / Management Alternative

Regarding the execution strategy, the outcomes of a Transect walk have substantiated the impracticality of waste transfer between ULBs. As a result, the imperative is for the waste remediation procedure to take place on the premises, allowing only the byproducts to be considered for potential transfer.

The logistical aspects of arranging machinery and designating storage space for these byproducts will hinge upon the extent of land available.

### 4.3 Technology Alternative

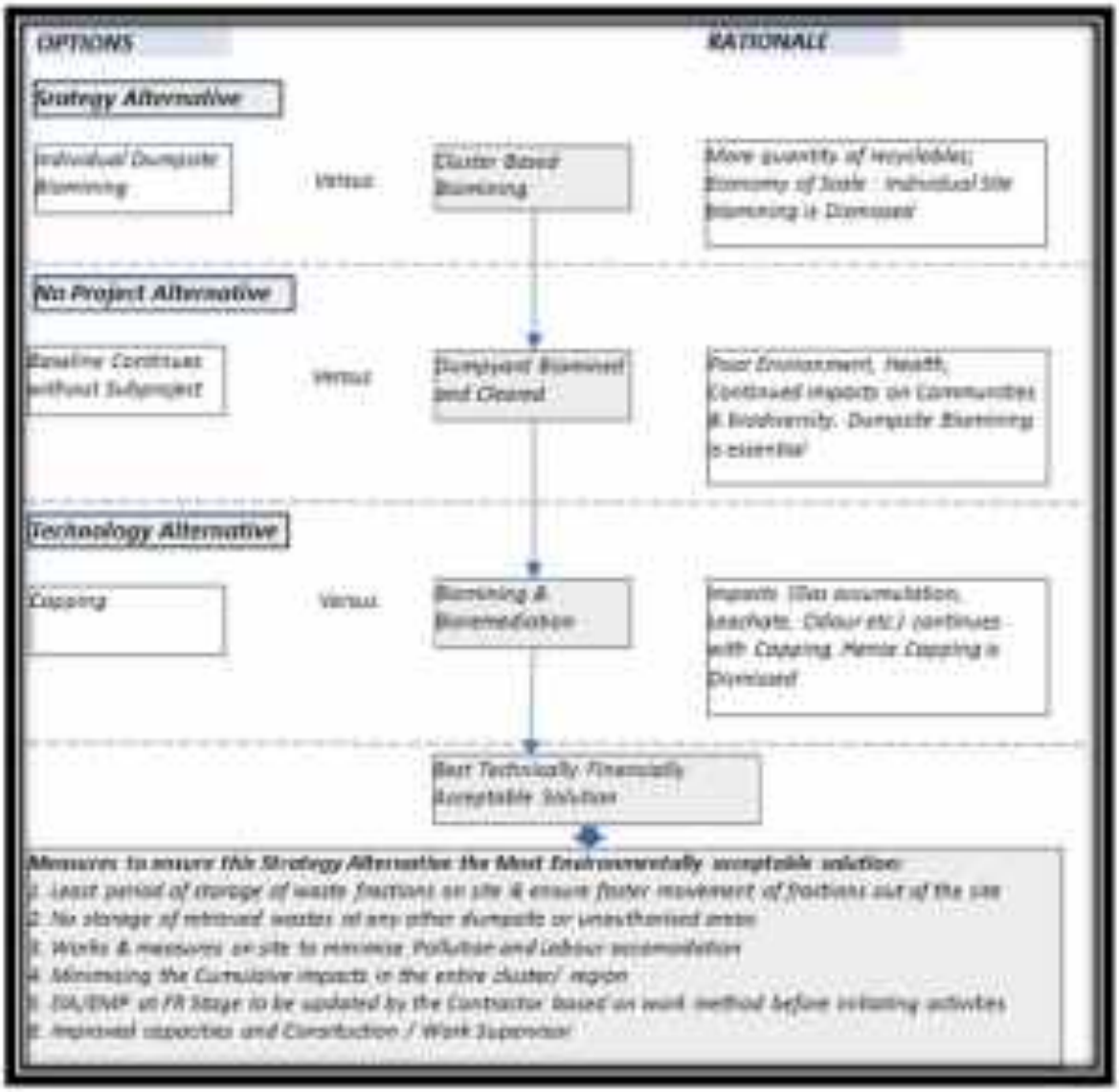
The selection of the appropriate method or technique for remediation is determined by considering several parameters. These include the significant aspects and suitability of remediation types such as

1. Capping without land recovery,
2. Bio-mining – reclamation/recovery of 100% land
3. Capping with partial land recovery.

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Additionally, factors like available resources such as manpower, machinery, finances, and physical site conditions, including the quantity and characteristics of legacy waste, Environmental baseline, social concerns, regulatory compliance (KSPCB/NGT), the need for complete land recovery, and opportunities for utilization of processed aggregates/by-products are taken into account.

After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.





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## 5. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISK IMPACTS

Biomining and bioremediation of existing legacy dumpsites brings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more man-days at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, biomining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration)are important in this case. In addition, cumulative impacts of simultaneous biomining of multiple such legacy waste sites on the environment are important. Especially with respect to

(i) Drainage and leachate flow into regional water bodies(& esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies,

(ii) Pollution on land/soil, dust and odor nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks,

(iii) Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and

(iv) Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at this stage, while some would be known only based on the project details that would be known from the work plan of the contactor once on board.

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### 5.1 Impact Assessment Methodology

Impacts are assessed based on Magnitude, Duration, and Significance of the impacts and sensitivity of the receptors present within the 500 m aerial distance of Kasaragod dumpsite

#### 5.1.1 Magnitude and Duration of Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Bio mining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;
- The spatial extent of the potential impact;
- Reversibility of the Impact;
- Legal standards and established criteria.
- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table 1 - Aspects for Determining the Magnitude of Impacts. Magnitude is assessed as medium, considering shorter duration of the activity However, magnitude of cumulative impacts of various dumpsite remediation might be High.

*Table 15 Aspects for Determining the Magnitude of Impacts*

| Aspects | Large | Medium | Small | Negligible |
|---|---|---|---|---|
| **Duration of the potential impact** | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or Less than the lifespan of the program | Temporary with no detectable potential impact |
| **Spatial extent of the potential impact** | Regional – much beyond project boundaries | Beyond immediate Program components, site boundaries or local area | Within program boundary (but cumulative impact of various dumpsite bio | A specific location within program component or site boundaries |


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| | | | | |
|---|---|---|---|---|
| | | | mining activities will be on larger extent) | with no detectable potential impact |
| **Reversibility of potential impacts** | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months | Baseline remains constant |
| **Legal standards and established professional criteria** | Against national/approved standards and or international guidelines/obligations | Complies with limits given in national standards but not confirming to international leader guidelines in one or more parameters | Meets minimum national standard limits or international guidelines | Not applicable |
| **Likelihood of potential impacts occurring** | Commonly occurs under typical operating or construction conditions (Certain) | Usually seen occurring under most situations (Likely) | Occurs under abnormal, exceptional or emergency conditions (Occasional) | Unlikely to occur |

**NOTE: Anticipated Project Duration - 5 to 6 months**


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### 5.1.2 Sensitivity of Receptor

The dumpsite is surrounded by residential buildings and some commercial establishment, during the time of site assessment the experts observed, some sensitive receptors within 500m from the site. Namely some Anganwadi, religious places and households. The project's lies near residences, within a 200-meter radius, and its potential air, odor, fire, noise, vibration, ground water impact on over 60 families (250 people) over a duration of 5 to 6 months. The sensitivity of these receptors is high. In addition, there is a drain which flows through the residential areas of Thalipaduppu (North East) which drains the runoff and leachate from the site. The sensitivity of this receptor is also estimated as High.

### 5.1.3 Significance of the impact

- Significance if the impact is high as it would even result in community resistance to biomining and bioremediation.

Since the project operational time 5 to 6 months, then the magnitude of the negative impact can be considered as small and medium sensitivity. In other hand magnitude of the positive impact, after the biomining of the existing land can be used for the recreational park for the public use.

## 5.2 Source-Pathway-Receptor Analysis

**A) Source**: The source of contamination is the legacy waste remaining and being deposited at the Thalipaduppu closed dumpsite, more specifically the landfill gas and leachate generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. In this case the waste is 50 years old, as dumping had started in year 1970and ceased in 2010-. The total waste volume is 20,115 cu.m with the dumpsite spread over 0.44ha and rises to a height of approximately 5m from the base. Waste is seen 2.5m above ground level and 2.5 m below ground level. In addition to the landfill gas and leachate, material spill over from the existing compound and windblown dust and litter are also considered as sources of contamination.

**B) Pathways**: The following pathways for migration of contaminants have been identified: Wind- The main pathway for litter and dust dispersion is the wind. As long as the waste is kept uncovered, the dust and litter will continue to be blown off the dumpsite to the

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surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. Rainwater runoff through the dumpsite acts as a pathway for transport of leachate to the soil and groundwater. The rainwater flowing off the dumpsite along the slope towards North East direction acts as a pathway for the uncovered waste to flow into the unlined drainage canal along the boundary to North Eastern side. Which may not affect surface water body which runs through the residential areas and terminates at Sankarankuzhithodu canal at 300 m aerial distance from the dumpsite?

Lateritic Soil acts as a pathway for transport of leachate to the groundwater and for uptake of contaminated surface run-off.

The leachate flows with groundwater and acts as the pathway. Surface water Contaminants like run-off from the dumpsite, leachate and windblown dust and litter that reach nearby surface water bodies like canals, rivers and streams are further transported by surface waters and in this case the surface water acts as the pathway.

**Receptors:**

Receptors are air, surface water (drain passing through residential areas)and ground water. For drinking purpose, they mainly use mini water supply scheme by KWA. (6 nearby Households within 50 m and 1 school within 750 m), soil, flora, fauna and humans. In the case of remediated dumpsite, the most prominent group of receptors are the residences and institutions living nearby in Adkathbail. As the dump is not contaminated, remediation would improve the pollution scenario provided the bioearth used is pollution free and of good quality. However, other impacts are expected on the final destinations of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF/MRFs in the region. Depending on the locations of end use of fractions retrieved from biomining, the contractor shall assess the impacts on communities and workers on site & nearby; and near locations of end-use. Key impacts may result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after biomining activity, activities in biomined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post biomining activity.

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### 5.3Impacts on Air Environment

Key impacts on air include:

- Emission of Methane and other Greenhouse gases; and its impacts on scavengers, workers on site/other facilities on site, nearby communities of Ward 4-Thalipaduppu.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odor, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.
- When the legacy site is opened, existing gases would get emitted. Further, any delay / unexpected stoppage of biomining activity, might further the process of gas formation depending on waste composition, odor and fire risks. In the case of Thalipaduppu, since the analysis of wastes shows calorific value of 1300 for combustibles with around 17 percent plastics, 4 % paper and 2% cloth rags, it's well combustible; and the risk of fire is high during summers and incidents

### 5.4 Impacts on Water Environment

Ground water

- Post and pre-monsoon water levels are 11.02 m and 13.22mbgl. Borehole data indicates waste upto depth of 5m with hard lateritic strata after that. Hence it is expected that the ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. With the slope of the ground of the dumpsite, this tends to get accumulated at low-lying gradients and flows into unlined drain up till300m and terminates at Sankarankuzhi thodu. High BOD levels of the drain and ground water wells around are indicative leachate and runoff pollution. Oozing & Pooling of leachate &it draining to nearby areas during rains would be an important aspect to

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be managed during biomining to prevent ground water contamination. There a need to separate out site drainage and leachate

- Leachate samples: BOD, COD, TDS, E.coli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution.
- Borehole data: Dump below water table; impacts on water resources, wells nearby
- Ground beneath the dump remains polluted if heavy metal/other parameters exceed limits in leachate, soil, water. There are no parameters exceeding the permissible limits for heavy metals.

Surface water

- The dumpsite experienced flooding during 2018 floods. The site is at a higher elevation, and hence no submergence was experienced at the site during the floods. The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas.
- There are no surface water bodies near the site, except Sankaran Kuzhi canal at 300 m distance.
- Predominant slope is in the North East Direction At Northeast direction, (end direction) there are residential households and mixed vegetation are seen. The drainage and leachate from the site flows to nearby open drainage channel which flows through residential areas, and ends at Sankarankuzhi thodu. It is important to contain and treat leachate from the proposed bio mining activities on site. Treated leachate may be recirculated or used for other purposes.

### 5.5Impacts on Land/Soil

- Historic land use assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it shall be excluded from the site as biomining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.

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- Spillover of activities to nearby road, and land would result in pollution of all types on these areas. Hence it is important to restrict all activities to the site for legacy waste biomining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.
- Ground beneath dump remains polluted if heavy metal/other parameters exceed limits in leachate, soil, water. In Thalipaduppu, all heavy- metals are falling within the limit as per Fertilizers Control Order 1985 and its amendments. Thalipaduppu does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste (including legacy asbestos), e-waste or biomedical waste is found while biomining, same shall be retrieved, transported, treated and disposed as per specific waste guideline of the Central Pollution Control Board, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste),Feb 2019) and World Bank EHS Guidelines. A plan shall be auditing of all wastes, management, eliminating pollution & OHS risks and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.
- Wherever fuel, combustibles and retrieved waste is stored, it shall be on impervious surface, at appropriate elevation, protection against rains, flooding (such as cut off drains, berms etc.), wind and fly / pest menace (screens, green cover etc), intruders (compound wall existing at Thalipaduppu), watch and ward, lighting, remote monitoring measures etc). Risk of fire, dust and leachate contamination shall be well assessed by the contractor. Emergency Action Plan shall be prepared and mitigation measures shall be updated based on work plan/DPR, and implemented.

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Communities shall be made aware of works and advice to follow measures such as use of fly/dust covers/nets on wells etc.

- Of the waste samples analyzed, 50 to 60 percent comprises of Bio earth; 30% being <4.75mm size; C/N ratio (15:01) indicating slight unpleasant odor (high Nitrogen; releasing ammonia) less than that suitable for good compost.

### 5.6Impacts due to Noise and Vibration

- Various machines vehicles and activities contribute to noise and vibration on and off site. This includes vehicles carrying recyclables, operation of JCB, and other machines, diesel generator sets, motors on site, etc. In addition, activities on the site such as vehicles transporting the dry waste from households to MCF, loading / unloading of collected waste materials, and workers activities on site would add to noise and vibration. Impacts include disturbance to fauna flora on site, health impacts on communities around due to exposure to large volume of sound.

### 5.7Other impacts on Biodiversity - Fauna/Flora

- There are no sensitive biodiversity areas within 10km of the site. However, since the project involves transport of wastes, it is important to consider the impact beyond the project boundaries. Within 50km from the site is Western Ghats, World Heritage biodiversity site, and 4 key biodiversity areas; including Kottancheri Hills, Malom Wild life area, Kareem Forest Park, and Elephant Park Charladka which hosts multiple species. Depending on the contractors plan for disposal of retrieved waste fractions, EIA shall be updated for biodiversity impacts.
- Fauna: impacted by direct consumption of the solid wastes, sharps, entanglement, or by consumption of plants and/or animals contaminated by wastes, or as a result of leachate effects on groundwater and surface water.
- Flora Plants near open dumpsites can be impacted directly by the waste, dust or smoke from burning. Disturbance to vegetation due to machinery, trampling by foot, vehicle or animals, or contamination by waste or leachate, the migration of landfill gas, or as a result of burning or smoke effects

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- Disturbance to other fauna and flora on site: SWM activities onsite including those related to MCF may also impact fauna/flora through high noise levels of pre-construction / construction activities.
- Biodiversity of existing site: Available Biodiversity of existing site is mentioned in the Environmental Baseline session and there is no key species listed by IUCN.

### 5.8 Other impacts on Workers and Communities

- Contaminants in soil and water: Direct or indirect contact with polluted soil or water by neighboring water users. Additionally, because of their locations, recovered lands are subsequently used as parks, or for SWM facilities or office spaces etc. This may pose risk of bioaccumulation of metals which can constitute a health risk. Also impacts on buildings due to gaseous emissions, risk of fire etc if used after clearing.
- Health Risks: One of the primary health risks of dumps is the spreading of diseases - diarrhea, hepatitis etc. The ways such infection can be spread are numerous but are often related to direct contact with the waste (e.g., clinical waste, fecal matter) by scavengers and other unauthorized persons being on the site. The other main pathway is by vectors such as, foraging animals, rats, birds, flies and mosquitoes etc. - Flies, mosquitoes, rodents, crows, pigeons, pest menace on site, for workers & communities & their assets (such as wells) due to exposure of putrefied wastes
- Impacts if separate common site/s or a site among these dumpsites is chosen to store wastes from other dumps till it is disposed, or as transfer stations or for common processing of certain fractions: Such activities would result in Air, odor, dust, noise, water, vibration, flora, fauna, communities around the new site. There is also risk of contamination due to newly placed wastes, and pollution impacts and disturbances to communities due to works/activities on this site. Such sites and activities shall be avoided, and if quintessential for the project, be carefully chosen and approved only after thorough discussions with KSPCB, and all stakeholders. An assessment of their sensitivity and appropriateness shall be undertaken considering the environmental risks. They shall be audited and assessed for existing and future environmental impacts of such activities and mitigation shall be implemented.

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However, details on such sites shall be known only based on the final schema of implementation proposed by the contractor. Hence, the Contractor shall update EIA based on this before starting any activity on site.

- OHS impacts: Infectious wastes, fecal matter, clinical wastes and sharps; batteries, e-waste and possible bursting; Hazardous wastes like asbestos and other chemicals dumped; pesticides / insecticides, inoculum storage, handling and use on wastes/land leading to diarrhea, hepatitis, insect & reptile bites, interactions with foraging animals like rats, dogs, cattle, vector (mosquitoes, flies etc) transmitted diseases etc.
- This activity would result in large influx of workers from the region and beyond as this involves 20 dumpsites in two clusters. Worker facilities in the labour Camp if any, & site are important, as the density of population is high in Kerala. It is important that camp sites are not set up in the land to be remediated. Periodic health checkups (once a week) are very important as the work involves handling of waste. It is important to also provide periodic health checkup and co-ordination with local Primary Health Center/Central Health Services for medical camps for residents, schools and others during the biomining period.
- Risk of Fire during biomining and due to retrieved material storage; possible Burning of retrieved materials; storage and use of firewood for various purposes, fuel for vehicles. The smoke from burning solid waste can result in respiratory complaints, dizziness, and headaches in the short-term, as well as potentially more serious diseases such as cancers and heart disease in the long term.
- Impacts of other site development works shall be well assessed, EIA/EMP updated, and mitigation measures included in Project costs and implemented by the contractor/ULB (whoever is responsible as per FR/Final Bid document)

**5.9Visual impacts, Noise, Odor , Vibrations**

- Odor & impacts on workers and communities during biomining, storage and Transport are key determinants of community agreement to the activity. Such odor would attract flies and vectors in large numbers, who may also contaminate the food, and water sources of nearby communities. It is important to minimize odor

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emission as guided by the CPCB Guidelines on Legacy Waste Biomining, 2019. also provide periodic health checkup and co-ordination with local PHC/CHS for medical camps for residents, schools and others during the biomining period.

- Visual impacts of the waste being dug up, screened ad heaped/stored is not appealing. It is important to mask this appropriately.

### 5.10 Traffic impacts

- Impacts due to new access road construction/upgradation. Access road to the site is unpaved and slushy during rains. It is important to minimize temporary pollution due to increased movement men, and materials from and to the site during biomining activity and beyond as it is proposed to store material on site including air and noise pollution, access restrictions to properties nearby, and vehicular conflicts
- Large vehicles moving in and out of the site carrying materials, tools, equipment & pedestrian/worker -vehicular conflicts; increased traffic on roads, large equipments & vehicles, noise, air pollution: vehicle emissions, DG sets
- Vehicles, equipment's not adhering to pollution standards

### 5.11 Other Impacts on existing or proposed activities on sites

- There may be approvals from various agencies for biomining activities and associated facilities; depending on utilities and uses on site. & associated activities. These permits shall be obtained prior to initiating activities on site.
- Impacts of biomining on existing facilities on site such as Compound wall, MRF, MCF, composting yard etc (disturbance to activities & people due to dust, leachate, noise, odor, additional load of wastes to these facilities, vibration impacts & structural damage, etc).
- Post biomining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped & impacts if this is dumped elsewhere or not processed. This alternate


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location, being associated facility need mitigation measures to avoid/minimize pollution, Health &Safety impacts on workers, communities. Also forward linkages are considered as associated facilities/linked activities. Impacts of Transportation of these fractions (traffic increase, odor, leachate, dust) impacts during rains & emergencies, and its handling, storage at the identified locations, reuse etc. shall be mitigated.

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## 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT & MONITORING PLAN

### 6.1 Scope of Environmental Management & Monitoring Plan

An Environmental Management Plan (EMP) is a comprehensive strategy designed to manage and mitigate the impacts of activities on humans and the environment, particularly concerning air, water, soil, and biodiversity.

### 6.2 Environmental Management Plan

The detailed anticipated impacts and corresponding mitigation measures/management of the impacts are given in the below.

*Table 16 Environmental Management Plan*

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| *A* | **Planning and Pre-Construction Stage** | | | |
| *1* | ***Planning for biomining facility*** | | | |
| 1 | Biomining & Bioremediation Plan & Capacities | • Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / biomined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these biomined material in line with the agreements with such facility owners and National, State regulations and WB EHS<br>• Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odor and Leachate Management Plan.<br>• The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers.<br>• Contractor to get all required licenses & permits before start of any activity on site | Contractor | SPMU/DPMU/ULB |
| 2 | Site Access Closure | • The total cessation of dumping in the site will be implemented before any works.<br>• All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid | ULB or Contractor as per Bidding mechanism | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | risk to the public.<br>▪ The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance to indicate that the waste dump has been closed from the operation.<br>▪ To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br>▪ Grading shall be performed where necessary to provide a neat appearance | | |
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – *impact on air quality, odor, water contamination due to leachate, health and safety impacts of the people working in the site assessment* | ▪ Carry out site assessments as per Guidelines for Biomining of Legacy waste Dumpsites of CPCB<br>▪ Consider safe biomining & gas / leachate generation from existing capped portion of the site<br>▪ Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means<br>▪ Provision of appropriate PPE's to the team undertaking the site assessments<br>▪ Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>▪ Plan for machinery operated which will be operated by skilled operators at all times.<br>▪ Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures.<br>▪ Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | TSC, ULB, Contractor | SPMU/DPMU/ULB |
| 4 | Absence / Delay in Permissions for Developing the | ▪ Required permissions for undertaking biomining at the existing dumpsite and assessments conducted for undertaking biomining as per existing Laws, Regulations; including for associated infrastructure, DG Sets, Consent to Establish; | Contractor, ULB | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | biomining facility and associated works as per National regulations | and other licenses including those as per Labor Laws, before the start of works on site | | |
| 5 | Dust impacts due to Site works, screening & stacking of retrieved wastes<br><br>*(Air Pollution) and Visual Blight due to excavation* | ▪ Plan to Provide temporary high screen, buffers around the site before the start of work to curtail dust emissions<br>▪ Arrange a green belt as early as possible on the area of the site with no / less dump. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers)<br>▪ PPEs to be used by workers<br>▪ Awareness to communities & suggest to use PPEs | Contractor and or ULB depending on agreement on bidding mechanism/DPR | SPMU/DPMU/ULB |
| 6 | Material sourcing, transport, and stacking of construction materials<br><br>*(Occupational Health and Safety issues and Air noise pollution)* | ▪ Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism<br>▪ Prior intimation to nearby Primary Health Centre on work activities need for medical support, emergency support needs, type of laborers on-site and labor camp if any<br>▪ Materials shall be sourced only from approved quarries<br>▪ Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions.<br>▪ The driver should be with required license and follow speed regulations<br>▪ Materials shall be transported preferably through well-surfaced roads. If road is kuchcha, water sprinkling shall be done to prevent dust emission before and after truck passes<br>▪ Material transport and unloading activities should not result in noise disturbance to locals and should be during day time<br>▪ Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors.<br>▪ Provide vehicle wheel wash area on site<br>▪ Workers to be provided with Personnel Protection Equipment (PPE) including | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | safety boots, jackets, ear muffs, gloves.<br>▪ Proper rest area on site shall be provided with water, first aid, toilets | | |
| 7 | The layout of Labour camp *(Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)* | ▪ Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp<br>▪ Nearby health center shall be informed about the labor camp & appropriate medical checkup shall be arranged periodically<br>▪ Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters)<br>▪ It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with land owners wherever the labour is accommodated<br>▪ Camp must not be provided in an area prone to Hazards<br>▪ Camp should be adequately at higher plinth levels to prevent water intrusion<br>▪ Rooms shall be of appropriate sizes with adequate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG)<br>▪ Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female labourers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc.<br>▪ The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security<br>[Refer ECOP section 06 and section 11 of EMF for KSWMP] | Contractor | Site engineer of SPMU, Labour Commissioner, PCB |
| 8 | Nearness/disturbance to sensitive areas such as forests, wildlife habitations, etc. especially in case of providing support facilities<br>*(Impacts on Fauna /* | ▪ Ensure site selection for any support facilities or activities (such as vehicle storage etc. if no in biomining site) based on the screening checklist and the master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate, Reduce. Obtain requisite permissions from respective authorities such as Pollution Control Board, ULB etc.<br>▪ Identify appropriate government site to avoid land acquisition and resettlement impacts<br>▪ Covered and well-marked storage area with cut off drains & odor /fly/dust/ fire prevention shall be ensured for excavated wastes and washing, segregation of the | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | *Flora)* | same are to be arranged with due consideration to nearby residences | | |
| 9 | Contamination of groundwater due to leaching. Leachate parameters; BOD, COD, TDS, Ecoli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution | ▪ During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant<br>▪ Depending on the contractors plan for biomining of the capped area on site, adopt plans to manage leachate | Contractor | SPMU/DPMU/ULB |
| 10 | Impacts on flora, fauna" consumption of wastes, leachate impacts, dust smoke – burning, trampling/machinery | ▪ Movement routes of vehicles to be planned to avoid key fauna/flora on site such as *Haliaeetus leucogaster(white bellied sea eagle),Ailanthus sp.*(Tree) &*Funambulus tristriatus* ( Jungle Palm Squirrel)<br>▪ Leachate collection & storage/treatment and recirculation shall be planned to avoid impacts on flora, fauna | Contractor | SPMU/DPMU/ULB |
| 11 | Nuisance hazards to neighboring areas | ▪ Ensure proper design and adequate compound wall; high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements<br>▪ In case of waste mound and site edges are sliding or unsafe; provide engineered retention walls. | Contractor | SPMU/DPMU/ULB |
| 12 | Treatment & Disposal of wastes and rejects | ▪ Contractor to Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & inert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventoried and quantified, including Biocarth, rejects, inerts. These shall be tested and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertilizer Control Order 1985 and | | |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | their amendments. Asbestos Management Plan shall be prepared for management if Asbestos wastes retrieved if any<br>▪ Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, water bodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period. | | |
| **B** | **Implementation or Biomining & Bioremediation stage and Construction of ancillary facilities such as access road improvements, compound walls, greenbelts, drainage etc.** | | | |
| **Implementation of biomining of the dumpsite** | | | | |
| 1 | Impact due to the vehicular movement<br><br>*(Air and noise environment & Vehicular - Vehicular & Vehicular - Pedestrian Conflicts)* | ▪ Vehicles and machinery are to be maintained so that emission conforms to National Ambient air quality standards.<br>▪ All vehicles and machinery should obtain Pollution Under Control Certificates<br>▪ HORN PROHIBITION signpost to be erected.<br>▪ Rumble strips/speed breaker to be provided on access roads.<br>▪ Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed.<br>▪ Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle<br>▪ Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements.<br>▪ Avoid heavy vehicle movement through Kasaragod roads during peak hours 7 a.m to 10 a.m – mention: school hrs / peak hrs; and during important period / festivals when people use the road to access temple<br>▪ Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents. | Contractor, ULB | SPMU/DPMU/ULB |
| 2 | Impact due to the use of heavy vehicle and equipment<br><br>*(Air and Noise environment)* | ▪ Mixing equipment (in case of construction of ancillary facilities) should be well sealed and be equipped with a dust-removal device.<br>▪ Equipment Operators & laborers should wear dust masks, ear protection, and hard hats.<br>▪ Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load.<br>▪ Labor to be provided masks / PPEs. | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | • Construction / Biomining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spreading into neighboring sensitive land uses<br>• Noise standards at operation machines are to be strictly monitored to prevent exceeding of GOI noise standards.<br>  ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines.<br>  ▪ Using modern, well-maintained and regularly serviced vehicles.<br>  ▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>  ▪ Provision of earmuffs and ear protection to workers and employees in high noise areas.<br>• Workers in the vicinity of strong noise to wear protectors and their working time should be limited as a safety measure.<br>• As Thalipadappu dumpsite has sensitive receptors and settlement areas within 150m of it, noisy works shall be stopped from 22:00 to 06:00.<br>• Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum.<br>• Avoid noisy activities/machines near south west side of the site where settlement exist within 50m. Noise barrier shall be provided at all noise-sensitive locations / for noise generating equipment such as DG sets, mixers (for ancillary facilities) especially near south west side of the dumpsite<br>• Adopt required measures as per CPCB guidelines, and site & work specific safety requirements | | |
| 3 | Impact during the construction activities<br>*(water environment)* | • Labour camps if any (depending on Contractors work plan & arrangements) are to be located away from water bodies.<br>• Vehicle washing or maintenance near water bodies are to be avoided.<br>• Contaminated water from construction / biomining activities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated on site. | Contractor | SPMU/DPMU/ULB |
| 4 | Leachate and Runoff from biomining | • Provide site cut off drain around the site to divert off storm water from entering the site, and to prevent contaminating downstream resources with runoff from the | Contractor | SPMU/DPMU/UL |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | activities<br><br>*(Soil contamination and groundwater contamination)* | dumpsite<br>• Depending on the contractors plan for biomining of the capped area on site, implement leachate management to cause no harm to communities & environment<br>• Ensure storm water drains will lead to drain outlets (along the north east boundary of the site) on roads adjoining the dump yard<br>• Provide leachate drains – lined – from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area preferably to the north east of the site<br>• Provide proper treatment of leachate and storm water that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by biomining activities like excavation and waste segregation and stabilization<br>• The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB.<br>• The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata<br>• Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff and hence reduce infiltration<br>• Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism<br>• Plan the works on-site only during non-rainy seasons and to complete the works before rains<br>• Store leachate preferably in aboveground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide | | B |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | for emergency containment additionally | | |
| 5 | Soil decontamination from accumulated waste levels<br><br>*(Impact on leachate, odor)* | • Decontaminate the soil / stabilized layers remaining after sieving out wastes using windrow and bioculture of appropriate quality in line with standards / regulations or appropriate means as per CPCB Guidelines<br>• Vegetative layer using contaminant absorptive root varieties like Vetiver may be tried on soil and along the edge of the green belt or floating wetlands may be deployed in water channels nearby to maximize absorption of leachate in the soil by root-zone phytoremediation<br>• Soil and water testing shall be done and changes in contamination shall be noted. | Contractor | SPMU/DPMU/ULB |
| 6 | Excavation of waste from the waste mound<br><br>*(Health and safety impacts)* | ▪ The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound.<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided.<br>▪ Machinery operated for excavation should be operated by skilled operators at all times.<br>▪ Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on wastes.<br>▪ Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound<br>▪ In case of the waste mound and site edges are sliding or unsafe, provide engineered retention walls or string boundaries.<br>▪ When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection & treatment mechanism. | Contractor | SPMU/DPMU/ULB |
| 7 | Transportation of wastes or retrieved or other material in overloaded and open | ▪ All vehicles shall carry only approved load of weight<br>▪ Regular cleaning of roads & drains and removal of spills if any.<br>▪ All waste transport vehicles shall be covered and movement shall be during non-peak hours.<br>▪ Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | vehicles<br><br>*(Air, Odor nuisances; spills and littering impacts on Air, Water, Land)* | Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities.<br>▪ Adopt required measures as per CPCB guidelines, and site specific safety requirements. | | |
| 8 | Spreading and compaction of waste<br><br>*(Safety)* | ▪ Follow technical details in line with CPCB Guidelines<br>▪ The active working face should be minimized as much as practical an appropriate size is about 2 to 3 times the width of the compactor vehicle.<br>▪ Waste should be spread and compacted in layers not greater than 0.6m (2ft.) after compaction.<br>▪ Compaction of the waste should be on a slope of about 20-30% as guided via the permissible levels and worked from the bottom of the slope to the top | Contractor | SPMU/DPMU/ULB |
| 9 | Occupational health and safety impacts of the workers during the biomining & construction of support facilities:<br><br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage of chemicals/other materials, biocultures or wastes etc; by moving vehicles.<br>• Cut & Bruises | ▪ Avoid direct & double handling of wastes through avoidance measures (suitable planning & equipments), engineering controls & use PPEs<br>▪ Work area & Labour camps shall be provided with First Aid and other related activities.<br>▪ Emergency Preparedness plans shall be prepared and implemented for all manpower working centers and its field extension centers.<br>▪ An Environment Health & Safety policy shall be prepared and implemented<br>▪ Adequate manpower shall be provided & manager & staff shall listen and act upon the manpower related grievances.<br>▪ Workers will be provided with PPE such as face mask, gloves, shoes, nose masks & goggles<br>▪ Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed without slip, trip, fall especially on waste, leachate or trenches<br>▪ Proper training will be provided regarding the maintenance of health<br>▪ Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks & water supply), food, and water in a hygienic environment (with proper handwash). Provide clean eating areas | Contractor, ULB | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | where workers are not exposed to contaminated, hazardous or noxious substances.<br>▪ First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus<br>▪ Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health checkups. Arrange daily health checkup for workers working on waste heaps<br>▪ Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals.<br>▪ Measures such as deferred timings and stretch break to be adopted<br>▪ Secure all installations from unauthorized intrusion and accident risks;<br>▪ Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every days start of works / activities. Key hazards would be (but not limited to) are flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and leachate from existing capped area on site, electric shocks, works with heavy machines & equipments, slips of men & material (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc.<br>▪ EHS specialist with adequate experience & third party supervision are important for biomining activity<br>▪ Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites<br>▪ Provide visitor orientation if visitors to the site need to gain access to areas where hazardous conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible<br>▪ Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; | | |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | ▪ Ensure moving equipment is outfitted with audible back -up alarms & flag men with whistles or speakers;<br>▪ Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit.<br>▪ Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenance to be marked well & safe kept before activity start near those. In close proximity to this location, there is a transformer. to be marked well & safe kept before activity start near those<br>▪ Disallow worker exposure to noise level greater than 85 dBA for more than 8 hours a day without hearing protection<br>▪ All workers shall be registered as per prevalent labor laws (including a workforce of subcontractors) and provided insurance cover & others as per existing acts/laws<br>▪ Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractor's person/insurance agent<br>▪ While using heavy machinery like JCB, cranes, etc, inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle.<br>▪ While using heavy machinery like JCB, cranes, etc, inform communities to prevent children and others from going near operating / movement areas including roads.<br>▪ Flagmen shall be arranged if work is near schools, hospitals, major roads, and traffic control is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if possible<br>▪ A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs;<br>▪ No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor | | |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • All works related to working at heights will be undertaken only during the daytime when sufficient sunlight is available;<br>• Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done;<br>• All excavation activities to be conducted in supervision of the site contractor;<br>• Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured.<br>• All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans prepared and implemented, as per Banks Incident Reporting Tool | | |
| 10 | Risk of fire due to conditions leading to spontaneous combustion<br><br>*(Air environment, disturbance to communities and workers, health impacts, safety issues)* | • Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for implementation of SWM Rules 2016 – regdg Fire Incidents at MSW Dumpsites (https://cpcb.nic.in/openpdffile.php?id=UHVblGl0YXBpb25GaWxlLzQyNDRfMTY1NDE2Mzk3N19tZWRpYXBob3RvNzYxMGwZGY=. ), LSGD Kerala Government GO on Fire Safety of MRF, MCFs (for the MRF on site if used for storage of wastes)and other Regulations, guidelines applicable<br>• Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3; and National/State regulations & WB EHS<br>• Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes<br>• Avoid conditions that can lead to spontaneous combustion such as:<br>○ Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard<br>○ Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.<br>• Design the facility for access by firefighting equipment, including clear aisles among waste heaps or work areas and access to adequate water supply. | Contractor, ULB | SPMU/DPMU |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • Ensure workers are briefed of fire hazard & its management<br>• No unauthorized entry shall be permitted to the site; including of workers during holidays, night time, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating "trespassers not allowed"<br>• The following activities should be implemented to prevent fires from occurring at the facility<br>○ adequate fire-fighting equipment should be made available on-site and stored in an accessible manner,<br>○ all operating staff should be trained and able to manage fire outbreaks at any part of the facility.<br>○ clear signage should be established to inform workers and the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area.<br>○ Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows.<br>○ all fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the biomining, storage, and processing areas.<br>○ all flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating stormwater.<br>• The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the biomining activity in line with National State regulations, guidelines and international good practices<br>• Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.<br>• Contain all local smokes/small fires inside the dump asap. Fire brigade help shall e | | |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | sought on all smokes/fires outside the dump asap<br>• Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured.<br>• Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers | | |
| 11 | Construction of new facilities in retrieved land | • The excavated site shall be protected from any dumping during or after the biomining activity and shall be reserved for SWM activities in line with SWM Rules 2016<br>• Any new facility under KSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations | ULB | SPMU/DPMU |
| 12 | Pest / Vermin Control & Visual impacts<br><br>(Odor , flies, rodent / other pest menaces) | • Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center<br>• Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups<br>• Biopesticides / biological control shall be followed. However, biopesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials<br>• Banned pesticides/insecticides shall not be used.<br>• Workers shall be made aware of storage and use of pest control measures and PPEs to be used<br>• Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate management | Contractor, ULB | DPMU, SPMU |
| 13 | Odor nuisance | • Waste with a strong odor to be covered immediately they are emptied from vehicles.<br>• Control and manage leachate treatment to minimize odor.<br>• Provide buffers screens to curtail odor from reaching surrounding communities especially to -South west side of site.<br>• Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor. | Contractor, ULB | DPMU, SPMU |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 14 | Storage, Collection, Transport, Treatment & Disposal of wastes and rejects | ▪ Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste<br>▪ Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, water bodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters<br>▪ Waste handling shall be in line with existing regulations & guidelines & avoid health & safety impacts<br>▪ No material is allowed to remain on site after the contract period<br>▪ Adequate fire safety arrangements & awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported<br>▪ Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/inerts in designated or agreed area & are in line with schedule; using GPS | Contractor, ULB | DPMU, SPMU |
| 15 | Other activities | ▪ No activity other than biomining shall take place on site & any activity shall cause no adverse impacts on the environment or people. | | |
| 16 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & biomining / construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees<br>▪ Waste water and Leachate to be treated & recycled/reused | Contractor | ULB |
| C | **Future Site Usage (EMP shall be updated in line with EMF & used if future site usage is proposed under KSWMP). This section is not the responsibility of the Contractor for Biomining, but of the future facility operator & ULB** | | | |
| 1 | Future use of the biomined site: Green Park, MCF, MRF, RRF, Treatment plants, landfill cell or any other, preferably for SWM | ▪ ULB to ensure that the site will not be used for future dumping. .<br>▪ ULB shall plan the future use of the site shall be in consultation with the communities.<br>▪ Phase 1 Environmental Assessment to be carried out, EA for existing facilities & EIA for proposed development in line with EMF in case this is proposed to be developed under KSWMP<br>▪ All applicable clearances, permits shall be arranged in line with applicable regulations for the proposed new use of the site, and appropriate designs/plans to | Future Facility Developer/ Operator & ULB | ULB (SPMU in case it is under KSWMP) |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | be prepared & implemented | | |
| 2 | Vehicle movement for new activities: MCF/MRF, RRFs, Treatment plants, landfill cell<br><br>*(Air, water environment, a nuisance to biodiversity, communities, Health impacts)* | • The movement route shall be scheduled for each vehicle.<br>• Enforce speed limits applicable and make drivers aware of this<br>• Vehicles movement shall be tracked by Health Supervisors to ensure keeping up to schedule; preferably using GPS<br>• Any adulterated fuel shall be avoided. There shall be periodic emission tests for vehicles<br>• Provision of Personal Protective Equipment such as face mask, gloves, nose masks & goggles to all workers in C&T vehicles, Maintenance yards<br>• Proper lubrication shall be provided to minimize squeaking noise due to friction<br>• Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br>• The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public<br>• Traffic will be managed at the site by providing adequate space for parking of vehicles<br>• Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design<br>• No waste or material shall be disposed in any place other than the designated area; including water bodies, coasts/forests, or sensitive areas. | Future Facility operator | ULB |
| 3 | Exhaust emissions<br><br>*(Air impacts)* | • No idling of vehicles on site.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed | Future Facility operator | ULB |
| 4 | Plying of vehicles through kutcha / unsurfaced roads and idling<br><br>*(Air pollution: SPM, CO, CO2)* | • Vehicle movement shall be well planned – through topped roads. In case of necessity to move through Kutcha roads, ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Future Facility operator | ULB |
| 5 | Odor | • Daily soil covers to compacted wastes to manage odors. | Future Facility | ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | *(Nuisance, Air)* | • Waste with a strong odor to be covered immediately they are emptied from delivery vehicles;<br>• Control and manage leachate treatment plant to minimize odor.<br>• Adhere to air quality regulations with quarterly air quality monitoring Maintenance of the buffer zone and protective berms<br>• Provide buffers screens to curtail odor from reaching surrounding communities | operator | |
| 6 | Impact on the ambient noise quality during the operations<br><br>*(Noise, nuisance to sensitive receptors, health impacts)* | • Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines;<br>• Using modern, well-maintained and regularly serviced vehicles;<br>• Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels<br>• Provision of earmuffs and ear protection to workers and employees in high noise areas | Future Facility operator | ULB |
| 7 | Occupational health and safety impacts of the workers:<br><br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health* | • All OHS and CHS measures to be followed in line with applicable regulations, guidance<br>• Workers & communities shall be made aware of OHS, CHS risks and impacts & mitigation measures adopted<br>• Emergency management plan to be prepared & followed<br>• Workers shall be appropriately trained on OHS during construction & Operation of all future facilities | Future Facility operator | ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | impacts) | | | |
| 8 | Pest / Vermin Control<br>(Odor , flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted<br>▪ Biopesticides / biological control shall be followed.<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used | Future Facility operator | ULB |
| 9 | Fire Safety | ▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented in line with National State regulations, guidelines and international good practices | Future Facility Operator | ULB |
| 10 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees<br>▪ Waste water to be treated & recycled/reused | Future Facility Operator | ULB |

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### 6.3 Emergency & Disaster Management Plan

**Hazards Associated with Dumpsite Activities**

The Disaster Management Act, 2005 mandates every Government Department to prepare, review and update Disaster Management Plan

#### 6.3.1 Identified Emergency Situations

*Table 17 Hazards associated with Dumpsite Biomining & Bio remediation*

| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| **As per World Bank EHS Guidelines** | |
| **Waste Storage** | **Regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases** |
| **Waste Segregation** | **Regular audits of segregation of Bio mined wastes.** |
| **Monitoring records for hazardous waste collected,stored, or shipped should include** | **1. Material Identification:**<br>- Name and identification number of the hazardous material(s) present in the waste.<br><br>**2. Physical State:**<br>- Indicates whether the waste is in a solid, liquid, gaseous form, or a combination of these.<br><br>**3. Quantity:**<br>- Specify the amount of hazardous waste, and biomedical waste retrieved from site typically measured in kilograms or liters, or by the number of containers. All such waste shall be staked in appropriate places/containers for disposal; duly marked & records kept<br><br>**4. Waste Shipment Tracking:** |


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| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| | - Documentation tracking details include:<br>- Quantity and type of hazardous waste.<br>- Dates of dispatch, transportation, and receipt.<br>- Records of the originator, receiver, and transporter involved in the waste shipment.<br><br>**5. Handling and Treatment:**<br>- Describes the method and date of various actions taken with the retrieved waste, such as storing, repacking, treating, or disposing it.<br>- Cross-referenced with specific manifest document numbers relevant to the hazardous waste.<br><br>**6. Location within Facility:**<br>- Specifies the specific locations within the facility where – various types shall be stored or processed.<br>- Includes information about the quantity of waste at each location. |
| **Falls and Slips at the dumpsite**<br>**Slippery surfaces or uneven surfaces and poor access to work areas climbing on and off the facility, equipments/machinery or the waste segregation/other facilities set up.** | Tidy workplace by maintaining good housekeeping. Handholds wherever necessary and clear/ safe access to work areas with proper PPE to the persons working at the site. |
| **Fire Hazard**<br>**Fire risk may occur due to the following**<br>**Storage of flammable liquids / Gas like LPG, Diesel**<br>**Any combustible materials**<br>**Sparks**<br>**Open flames** | Combustible/flammable materials should be properly managed and stored/used. Fire extinguishers and Fire hydrant Network with reserve water (As per NFPA Code) should be made available. Emergency Plan in case of fire. |


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| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| **Absence of Fire hydrant network may increase the risks in case of major fire accident** | |
| **Absence of Personal Protective Equipment**<br>**Lack of adequate footwear, Helmets, hearing/ eye protection, gloves & goggles may lead to injuries and death.** | Proper footwear, Helmets, hearing/ eye protection, gloves & goggles should be given to the workers at the dumpsite. Proper training should be given to the workers on the use of PPE. |
| **Electrical Hazard**<br>**Electric wires if any damaged**<br>**Poorly insulated**<br>**During temporary repairs**<br>**Circuits overloaded may lead to major accident** | Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit. |
| **Ladders**<br>**Risk may occur due to the following**<br>**Not secured against dislodgement**<br>**Defective ladders**<br>**Not sufficient length**<br>**Incorrectly placed** | Ladder risk can be mitigated by the following<br>Secured against movement or footed<br>Ladders in good condition<br>Regular inspection<br>Ladder should be extended one (1 m) meter above platform to avoid injuries |
| **Excavations**<br>**Risk may occur due to the following**<br>**Trench collapse**<br>**Gas emission** | Risk can be mitigated by the following<br>Soil stability should be known before excavation<br>No water accumulation<br>V500 mask should be used at the in order to counter the gas emission.<br>Emergency Plan |
| **Defective or wrong Hand Tools**<br>Wrong/defective tool may end up with injuries to the workers using the tool | Right tool for the job should be used properly and it should be in good condition |


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| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| **Accidents due to vehicular movement**<br><br>**Vehicle movement inside the site** | Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents |
| **Noise Hazard**<br>**Noise levels over 85 decibels would cause trouble to the people working at the site** | Noise Levels should be maintained below 85 decibels and with proper protection |
| **Falling Material**<br>**Fall during carrying/Lifting of waste and materials from overhead work areas.** | Risk can be mitigated by preventing the falls by barriers, training, strengthening the materials used for works and the following<br>Use of hard hats.<br>Person operating the Jcb/machine must be provided with walkie talkie/hand signals to know about the clearance |
| **Visitors Presence at site**<br>**Insufficient fencing may lead to attract pedestrians to enter the site.** | Fencing and barricades with proper signage boards indicating trespassers not allowed |

### 6.3.2. Proposed Organizational Structure for Disaster Management

The Organizational structure for the Disaster management contains the following team members.

**Emergency Response Team:**

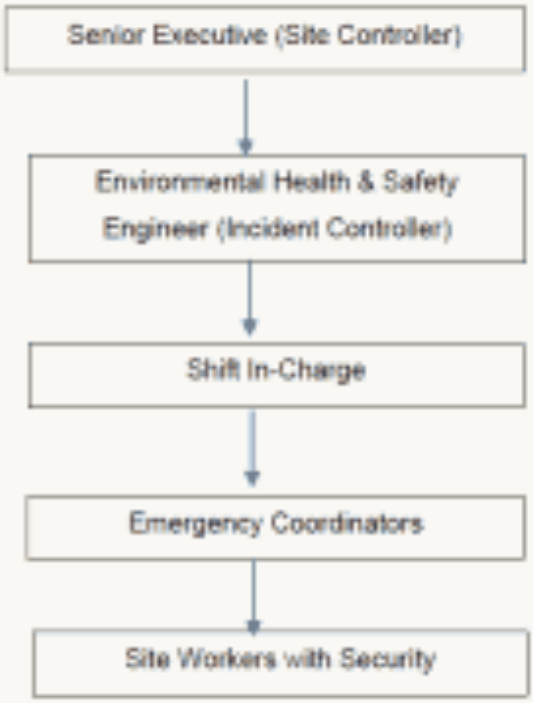
A response team needs to be set in assistance with a senior executive (Site controller), Manager Safety (Incident controller), Shift in charge, and Emergency Coordinators.

Incident controller would be reporting to the Site Controller. Incident Controller organizes a team responsible for controlling the incidents with the personnel under his control.

Shift In-charge would be the reporting officer, who would bring the incidence to the notice of the Incidence Controller and Site Controller.


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Emergency Coordinators would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential support services. For this purpose, security in-charge, personnel department, essential services personnel would be engaged. All these personnel would be designated as key personnel.




**Organizational structure for the Disaster Management Team**

### 6.3.3 Emergency Response Facilities

Emergency Control Center – with access for emergency shutdown procedures, duties and contact details of key personnel and government agencies, emergency equipment, etc.

- Assembly Point – with minimum facilities for safety and rescue
- Emergency Power Supply – connected with diesel generator, flame proof emergency lamps, etc.
- Fire Fighting Facilities – first aid fire-fighting equipment, fire alarms, etc.
- Location of Wind Stock – located at appropriate location to indicate the direction of wind for emergency escape
- Emergency Medical Facilities – Stretchers, gas masks, general first aid, emergency control room, breathing apparatus, other emergency medical equipment, ambulance


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the medical centre should display poster for treating burns and first aid. Some medicines and facilities to be kept in the medical centre are suggested.

**Health and Safety Measure for the workers**

All workmen employed in working conditions will be provided with adequate personal safety equipment as applicable to the work including (but not limited to):

- Safety shoes/boots
- Safety Helmets
- Hand gloves
- Ear muffs

**Monitoring Plan**

The considerations in an emergency planning include the following:

- Identification and assessment of hazards and risks
- Hazard consequences analysis
- Alarm and communication procedures
- Identification and equipping emergency control centre identify assembly, rescue points, medical facilities
- Emergency preparedness plan, procedure, steps to be taken before during and after emergency
- Formulation of plan and emergency sources
- Training rehearsal, evaluation and updating the plan
- Machinery should be examined regularly
- Medical examination for every employee shall be examined by doctors at least 3 months in a calendar. Health register should be maintained by the individual industry coming in the project site

**Emergency Action Plan for Fire**

In case of Fire the immediate plan of action will be "RACE" that stands:


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R - Rescue: When you discover a fire, rescue people in immediate danger if you can do so without endangering yourself.

A - Alarm: Sound the alarm by pulling a fire pull station and call fire station, from a safe distance, notify security of precise location of fire

C - Confine: if possible

E - Evacuate: Evacuate the place

Immediately informed the response team on site and local fire brigade Response team moves to the point of fire and take all necessary steps to stop the fire. Fire brigade to join at the earliest. If the fire is not controllable and spreads then the manager in charge should inform the district authorities and call for additional external help. Complete an Incident/Accident Report within 24 hours.

Firefighting system is proposed to prevent and control fire outbreaks .The firefighting system will consist of portable fire extinguishers, hose reel, wet riser, yard hydrant, automatic sprinkler system, and manual fire alarm system. In case of dumpsite biomining it is also important to shave fire lines in the biomining area & also in the storage area where material retrieved is stored.

**Emergency Action Plan for Electric Fire**

- Disconnect the affected areas electric supply
- If fire is small scale than $NAHCO_3$ or Sand will be effective.
- Attempt to extinguish fire with the help of $CO_2$ based extinguisher
- Seek support of Fire Brigade

Action Plan of on-site Emergency Plan

- The action plan considered is given as follows:
- To constitute Disaster Management Committee under senior officer not below the rank of General Manager
- To identify potential hazards areas in the layout map
- To predict degree of burns and distance of the risk zone by using model


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- To evacuate the area within risk zone
- To localize the emergency and if possible eliminate it
- To minimize the effects of accidents on people and property
- To take remedial measures in the quickest possible time to contain the incident and control it with minimum damage
- To mobilize the internal resource and utilize them in the most effective way
- To get help from the local community and government official to supplement internal manpower and resources
- To minimize the damage in other sections
- To keep the required emergency equipment in stock at right places and ensure that they are in working condition
- To keep the concerned personnel fully trained in the use of emergency equipment
- To give immediate warning to the surrounding localities in case of emergency situation arising
- To mobilize transport and medical treatment of the injured
- To educate the public in the surrounding village regarding hazards
- To arrange treatment of causalities
- To safe guard the people
- To identify the causalities and communicate to persons known to them
- To render necessary help to concerned
- To rehabilitate area affected

**Urban Floods:**

Floods are extreme events, usually triggered by extreme precipitation (river/inland floods) and/or storms (coastal floods). If these rainfalls exceed the retention capacity of the basins, drainage speed and volume, it causes floods.

**Different Types of Flooding:**

1) Localized flooding due to inadequate drainage;
2) Flooding due to overflows from River/Channels/drains, where the dumpsite is on or near flood plains or when flood plains are occupied by various settlements & other infrastructure without space for water to flow.

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**Stakeholders in Disaster Management:**

The policy also systematizes a frame work of operation for the following set of stakeholders that play key roles in disaster management.

- Kerala State Disaster Management Authority
- State and Central Government Departments and Disaster response forces
- District Disaster Management Authorities
- Local authorities including Municipal Corporations/Municipalities, District/Block/Grama Panchayats, Taluk/Village Officers etc.
- Voluntary and Civil Society Organizations
- Red Cross, multilateral aid agencies and U.N agencies
- Community – Village Disaster Management Committees / Task Forces
- Public sector Undertakings
- Private sector undertakings
- Army, Navy, Air Force, and Coast guard, Airport Authority, National Disaster Response Force etc.
- District disaster teams shall be informed of the proposed activity and its schedule

### 6.4 Proposed Environmental Monitoring Plan

Monitoring at a dumpsite site is carried out in four physical zones as follows:

i. On and within the dumpsite
ii. In the unsaturated subsurface zone beneath and around the dumpsite
iii. In the groundwater (saturated) zone beneath and around the dumpsite
iv. In the atmosphere/local air above and around the dumpsite

The Environmental Monitoring Program involves the following:

- Conducting survey and sampling program.
- Analysis of samples and data / information collected, and interpretation of data and information.
- Preparation of reports for submitting to management and statutory authorities.

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- Environmental monitoring is carried throughout the project operation to detect changes in the key environment quality parameters, which can be attributed to the project.

The results of the monitoring program used to evaluate the following.

- Extent and severity of the environmental impacts against the predicted impacts
- Performance of the environmental protection measures or compliance with pertinent rules and regulations.

### 6.4.1 Air Environment

The potential sources of air pollution from the dumpsite include vehicular movement emission of dust from biomining activities & wastes retrieved and stacked and passive leakage of landfill gas from the disposal site. Other important contributor is odor emissions from the existing legacy site disturbed. Monitoring of the air environment will be carried out during the operational phase in and around the project site.

### 6.4.2 Noise Environment

The operations shall induce noise due to operations of transport trucks, (men & material) JCB loaders and other types of machinery required at the dumpsite. For moving wastes, screening, stacking, turning etc. and the biomining activity per schedule. Monitoring of ambient noise levels and also the exposure of the workers to that environment is essential.

### 6.4.3 Water Environment

Water quality to be monitored during the operational phase. The monitoring frequency needs to be increased if higher concentrations are expected. Both groundwater regime and surface water domain is anticipated to be most-affected, through leachate contamination. Therefore surface & ground water will be periodically monitored for the parameters particularly increase in BOD, heavy metals and the hazardous chemicals

### 6.4.4 Land Environment

The soil in the dumpsite &neighboring areas will be analyzed for the relevant parameters.

The details of Environmental Monitoring Programs are given below:

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*Table 18 Environmental Monitoring Parameters*

| Environmental components | Locations | Frequency | Parameters |
|---|---|---|---|
| Ambient Air quality | Nearby habitations and downwind locations | Quarterly [1 sample] | $PM_{10}$, $PM_{2.5}$, $NO_X$, $CH_4$, CO, Ammonia |
| Noise | Outside the site – towards residential area. | Monthly | Noise levels |
| Ground and Surface water | Ground water from the nearest well, drain upstream & downstream of where leachate is disposed, and Thodu upstream were the drain joins. | Quarterly | IS 10500:2012 drinking water parameter if for ground water wells, Class D,E for drain & Thodu (if these are not used as drinking water source) |
| Accidental release | Chemical, oil and fuel spills | Daily | Near Chemical, oil storage areas incident reports |
| Health safety Hazards | Medical records, documentation of injuries and accidents, Health and safety assessments | As and when accident/injury occurs | Incident reports |
| Leachate | 1 point per leachate pond | Weekly during bio mining activity | • pH<br>• Biological Oxygen Demand- BOD<br>• Chemical Oxygen Demand-COD<br>• Nitrogen (Ammonia, Nitrate, Nitrite) |


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| | | | |
|---|---|---|---|
| | | | • Oxidation-Reduction Potential- ORP<br>• Electrical Conductivity-EC<br>• Total Organic Carbon (TOC) Dioxins |
| | | | • |
| | | | |

In case of any deviation from FR, this would be updated and mitigation monitoring measures would be revisited. Currently the location of disposal of biomined material, or type of transport of biomined material is unknown & hence, these impacts & mitigation, monitoring requirements will be updated & implemented by the Contractor. This aspect should be made a Bid condition.


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### 6.5 Environmental& Social Safeguard Budget

The details of Environmental Budget for Implementation and Supervision of Environmental Management Plan (EMP) are given below:

*Table 19 Detailed Cost Breakup*

| S. No. | Description | Frequency | Unit Price | Qty | Amount in Rs |
|---|---|---|---|---|---|
| | **Environmental Safeguards** | | | | |
| 1 | Deodorizer equipment (power sprayer) | Only Once | [redacted] | [redacted] | [redacted] |
| 2 | Green Net ( Approx., 300 m Length – Height – 3 m) and installation charges | Based on requirement | [redacted] | [redacted] | [redacted] |
| 3 | Spillage Kit | Only Once | [redacted] | [redacted] | [redacted] |
| 4 | Monitoring of Environmental parameters [Air, Ground water, Surface water, Noise, Soil and Leachate] Actual Noise abatement, odor management, dust management measures to be included in DPR cost | Quarterly, first six months by contractor and next two years by ULB | [redacted] | [redacted] | [redacted] |
| 5 | Gas monitoring to check the gas accumulation at the dumpsite | Gas monitoring should be conducted at least twice a day for about 7 consecutive days | [redacted] | [redacted] | [redacted] |
| 6 | Personal protective equipment | Entire Process | [redacted] | [redacted] | [redacted] |
| 7 | Training on capacity building | Entire Process | [redacted] | [redacted] | [redacted] |


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| S. No. | Description | Frequency | Unit Price | Qty | Amount in Rs |
|---|---|---|---|---|---|
| | **Environmental Safeguards** | | | | |
| 8 | Leachate Management (Full costs included in DPR. This is only for incidental mitigation of odur, leaks, spillage, flies etc. ) | Entire Process | [redacted] | [redacted] | [redacted] |
| 9 | Access Road Improvisation | Only Once | [redacted] | [redacted] | [redacted] |
| | **Social Safeguards** | | | | |
| 10 | Overall Budget for Social Safeguards | Entire Process | [redacted] | [redacted] | [redacted] |
| **TOTAL (actual costs for works involved for mitigation measures are to be included by the contractor in DPR costs based on his work method. This is only indicative cost for incidental mitigation & management measures. EIIS in Labour camp also not included here; but shall be included by the contractor based on his work plan as this is combined with multiple other dumpsite biomining works)** | | | | | [redacted] |


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## 7. INSTITUTIONAL ARRANGEMENTS

### 7.1 Proposed Institutional Arrangements

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of ToR for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation. The Support Organization will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments. Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level. The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances.

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The PIU will submit the compliance reports on clearances, permits, and environmental and social safeguards to D-ESDU

### 7.2 Capacity Building

- Sensitize and orient different stakeholders of the project with adequate communication of benchmark standards on various project components.
- Training for ULB officials, Councilors and Ward convener
- Training for Political and trade union leaders
- Training for workers of Municipal Sanitary workers

**Importance of Capacity Building**

Capacity building is defined as the "process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in the fast- changing world. It is the development of knowledge, skills and attitudes in individuals and groups of people relevant in the design, development and maintenance of institutional and operational infrastructures and processes that are locally meaningful. It is generally defined 'capacity building' as the creation of an enabling environment with appropriate policy and legal frameworks, institutional development, including community participation, human resources development and strengthening of managerial systems. It is a long-term, continuing process, in which all stakeholders participate. The main aim of capacity building under solid waste management is to build a basic understanding regarding the solid waste management project at each step of value chain (waste generation, segregation & storage at source, primary collection, secondary collection, transportation, processing and disposal) and importance of their work and develop a sense of belonging towards the work.

### 7.3 Grievance Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizen can lodge complaint either directly to ULBs, toll free number or through digital platforms (website/email –https://kswmp.org/grievances/grmkswmp@gmail.com/ Toll free number-18004250238). The complaint will automatically be recorded in login of ward level official of ULB and an escalation system is constituted according to the category of each complaint to close the complaint in time. The complainer can close the complaint through a feedback form according to their satisfaction.

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## 8. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

"Public Consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate.

Initially the public opposed the dumping of waste at Kasaragod dumpsite and the same has been inactive from year 2010. Now this proposal is to remediate the existing site in order to protect the environment and human health of the nearby area. The summary of the document will be made available in the website, which will also be featured in a newspaper advertisement in Malayalam language for public disclosure.

### 8.1 Public Consultation

In connection with the dumpsite remediation, a consultation meeting was conducted on 02.02.2023 at Kelugudde, the place where the dumpsite was located. Stakeholders from different groups including head load workers, employees of grocery shops and tea shops participated in the meeting followed by a transect walk. Local municipal ward councilor (Aswani. K), Clean City Manager, PIU Engineer, Kudumbashree CDS member, ADS Secretary, NHG member, local politicians and public along with KSWMP officials participated.

### 8.2 Outcome of the meeting

A transect walk was followed by the meeting with the participation of local residents. The local community, after the meeting and interactions, decided to extend wholehearted support for the dumpsite remediation activity, provided there should be an assurance from the wauthority that the land would not further be used for the same dumping purposes. The meeting also discussed various aspects of dumpsite remediation in detail including the possible social and environmental issues that may affect their routine life as well as the free movement during the time of operation

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### 8.3 Information, Education and Communication (IEC) Plan

| IEC Plan for Kasaragod dumpsite remediation | | | | |
|---|---|---|---|---|
| **Programme** | **Methodology** | **Topic** | **Responsibility** | **Monitoring** |
| **Sensitization/ Awareness programme** | Meeting with all concerned Stakeholder's with prior notification to discuss about the process and remediation methods | Process of dumpsite remediation Developing as a Recreational park | Contractor | TSC/DPMU/ DPMC |
| **Pamphlet** | Distribute to all households within the limits in connection with the dumpsite remediation programme. | Awareness through community participation Different locations in the neighboring area | Contractor | TSC/DPMU/ DPMC |
| **Informative standees in all** | Visible places near the dumpsite | Protocol to the public who reside nearby areas and also trespassers. | Contractor | TSC/DPMU/ DPMC |
| **Announcement vehicle** | All across places near the dumpsite | Health and hygiene protocols during the dumpsite remediation process | Contractor | TSC/DPMU/ DPMC |

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| IEC Plan for Kasaragod dumpsite remediation | | | | |
|---|---|---|---|---|
| **Programme** | **Methodology** | **Topic** | **Responsibility** | **Monitoring** |
| **Digital campaign (Social media)** | Areas near to the dump site. In and around the concerned ward area.<br>(in Malayalam and Kannada Languages) | Short video presentations tocommunicate through different digital platforms like WhatsApp pertaining to the existing scenario and proposal of Recreational Park with self-explanation | Contractor | TSC/DPMU/ DPMC |
| **Cautionary notification boards** | About vehicle movement and the transit of waste | precautionary measures should the general public take. | Contractor | TSC/DPMU/ DPMC |

**Conclusion**

The dumpsite remediation activity at Kasargod involves substantial social and health risks. However, a set of risk mitigation activities are proposed in the social management plan to overcome the identified risks and its negative impacts on the people residing near to the site. Formation and regular meeting of GRM & stakeholders committee, capacity building, awareness generation, regulated working hours, controlled operation at office working hours, counseling for the aggrieved parties, gender sensitization, legal awareness, providing safety are the major mitigation measures. This proposal is made to reduce the social risk associated with dumpsite remediation and to minimize the negative social impacts.

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ANNEXURES

## Annexure 1 – Environmental Screening

**Environmental Screening**

**Sub Project Details**

| Name of Subproject: | Dumpsite Remediation |
|---|---|
| Sub project Components: | Dumpsite Remediation |
| Subproject Location (City / Town/ Village with ward numbers): | Kasaragod ULB, Ward 4Thalipadupppu, Kasaragod District. |

**Stage 1: Exclusion List**

| Sl.No | Non-permissible Activities |
|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i) any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to siting criteria as per SWM Rules 2016 (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible) |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides |
| The project does not fall under the above conditions as mentioned under exclusion list | |

**Stage 2: Environmental Screening Checklist**

| Sl.No | Components | Details |
|---|---|---|
| 1 | Project Components | Dumpsite Remediation |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste | This proposed project involves biomining of existing dumpsite.<br>This remediation process |


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| | | |
|---|---|---|
| | management, centralized non-biodegradable waste management facilities, centralized biodegradable waste management facilities, sanitary landfills, biomining of dumpsites, including for Linked activities / associated facilities) | involves<br><br>**Pre-processing of legacy waste**<br><br>1. Clearing and grubbing of site<br><br>2. Windrow formation for stabilizing the excavated waste<br><br>3. Windrow turning, tilling and cone formation<br><br>**Machinery erection**<br><br>1. Site leveling for Plant erection on the site and commissioning of machineries.<br><br>2. Operation of plant for processing the waste.<br><br>3. Office set up and fire safety measures<br><br>The byproducts of the process are<br><br>1. Bio earth and coarse fraction soil – will be used within the site<br><br>2. RDF – will be send to nearby waste to energy plants like cement plant and power plant which further processing it will be used as fuel<br><br>3. Recyclables – will be send to the authorized recycling agency |


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| | | |
|---|---|---|
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project: including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination) Site Survey No:/s (attach map) with ownership details. Geographical co-ordinates of the site location (including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | Latitude: 12°30'59.0"N, Longitude 74°59'10.3"E<br><br>Land ownership: Kasaragod Municipality<br><br>Land use: Public<br><br>Disaster Zone: It falls under Zone III (Moderate) |
| 4 | Land Area proposed to be used: Location wise (in sq. km / sq. m) | It is remediation of land and hence no land required |
| 5 | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | Operational phase – 0.5 KL/day<br>Domestic use – 1.0 KL/day |
| 6 | Power Required and Source of Power | Demand load for the proposed equipment during the remediation process is available and additional power required will be made available by DG sets |

**Baseline Environmental Conditions**

| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| 1<br><br>(i) | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers)<br><br>Critically Vulnerable Coastal Areas (CVCAs), Eco sensitive Areas (ESAs) | | No | The project site is not located near any Critically Vulnerable Coastal Areas (CVCAs), Eco sensitive Areas (ESAs) |


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| | | | | |
|---|---|---|---|---|
| (ii) | Cultural Heritage site, protected monuments - listed by ASI/State | | No | The project site is not located near any cultural Heritage or protected monuments as listed by ASI/state |
| (iii) | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensitive area, with any schedule 1 species? If yes, which is the area? | | No | The project site is not located near Natural Forests / Protected Areas / Bio-Reserves |
| (iv) | Other Wetlands/ Mangrove/ Estuarine Region | | No | The project site is not located near any Wetlands/ Mangrove/ Estuarine Region |
| (v) | Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas: areas with natural features like waterfalls, sacred groves | | No | The project site is not located near any Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas: areas with natural features like waterfalls, sacred groves |
| (vi) | Other Sensitive Environmental Components listed in EMF | | No | No other sensitive environmental components listed in EMF exist nearby the project site |
| (vii) | Drinking water source, upstream and downstream users of rivers, etc | | No | No river source is resorted for drinking water use. Downstream the ground water source is available |
| (viii) | Low-lying areas/areas of Tidal Influence (provide CRZ details) | | No | The sea is located 1.86 km (Aerial Distance) from the project site. |


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| | | | | |
|---|---|---|---|---|
| | | | | There won't be any influence of tidal influence |
| (ix) | Sensitive Receptors – a) Habitations / Households / Hostels, other special areas, etc. b) School c) Religious Places d) Tourist Areas | Yes | | a. **Nearest Habitation**- 6Houses are located at an Aerial distance of 40 m<br>b. **Religious Place**- Ayyappa Bajana Mandhir Temple is located at an aerial distance of 210 m<br>c. **School** -Adkathbail GUP School is located at an aerial distance of 750m.<br>d. **Tourist Places** – Kanha Beach is located 3 km from the proposed project site. |
| 2 | Is the site in Critical / Over Exploited Ground Water Block. Provide the level of the groundwater table | | No | Semi critical |
| 3 | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other (specify) | | No | The site does not fall under major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion.<br>There may be chance of fire due to<br>1. Fire breaking due to high temperature<br>2. Electrical short circuit due to poor maintenance. |


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| | | | | |
|---|---|---|---|---|
| | | | | 3. Smoking in the premises near the waste storage.<br>4. Burning of the waste by unauthorized persons<br>5. Keeping highly flammable materials like, cooking gas, kerosene, match boxes, etc.<br>6. Not having provision for proper fire/smoke detecting system. |
| 4 | Describe the type of soil and vegetation on site | Yes | | Hard laterite soil with few trees present in the site |
| 5 | Is the site present in the flood plains as recorded in the last 100 years. Provide the HFL level of the site/region | | No | The sea is located 1.86km (Aerial Distance) from the project site.<br>The 2018 peak flood experienced minimal problems or issues. |
| 6 | Existing pollution/contamination or degradation on site | Yes | | Dumpsite located in Kasaragod ULB is the existing contamination and detailed under section 3.11 |
| 7 | Any other remark on baseline condition | Yes | | Based on the test result of environmental baseline for Kasaragod dumpsite certain parameters exceeds the permissible limits and test report are |


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| | | | | |
|---|---|---|---|---|
| | | | | given under section 3.11 |

**Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology, and Soils**

| S.No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Total extend of land to be covered/built | Yes | | 1.1 acres |
| 2 | Total extend of land where the waste will be dumped openly / or expected to get contaminated by waste or leachate/material storage | Yes | | Due to open dumped area |
| 3 | Extend of Land to be remediated | Yes | | 1.1 acres |
| 4 | Extend of land expected to be under green belt | Yes | | Will be under the scope of contractor |
| | proposed project cause the following on Land / Soil: | | | |
| (i) | Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains | | No | There will be no major impact other than the operational phase as this project is remediation project. During operational phase the anticipated impacts are identified and mitigation measures are provided |
| (ii) | Substantial removal of Top Soil (mention area in sqm) | | No | Nil |
| (iii) | Any degradation of land / eco-systems expected due to the project? | | No | There will be no Land degradation instead it will be a remediation of land from further contamination |
| (iv) | Loss or impacts on Cultural/heritage areas/properties | | No | There will be no loss or impacts on |


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| | | | | |
|---|---|---|---|---|
| | | | | Cultural/heritage areas /properties |
| (v) | Does the project activity involve cutting and filling/ blasting etc? | | No | The project does not involve cutting and filling/ blasting as the building is existing. |
| (vi) | Will the project cause physical changes in the project area (e.g., changes to the topography) due to excavation, earthwork, or any other activity? | | No | The project will have change in a positive way by clearing the waste dumped into vacant land |
| (vii) | Will the project involve any quarrying/ mining etc? | | No | The project does not involve any quarrying/ mining |
| (viii) | Will the project / any of its component contaminate or pollute the Land? | | No | Presently there is contamination and due to the project activity the further contamination shall be eliminated and natural system shall be restored |
| (ix) | Will the project contribute to any long term significant adverse (negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | No | There will be no negative impact due to the proposed project |
| (x) | Will the Project or related activities cause negative impacts on the land in combination with other anticipated / existing projects in the region? | | No | There will be no negative impact due to the proposed project |


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| Sl.No | Impacts on Air and Noise Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the project cause or increase air pollution due to dust and / or vehicle emissions? | Yes | | It will be minimal and adequate mitigation measures will be taken to reduce the impact. |
| 2 | Will the project cause or increase pollution due to GHG emissions? | | No | Nil |
| 3 | Will the project cause or increase odor nuisance? | Yes | | The Biomining project will be create odor nuisance but it is temporary and once the process is completed there will be no odor nuisance. |
| 4 | Is there a potential for release of toxic gases or accident risks (eg: potential fire outbreaks) | Yes | | There may be chance for any release of toxic gases or potential fire outbreaks which will be mitigated through proper mitigation plan by adopting gas collection system. |
| 5 | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | Yes | | The Biomining project will create increase in noise level but it is temporary and once the process is completed there will be no noise. |

| Sl.No | Impacts on Water Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the activities proposed at the site(s) impact water quality (surface | | No | The leachate generated will be properly |


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| | | | | |
|---|---|---|---|---|
| | or ground) – leachate, runoff, wastes deposition, erosion? | | | collected in leachate collection tank and thus avoiding the impact with the surface or ground water |
| 2 | Will the activities proposed at the site(s) impact water resource availability and use – leachate, runoff, wastes deposition, erosion? | | No | The leachate generated will be properly collected in leachate collection tank and thus avoiding the impact with the surface or ground water |
| 3 | Chances of Pollution of Water bodies / groundwater wells, nearby or downstream | | No | This remediation project will transform the existing polluted area into a healthier and improved environment. Hence there will not be any chance of pollution of water bodies / groundwater wells, nearby or downstream |
| 4 | Will the activities proposed at the site(s) hinder natural drainage | | No | As the existing dumpsite will hinder the natural drainage pattern. The proposed activity once completed will improve the natural pathway without any obstacles. |
| 5 | Will the activities proposed at the site(s) decrease permeability /rainwater percolation | | No | The activities proposed at the site will not decrease permeability /rainwater percolation |


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| Sl.No | Impacts on Bio diversity & Host Communities | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the project necessitates cutting of Trees /Loss of Vegetation | | No | There will be no cutting of Trees. But there will be Loss of Vegetation due to this project |
| 2 | Will the project necessitate substantial removal of Top Soil (mention area in sqm) | | No | There will be no Substantial removal of Top Soil. |
| 3 | Any degradation of land / eco-systems expected due to the project? | | No | There will be no degradation of land / eco-systems expected due to the project activity.<br>Also, the proposed activity will protect the land from further contamination |
| 4 | Will the project result in Health & Safety Risks in the neighborhood including the release of toxic gases, leachate, accident risks | Yes | | There may be chance of accidental risks due to leachate and toxic gases, which will mitigated by proper lined leachate drain and PPE kits |
| 5 | Potential Noise, Light Pollution/movements causing disturbance to nearby habitats/communities | | No | There will be no major impact.<br>During operational phase there will be noise pollution due to movement of vehicles which will be curtailed by adopting mitigation measures. |
| 6 | Potential disruption to common property, accessibility, traffic | | No | There will be no major impact. |


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| | | | |
|---|---|---|---|
| | disruptions, conflicts, or disruption to the local community within the subproject area? | | During operational phase there will be slight increase in traffic due to movement of vehicles which will be mitigated by adopting movement of vehicles during off peak hours. |

**Project Categorization and Need for Safeguards Instruments**

| Project category | ☐ E1 ☑ E2 ☐ E3 |
|---|---|
| Key Reasons | During screening, it has found that the proposed subproject is moderately causing impact to the base line environment, land/ soil / water /noise environment, biodiversity or to the community. Site is not close to any Environmental Sensitive Receptor. Moreover, Project results positive impacts on Environment. The Environmental Baseline analysis reveals that dumpsite not having any Heavy metal contamination. Hence it is categorized as E2. |
| Safeguards Instruments Required | a) E1: Project-specific EIA (impact assessment considering the project details & location) by Independent Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>b) E2: Project-specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>c) E3: signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities |


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| Status | Agency / Official | Name, Signature with Date and Seal |
|---|---|---|
| Prepared by | PIU or ULB (project in charge) | |
| | Environmental Engineer | |
| Checked, categorized as __ (E1, E2, E3) & ToR issued by: | DESDU / SESDU | |
| | Environmental Specialist | |


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**Annexure 2 – Fire and Risk Assessment**

A fire and risk assessment is a systematic evaluation of potential fire hazards and associated risks within a particular environment or premises. The assessment aims to identify potential fire hazards, assess the level of risk they pose, and recommend measures to mitigate or manage those risks effectively. Fire and risk assessments are essential for ensuring the safety of the workers, protecting property, and complying with fire safety regulations.

The existing legacy waste dumpsite, occupying about 1.1 acres in ward 4Thalipaduppu, aims to fully reclaim the land for future development. Bio-mining, a technique chosen after careful evaluation will be used to recover the land and ensure sustainable and environmentally friendly treatment of the waste. The process will yield various by-products, which require immediate attention to prevent fire hazards.

The by-products as follows:

1. The bio earth (10057.50 cu.m)& C&D (4224.15 cu.m)waste.
2. Retrieved plastics, rags, paper& other combustibles that cannot be recycled,but may be used as Refused derived fuel (RDF) of 5239.96 cu.m.
3. Recyclables of 593.39 cu.m will be sold to authorized recyclers

The retrieved plastics, rags etc that cannot be recycled and the recyclables if stored on site, poses a potential fire risk and requires proper handling. To mitigate the risk, a storage and disposal process spanning 3 to 4 months shall be devised by the contractor in line with his work plan During this period, the contractor shall implement various protective measures to prevent the possibility of a fire outbreak.These following measures are important for preventing fires, ensuring the safety of workers and nearby communities, and minimizing risks to the environment and property.

**Pre-Construction/Planning Stage:**

1. Fire Safety and Emergency Plan: Develop a comprehensive fire safety plan and emergency response plan to address potential fire incidents.
2. Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard.
3. Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.
4. Fire Equipment: Ensure that the site is equipped with fire extinguishers.

**Storage of Waste & RDF:**

**Fire Standards and Facilities:** Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.

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Below equipment and their required quantities should be strategically positioned according to the site's specifications.

- Fire extinguisher (A, B, C powder): It will be used to immediately put off fire caused by wood, Paper and textiles, flammable liquids and flammable gases. Commonly can be placed anywhere inside the site
- Fire extinguisher (Foam spray): Mainly used to put off the fire caused by flammable liquids. It should be placed in diesel storage area, lubricant storage area and DG sets.
- Fire extinguisher ($Co_2$): Mainly used to put off the fire caused by Electrical short circuit. It should be placed near the control panel room/operation room.
- Fire bucket filled with sand: It should be placed near the diesel storage area

To ensure rapid response in case of a fire, it's essential to have a water tanker filled with water, equipped with a fire-fighting hose, readily accessible along with the portable motor. The presence of this equipped water tanker ensures timely and effective action during fire emergencies. All requirements in line with National/State regulations and as advised the local Brigade Shall be arranged & followed.

The following points to be considered for assessing the fire risk and procedure to mitigate it.

1. **Identification of Fire Hazards:** The first step involves identifying potential fire hazards in the premises. These hazards could include sources of ignition (e.g., electrical equipment), combustible materials (e.g., flammable liquids, paper, cardboard), and other factors that could contribute to the outbreak of a fire.
2. **Assessment of Risk:** Once the hazards are identified, the next step is to assess the level of risk associated with each hazard. This involves evaluating the likelihood of a fire occurring and the potential consequences if a fire were to break out.
3. **Escape Routes**: Since operational phase occurs in an open environment, the need for conventional escape routes in the event of a fire emergency may not be required.
4. **Fire Safety Measures:** The assessment reviews existing fire safety measures in place, such as fire alarms, fire fighting equipment, and fire suppression systems. Proper assembly point is required in case of fire break out
5. **Emergency Procedures:** The assessment evaluates the effectiveness of emergency procedures and evacuation plans in the event of a fire, ensuring that workers can safely evacuate the premises.
6. **Fire Training and Awareness:** The assessment considers the level of fire safety training provided to workers and the awareness of fire hazards and evacuation procedures.
7. **Record-Keeping:** Detailed records of the assessment process, findings, and recommended actions are maintained for future reference and regulatory compliance.

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8. **Recommendations:** Based on the assessment, the fire risk assessor provides recommendations for improving fire safety, which may include installing additional fire safety equipment, conducting training programmes, or implementing any changes to reduce fire risks.
9. **Review and Updates:** Fire and risk assessments should be regularly reviewed and updated to account for any changes in the premises or regulations.

Fire and risk assessments play a crucial role in preventing fires and minimizing their impact if they occur. They are particularly important for dumpsites and other places with a higher risk of fire hazards to ensure the safety and well-being of workers.

NOTE : The major assessments had been referred based on the EMF Vol-II Part A – Indicative EMP in the Impact assessment.

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## Annexure 3 – Dumpsite screening checklist

Checklist for screening of dumpsites for potential landfill/ processing facility

| Name of the contact person from ULB-Phone number and email Address | Kasaragod |
|---|---|

| S.No. | Item | Norm | Information |
|---|---|---|---|
| 1 | Land ownership (including that required for approach road) (in line with revenue records) (supporting data to be provided as annex) | | Kasaragod, Municipality |
| 2 | Name of the location of site and Map of the site (include as an annex) | | Thalipaduppu, Kasaragod |
| 3 | GPS coordinates of site | | Latitude: 12°30'59.0"N, Longitude 74°59'10.3"E |
| 4 | Is there a Pollution Control Board permit for dumping/SWM activity? | | Yes |
| 5 | Is there a notified no development zone or buffer or green belt around the dump? | | No |
| 6 | Possible area to be kept as buffer green belt around (within / outside the site for purchase) | | Not available |
| | Site Selection Criteria - give distances, wherever applicable | | |
| 7 | Groundwater (m below liner bottom) | 2m | Pre-monsoon-13.22m Postmonsoon-11.02m |
| 8 | Private water sources (well etc.)-distance from site boundary (to be | 100 m (river) | Chandragiri puzha (south)river is |


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| | | | |
|---|---|---|---|
| | adjudged based on approx. distances during screening exercise) | | located at a radial distance of 2 km from the site |
| | | 200 m (Pond) | Pond is located at an aerial distance of 1.00 km from the site |
| | | 30 m (Local Canal) | 300m from the dumpsite. (Shankarankuzhi Thodu) |
| 9 | Env. Sensitive Areas/ Wetlands | Not Permitted | No |
| 10 | Site having Rare and Endangered Species | Not Permitted | No |
| 11 | Site should not be within Protected/ Reserve Forests | Not Permitted | Site is Not within the Protected/ Reserve Forests |
| 12 | Residential Development within prescribed buffer zone of 200 m | Not Permitted | Yes. Local Residents nearby Dumpsite within 200 m |
| 13 | Perennial Stream within site | Not Permitted | No |
| 14 | Airport | 20 Km | No |

| S.No | Item | Norm | Information |
|---|---|---|---|
| 15 | Distance to the nearest village in the predominant wind (m)direction | | 50m |
| 16 | Flood prone site | | No |
| 17 | Accessibility - Road access for heavy vehicles | | 5 m wide Approach road. Partly Concrete and partly bituminized. |
| | i. Starting point of the access road | | Adkathbail |


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| | | | |
|---|---|---|---|
| | ii. length and width of the access road | | 5 m wide |
| | iii. Current condition of the access road (visual assessment) | | Tarring Road with good condition. |

| S.No. | Site Description | | |
|---|---|---|---|
| 18 | Is the site flat/stopping to nearby uses | | Flat |
| 19 | Soil base-soft soil/murrum,soft rock etc | | Hard Laterite soil |
| 20 | Direction of Leachate flow out of the site, if any | | No. The biodegradable waste dumping stopped since 2010 |
| 21 | Other uses within the dumpsite(recycling yard, compost pad etc) | | Nil |
| 22 | Boundary conditions-walls/fence/what land uses along boundary | | Compound wall |
| 23 | Year since the dump site is existing | | 1970 |
| 24 | Is the dumping Operation Ongoing | | Stopped the Biodegradable waste since 2010 |
| 25 | Any underground utilty/gas line etc near the site | | No |
| 26 | Existing power supply, water supply, electric poles going through/over/in the site etc. | | Yes. Nearby Transformer |
| 27 | Are there pools of leachate ,rat and fly infestations, domestic animals roaming freely, odor s,dust, vermin and birds,waste being burnt at | | No |


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| | | | |
|---|---|---|---|
| | dumpsites or families of scavangers picking through the wastes | | |

| Geography and Climatic aspects | | | |
|---|---|---|---|
| 28 | Average annual rain fall | | 3825 mm |
| 29 | Duration of rainfall | | May to August |
| 30 | Whether any incidents of flooding reported at site/other hazards | | |
| | No | | |
| | Very Rare | | Very Rare |
| | Some times | | |
| | Frequent | | |
| 31 | Any geological fault | | No |
| Waste characteristics | | | |
| 32 | Characteristics of the dumps, such as the height and area, characteristics of solid waste based on visual inspection and degree of compaction (subjective), and any details of variability of wastes within the site. | | Since the biodegradable waste dumping stopped from 2010 due to public protest because of the leachate issues. |
| 33 | Type of waste (MSW/HW) (subjective assessment based on visual inspection) | | MSW |
| | i. 100% MSW | | |
| | ii. 75% MSW +25% (domestic and/ or biomedical/ HW/EW) | | Yes |
| | iii. 50% MSW +50% (domestic and/ or biomedical /HW/EW) | | |
| | iv. > 50% (domestic and/ orbiomedical /HW/EW) | | |


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| | | | |
|---|---|---|---|
| 34 | Expected waste contamination (visual check of ground water, littering, dust pollution, Smell/odor , Is the ground water being used for drinking purpose) | | Ground water not used for drinking. |
| 35 | How much quantum of fresh waste is dumped every day? | | Stopped the dumping of waste. |
| | General Information | | |
| 36 | Any reported Environmental and health impacts of existing dump (from ULB eg-media report or complaint) | | NO |
| 37 | Any ongoing litigation or disputes related to site usage | | NO |
| 38 | Potential for mining decomposed organic materials (compost from the existing dumps (By visual inspection) | | NO |
| 39 | Presence of rag pickers and approx. How many? Male/Female and age group | | Not available as on visit time. But as per SWM data file 26 rag pickers |
| 40 | Number of sensitive receptors close to dumpsite (approx.200 m which is buffer zone criteria) (mention distance to closest residence, social profile of the people, school, religious structure, wetland, forest, river, canal, Eco sensitive area, well, lake/pond) | | Nearby Small canal within 1 kmAdkathbail GUP School. |
| 41 | Available open / clean space in the dump yard which can used to develop a treatment facility till such time the dump is cleaned, and land is recovered (percentage of land available for use) | | Yes |


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| | | | |
|---|---|---|---|
| 42 | Space / covered shed (which may be renovated to house segregation & storage facility) | | Nu |
| 43 | Estimated time for dumpsite capping/ mining/ remediation. Does it fall within the project lifetime? | | 90 days |
| 44 | Possible Range of solutions: rehabilitate existing open dumps through landfill mining where the resource recovery might serve as a source of energy, recycle and reuse of metals, plastic and glass ware, use of compost as fertilizer for agriculture and as a cover material for future landfills, etc. | | RDF materials can be processed and used for cement kilns. |
| 45 | Is dumpsite remediation likely to benefit in regaining a suitable site for an engineered landfill cell or for setting up any other waste management facility? If yes, what could be set up? | | According to feedback from nearby residents, there is a demand for the establishment of a Recreational Park. |
| 46 | Likely area of the site which can be salvaged for future use More than 70%, 50-70%, 30-50%, Less than 30% | | 50 % , |

| Upstream Linkages required | | | |
|---|---|---|---|
| 47 | Stop the waste coming to the site or delineate a separate area for proper processing of waste. | | Dumping of waste stopped |


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| | | | |
|---|---|---|---|
| 43 | Intention of anchor ULB (where the site is located) to allow the facility to be used as a regional facility, with other ULBs falling in the cluster, on a cost sharing basis. | | After thorough stakeholder consultation, the recommendation is to process the waste at a standalone site. |
| **Downstream Linkages required** | | | |
| 44 | Off-take of all the products coming out of the biomining - Plastic & RDF - cement factories, soil/bio-earth - farmers or gardens, inert - SLF/closure | | Forward linkage for the RDF yet to be finalized |
| 50 | Any wastewater treatment facility whether available within 10 km where leachate can be transported for treatment. | | No |


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## Annexure 4 - Occupational Health and Safety

Occupational Health and Safety Risk Assessment for Dumpsite Remediation is as follows

**1. Introduction:**

The purpose of this Occupational Health and Safety (OHS) Risk Assessment is to identify, assess, and mitigate potential hazards and risks associated with the implementation of a Biomining project for dumpsite remediation. Biomining is a sustainable and environmentally friendly method used for the disposal of dumped waste and reclamation of land.

**2. Scope:**

This risk assessment focuses on the occupational health and safety aspects of the Biomining process for dumpsite remediation. It covers the potential hazards and risks that workers may encounter during site preparation, Biomining operations, and waste disposal activities. The assessment will also outline control measures to minimize or eliminate these risks.

**3. Hazard Identification:**

Biomining process identifies potential hazards, which include but are not limited to:

a. Chemical Hazards: Exposure to hazardous chemicals present in the dumpsite waste and chemicals used in the Biomining process.

b. Biological Hazards: Potential health risks associated with the presence of pathogens, disease-causing microorganisms, and vectors within the waste. These hazards can arise from the decomposition of organic matter, the presence of infectious materials, and the attraction of disease-carrying organisms such as rodents, insects, and other vermin.

c. Physical Hazards: Potential for slips, trips, and falls on uneven terrain or during equipment operation.

d. Mechanical Hazards: Risks associated with operating and maintaining heavy machinery.

e. Ergonomic Hazards: Strain and injuries related to improper handling of equipment or materials.

f. Environmental Hazards: Adverse effects on air and water quality during the Biomining process.

**4. Risk Assessment:** The risk assessment will categorize the identified hazards based on their severity and likelihood of occurrence. Each hazard will be evaluated using a risk matrix to determine the level of risk and priority for mitigation.


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**5. Risk Mitigation Measures:**

To ensure the safety of personnel involved in the Biomining project, the following risk mitigation measures will be implemented:

a. Engineering Controls:

- Regular maintenance and inspection of machinery to prevent mechanical failures.

- Providing appropriate personal protective equipment (PPE) to workers.

b. Administrative Controls:

- Developing standard operating procedures (SOPs) for Biomining operations.

- Implementing a comprehensive training program for all personnel involved in the project.

- Scheduling regular breaks and rotation of tasks to minimize fatigue.

c. Environmental Monitoring:

- Regular monitoring of air and water quality to ensure compliance with safety standards.

- Establishing emergency response protocols in case of any unexpected environmental events.

d. Emergency Preparedness:

- Developing and practicing emergency response plans for potential accidents or incidents.

- Providing workers with first-aid training and easily accessible medical facilities.

e. Personal Protective Equipment (PPE):

- Mandating the use of appropriate PPE, such as respirators, gloves, safety goggles, and protective clothing.

**6. Worker Health Surveillance:**

Implementing a health surveillance program to regularly monitor the health of workers involved in the Biomining project. This may include medical examinations and assessments to detect any health issues related to exposure during the remediation process.

The work site to be equipped with first aid and the contractor must have tie-up with nearest primary health center/ medical facility for the welfare of the labors.

**7. Training and Education:**

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Conducting comprehensive training and educational programs for workers and supervisors to raise awareness of potential hazards, proper handling of equipment, and the correct use of PPE.

**8. Conclusion:**

By proactively identifying potential hazards, assessing risks, and implementing appropriate control measures, this Occupational Health and Safety Risk Assessment aims to ensure the safe and successful execution of the dumpsite remediation Project through Biomining. Continuous monitoring and improvement will be essential throughout the project to maintain a safe work environment.

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FEASIBILITY REPORT

# DUMPSITE BIOMINING AND BIOREMEDIATION, THALIPADUPPU, KASARAGOD MUNICIPALITY




November 2023

KSWMP

LSGD

LSGD

State Project Management Unit

Kerala Solid Waste Management Project (KSWMP)

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## EXECUTIVE SUMMARY

Kasaragod is a Municipality in Kasaragod District, of Kerala State. Even though the ULB has an excellent practice of waste management, the primary environmental issue currently faced by municipal authorities revolves around a longstanding existing legacy waste dumpsite. Despite discontinuing waste dumping activities, these dumpsites remain as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. As a consequence, these sites pose significant environmental, social, and economic challenges for the communities and ecosystems surrounding them. The SWM Rules 2016 directs all local bodies to identify the legacy dumpsites and to scientifically remediate it in order to ensure a safe and healthy environment. In acknowledgment of this imperative, the Government of Kerala has undertaken the endeavor through the Kerala State Solid Waste Management Project (KSWMP) to address the issue of remediating legacy waste dumpsites across all Urban Local Bodies (ULBs). As a component of the project's first phase, the remediation of the existing dumpsite located in Thalipaduppu, Kasaragod, has been proposed.

The Kasargod municipality has an area of 16.69 sq.km with 38 wards. The municipality intend to remediate the existing legacy waste dumpsite at ward 04 (Thalipaduppu) Kellugudde and recovery land 100% for development of recreational park for the public. The Kellugudde (Thalipaduppu) dumpsite is used for dumping of solid waste from the year 1970 to year 2010. The dumping of the solid waste was stopped due to protest from the local residents for addressing the issues of the problems created by odour and leachate from dumpsite and local residents are in demand to remediate the legacy dumpsite and to utilize the remediated land for social cause. The total quantity of legacy waste is estimated to be approximately 16735.685 Tons. Since the cessation of dumping activities in 2010. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes.

To assess the quantity & composition of the legacy waste & also evaluate the environmental baseline of the dumpsite, the samples from the strategic locations were collected and analyzed for various parameters viz., physical and chemical analysis of Legacy waste, Soil, Air, Noise, leachate, Ground Water and Surface Water. As part of the study, detailed site investigations were carried out as follows – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Chemical, Environmental Analysis by M/s Poluchem Laboratories. From the results of the investigations, it was found that the waste was found to depth of 4.5 m. The total estimated quantity of legacy waste was found to be around 20115 m3 (16735.685 T)

As per the SWM Rules 2016, selection of the applicable method/type or technique for dumpsite remediation needs to be arrived from the Feasibility study carried out and based on the results, remediation can be done by a) Capping without land recovery, b) Bio-mining – reclamation/recovery of land 100 %) capping with partial land recovery. The selection of technology shall also depend on the available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for 100% land recovery and forward linkages/utilization of processed aggregates/by-products. Based on the detailed assessment of the selection parameters, Bio-mining –

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reclamation/recovery of land 100% is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and 100% land recovery/remediation legacy waste dumpsite.

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land 100 %) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by-products as per the requirements of the utilization/forward linkage. Based on the detailed assessment of the selection parameters, mobile/compact screening is the machineries are which shall be the optimum screening machineries the for processing the stabilized legacy waste of 20115 m3 within the stipulated timeline of 31st March 2024 by NGT for remediation of legacy waste dumpsite.

Environmental & Social safeguards: The project attracts E2 Environmental category based on the project activities and status of the environment baseline. The project is categorized as possessing a moderate level of social risk, as determined through social mapping and a transect walk. This involves engaging with the local community residing near the prospective project site to evaluate the challenges posed by the existing legacy waste dumpsite and the potential ramifications during the project's implementation.

By-products utilization/forward linkages/Usage

1. The bio earth & inerts quantity 10057.50 m3 & 4224.15 m3 and waste will be utilized for development of the reclaimed legacy waste dumpsite as recreational park/facility.
2. Refused derived fuel (RDF) of 5239.96 m3 will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the processes
3. Recyclables of 593.39 m3 will be sold to authorized recyclers and will be collected from the dumpsite.

The activities of the bio-mining will be commenced from the Dec 2023 and end by Mar 2024. An expanse of 1.1 Acre is designated for reclamation, aiming to transform it into a facility like potential public-access green park etc., The project is projected to incur a total expenditure of [redacted]/-. The expense linked to the processing and disposal of legacy waste per cubic meter amounts to [redacted]/-.

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## 1. INTRODUCTION

Kasaragod Municipality stands as a swiftly advancing urban local body within the Kasaragod district. While demonstrating commendable waste management practices, the principal environmental concern confronting the municipal authorities pertains to an enduring legacy waste dumpsite. Despite ceasing waste disposal operations, these residual dumpsites persist from an era when waste disposal practices were less sophisticated and ecologically attuned compared to the present standards. Consequently, these sites present substantial environmental, societal, and economic complexities for the neighboring communities and ecosystems.

As the SWM Rules 2016, all local bodies to identify the legacy dumpsites and to scientifically remediate it in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the project of remediation of legacy waste dumpsites in all the ULBs. As part of the project, in phase -1 the existing dumpsite of Thalipaduppu, Kasaragod is proposed to remediated.

The legacy waste dumpsite remediation needs to be arrived from the feasibility study outlining the technical, economic, and social factors which will have implication of the process of remediation of legacy waste dumpsite. Based on the detailed field investigations & assessment and market sounding, the method proposed for remediation of legacy waste dumpsite will ensure long term sustainability and environmentally sound treatment which will be technically feasible, economically viable, and socially acceptable. `

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## 2. GENERAL DESCRIPTION ABOUT PROJECT

The Kasargod municipality has an area of 16.69 sq.km with 38 wards. Solid waste generated from 11586 households and 3189 institutions including commercial establishments is 9.79 TPD. The municipality intend to strengthen and enhance the existing treatment facilities of the bio degradable & non – degradable waste system at household, institutional and community level for effective management of the solid waste generated and also remediation of existing legacy waste dumpsite

The Thalipaduppu dumpsite was used for dumping of solid waste from the year 1970 to 2010. The legacy waste is spread in an area of 1.1 acres with approximate height of 4.5 m and a portion of the dumpsite is capped as part of the remediation. Almost entire area is filled with legacy waste on dumpsite. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes. The municipality intend to remediate the existing legacy waste dumpsite at Thalipaduppu, Kasaragod and recovery land 100% for development of recreational park for the public. The details of the legacy waste dumpsite are provided below:

*Table 1 Dumpsite Details*

| Name of ULB | Kasaragod |
|---|---|
| District | Kasaragod |
| Taluk | Kasaragod |
| Location | Thalipaduppu, Kasaragod |
| GPS Co-ordinate of the Site | Latitude: 12° 30'59.01"and Longitude: 74° 59'11.099" |
| Total dumpsite area (in acres) | 1.1 Acre |
| Legacy waste spread (in acres) | 1.1 Acre (Complete area occupied by legacy waste) |
| Ownership of Land | ULB |


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*Figure 1 Location of Dumpsite*


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## 3. LOCATION, DEMOGRAPHY, ACCESS, LAND-USE, WATER TABLE AND CLIMATE OF THE ULB

### 3.1 LOCATION

Kasargod is a Municipality in the state of Kerala, India and is located at Latitude: 12° 30'59.01" and Longitude: 74° 59'11.099" with an area square Kilometer 16.7 and has an average elevation of 19 m. It is Located 581 KM South towards State capital Thiruvananthapuram. Kasaragod District population is 13, 02,600. It is 11th largest district in the State by population. Kasaragod District is sharing border with Dakshin Kannad District of Karnataka to the North, Kannur District to the South, Lakshadweep Sea in the west. Kasaragod is about 581 KM by road to Thiruvananthapuram (Capital of Kerala). Major rail way stations in district are Kasaragod, Kanhangad and Nileshwar. The Key map of Kasargod Municipality is given below.

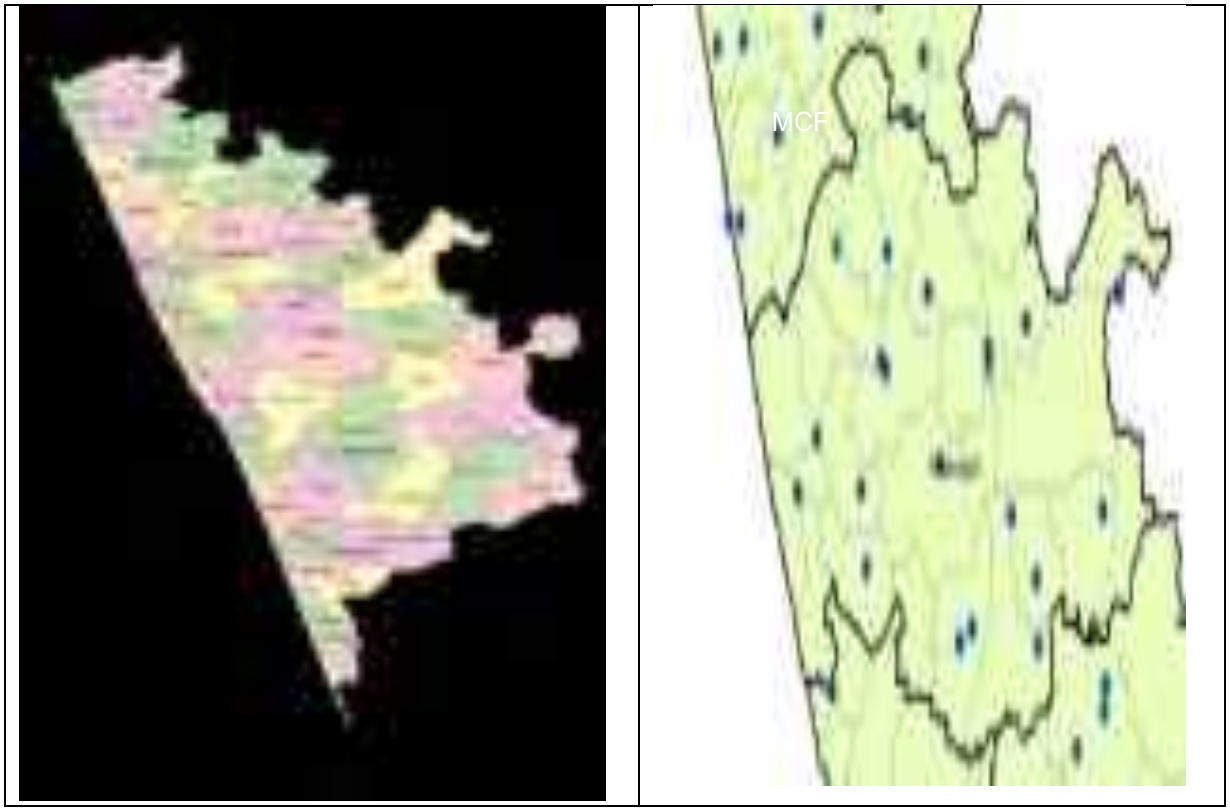


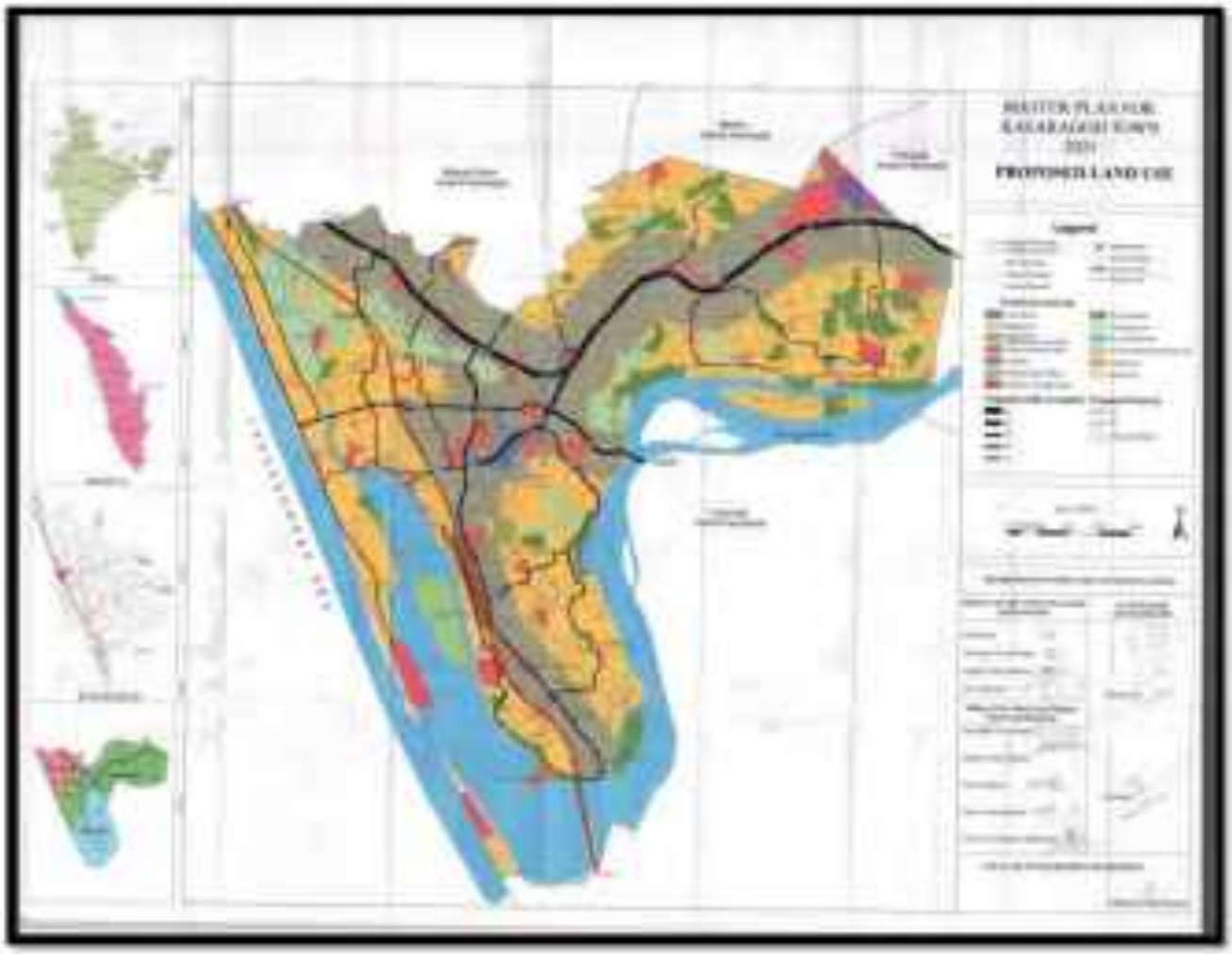

*Figure 2 Map for Kasaragod Municipality*

### 3.2 POPULATION, DENSITY AND LITERACY RATE

Kasaragod Municipality population is 57005, among them about 28,000 (49 %) are male and about 29,000 (51 %) are female. As of 2011 census there are 1054 females per 1000 male in the city. The Kasaragod Municipality was formed on 1964, as per the survey present population is 57,005.

The literacy rate of Kasargod city is 94.76 % higher than state average of 94.00 %. In Kasargod, Male literacy is around 96.53 % while female literacy rate is 93.12%.

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Source: Master Plan for Kasaragod town 2031(draft)

*Figure 3 Land Use Map of Kasaragod Municipality*

### 3.3 LAND USE

The Kasargod municipality has a total area of 16.69 Sq. km. The land use indices of Kasargod municipality are shown in below figure:

1. The predominant land use in the area is residential.

2. There is a nearby KSEB Substation Godown of civil supplies located approximately 20 meters away.

3. Kudumbashree Community Hall adjacent to dumpsite.

The land use indices of Kasaragod municipality are shown in below figure.

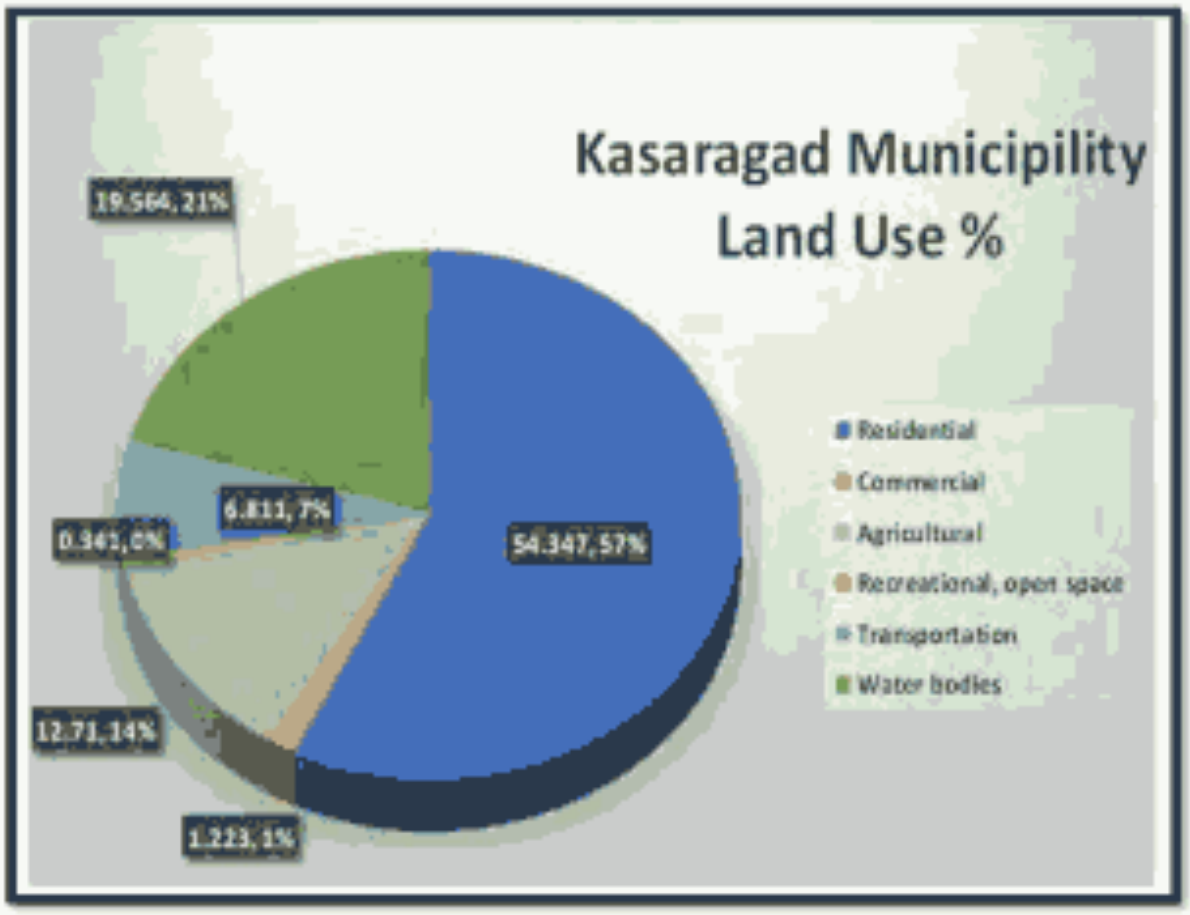
Table 2 Land use indices

| Description | Area (in sq.km.) | Land Use % |
|---|---|---|
| Residential | 9.064 | 54.347 |
| Commercial | 0.204 | 1.223 |
| Agricultural | 2.12 | 12.71 |


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| Description | Area (in sq.km.) | Land Use % |
|---|---|---|
| Recreational, open space | 0.057 | 0.341 |
| Transportation | 1.136 | 6.811 |
| Water bodies | 3.263 | 19.564 |
| **Other** | **0.834** | **5.00** |
| **Total** | **16.7** | **100** |

*Figure 4 Land Use of Kasaragod*




## 3.4 TRANSPORTATION CORRIDOR

*Table 3 Transportation corridor details*

| Mode | Details |
|---|---|
| **Road** | Kasargod has a good road network. National Highway 17 (NH17) leading to Mangalore passes through Kasargod town, the state highway through Kasargod are SH-31, SH-55, SH-56 & SH-57. The town is well connected with major urban centres in the state by rail and roads. S.H-32 to Kalladukka leads to Badiadukka, Perla Vitla and further to Karnataka State. The Jalsoor road passes through Muliyar and leads to Sulliyahas |


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| | |
|---|---|
| Train | Kasargod Railway Station is one of India's model railway stations, and is located in the Mangalore Shornur railway line of southern railway. A major thrust on the rail transport network happened with the opening of Konkan Railway, providing direct access from this region to Bombay. The Shornur-Mangalore broad gauge Railway line connects 12 Panchayats and three Municipalities of the District covering a distance of 81km through the coastal belt of the District. There are 10 railway stations and one halt station in the district. The new Konkan Railway link reduces the distance to Mumbai by 800 kms and makes this the shortest route for Keralalites to Mumbai, the Commercial hub of India. The Shornur-Mangalore broad gauge line adds to the regional linkage of the town. It directly links Kasaragod with Mangalore in the north and Kannur in the south. The rail to South passes along the Bekal Tourism Development Project area. |
| Air | The nearest international airports are situated at Mangalore (65 km away) and Kannur (110 km away). |

### 3.5 TOPOGRAPHY

Kasaragod has an average elevation of 19 m (62 ft). Based on altitude, land could be classified into three; low land, mid land and high land.

*Table 4 Topography*

| Altitude | Details |
|---|---|
| Lowland | The coastal plains, the midlands and the eastern highland regions. The coastal plains with an elevation of less than 10m occur as narrow belt of alluvial deposits parallel to the coast. To the east of coastal belt is the midland region with altitude ranging from 10 to 300 m amsl. |
| Midland | The midland area is characterised by rugged topography formed by small hillocks separated by deep cut valleys. The midland regions show a general slope towards the western coast. To its east is the high land region. The midland and hill ranges of the district present a rugged and rolling topography with hills and valleys. |
| Highland | The district is the northernmost district of the State of Kerala. Kasaragod is located at Latitude: 12° 30'59.01" and Longitude: 74°59'11.099". It has an average elevation of 19 metres (62 feet). Ranipuram or Madathunala (1016m) peak is the highest peak in the Kasargod district of Kerala. It is located in the Ranipuram Wildlife Sanctuary. |

### 3.6 CLIMATIC CONDITION

#### 3.6.1 TEMPERATURE & RAINFALL

Kasargod Municipality falls within the tropical to sub- tropical climatic region. The maximum temperature in the region varies almost between 32 °C to 37 °C and minimum temperature ranges from 21.6 °C to 32.6 °C .

Kasargod Municipality falls within the tropical to sub- tropical climatic region and dominant feature is the monsoon. The major source of rainfall is southwest monsoon from June to September which contributes nearly 85.3% of the total rainfall of the year. The northeast monsoon contributes nearly 8.9% and balance of 5.8% is received during the month of January to May as


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pre monsoon showers. Out of the 106 rainy days in a year, 87 rainy days occur during south west monsoon season.

*Table 5 Temperature & Rainfall Data*

| Month | Climatic Conditions of Kasargod Municipality | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Average High Temp. °C | 31.4 | 31.5 | 32.2 | 32.7 | 32.2 | 29.3 | 28.2 | 28.4 | 28.8 | 30 | 31 | 31.5 |
| Average Low Temp. °C | 21.7 | 22.8 | 24.3 | 25.9 | 25.7 | 23.9 | 23.4 | 23.6 | 23.5 | 23.8 | 23.1 | 22 |
| Average Precipation mm | 1 | 1 | 5 | 55 | 262 | 1002 | 1190 | 647 | 338 | 229 | 77 | 18 |

*Source: Climate-Data.org*

According to the Rainfall Data, the most favorable working period spans from December to March due to the lower precipitation levels.

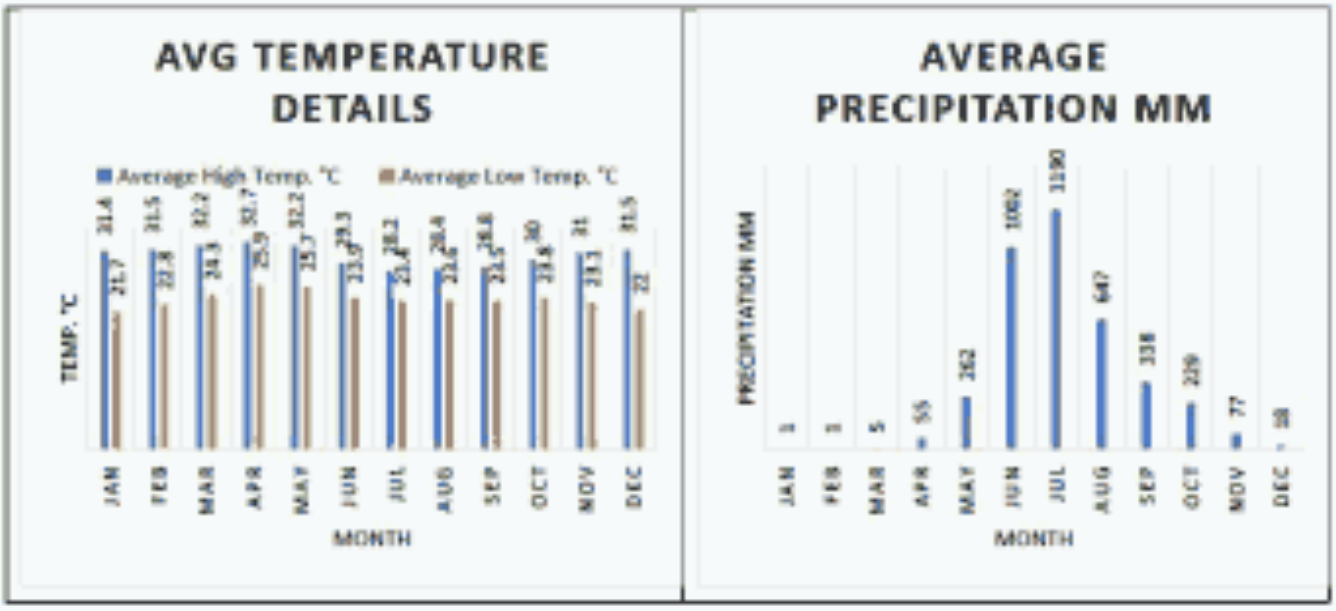



*Figure 5 Monthly Variation of Climate and Rainfall for Kasaragod Town*

### 3.7 FLOOD ZONE

According to the 2022 Flood Probability Report published by the Kerala State Disaster Management Authority, the Kasargad municipality as shown in below.


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*Table 6 Flood zone details*

| DESCRIPTION | BASE YEAR | 1 in 10 YEAR (CC RCP 8.5) | | 1 in 25 YEAR (CC RCP 8.5) | | 1 in 50 YEAR (CC RCP 8.5) | | 1 in 100 YEAR (CC – RCP 8.5) | |
|---|---|---|---|---|---|---|---|---|---|
| Kasargod Municipality | 2011 | Flood Inundation Area (Km2) | Max. Flood Level (m) | Flood Inundation Area (Km2) | Max. Flood Level (m) | Flood Inundation Area (Km2) | Max. Flood Level (m) | Flood Inundation Area (Km2) | Max. Flood Level (m) |
| | | 3.46 | 7.31 | 3.54 | 7.7 | 3.91 | 8.91 | 4.05 | 9.35 |

*Source: Kerala State Disaster Management Authority CC=Climate Change RCP= Representative Concentration Pathway*

### 3.8 EARTHQUAKE ZONE

The Bureau of Indian Standards (BIS) has grouped the country into four seismic zones viz. zones II, III, IV and V as detailed in the Map below. The Kerala state falls under Seismic Zone 3.

### 3.9 COASTAL REGULATION ZONE

As per the Coastal Regulation Zone (CRZ) notification 2011 and further amendment in CRZ notification 2019, the Kasaragod legacy dumpsite does not fall under the CRZ zone. The dumpsite located in the ward 4, Thalipaduppu which is around 1.3 km away from the Coastal Regulation Zone

### 3.10 GROUND WATER LEVEL

The details of groundwater level during pre-monsoon and post-monsoon, and the average fluctuation is provided in the table below.

*Table 7 Details of Ground Water level*

| Pre-monsoon (m) | Post monsoon (m) | Avg. Fluctuation (m) |
|---|---|---|
| 20 | 0.1 to 10 | 0-2 |

*Source: Ground Water Information Booklet of Kozhikode District, Kerala State, CGWB*


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## 4. DETAILED DESCRIPTION OF THE DUMPSITE

### 4.1 PHYSICAL FEATURE OF THE SITE

The total expanse of the dumpsite measures approximately 1 acre 10.45 cents, with a 100 % portion occupied by legacy waste. The average elevation of this legacy dumpsite is 4.5 meters. This historical waste repository is situated at geographical coordinates Lat: 12° 30'59.01'' N, Long: 74°59'11.099'' E in the region known as Thalipaduppu (ward-4), within the Kasargad Municipality.

At present, the Municipality's solitary dumpsite is located within the Thalipaduppu Area of Kasargad Municipality. Specifically positioned within ward No. 4, this site encompasses non of MCF, RRF or any other waste activity processing unit. The complete site are filled with legacy waste only.

The dumpsite is enclosed by a well-constructed compound wall initially. But now its one side is damaged partially. The two side of compound wall have 2m average height compound wall and the fourth side have retaining wall of laterite stone.



*Figure 6 Site Access Roads – Kasaragod Dumpsite*

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## 4.2 INFORMATION ON SITE MANAGEMENT

The Thalipaduppu dumpsite has served as a repository for solid waste disposal since 1970, spanning a period of over 40 years. This site was closed in 2010.

## 4.3 SITE HISTORY INCLUDING PUBLIC PROTEST

The Thalipaduppu dumpsite is used for dumping of solid waste from the year 1970 to year 2010. The dumping of the solid waste (bio degradable waste) was stopped due to protest from the local residents for addressing the issues of the problems created by odour and leachate from dumpsite and local residents are in demand to remediate the legacy dumpsite and to utilize the remediated land for social cause.

## 4.4 DIRECTIONS FROM AUTHORITIES LIKE NGT, PCB, ETC.

### 4.4.1 NGT DIRECTIONS & ORDERS

The National Green Tribunal (NGT) has set norms and guidelines (O.A. No. 606/2018) to address legacy waste accumulated at long-operating dumpsites, to mitigate environmental and health hazards. The norms focus on closure and remediation of dumpsites, waste segregation and treatment using appropriate technologies, conducting Environmental Impact Assessments (EIAs), implementing land use planning and zoning regulations, monitoring and compliance measures, and promoting public participation and awareness regarding legacy waste management. These guidelines aim to stabilize dumpsites, prevent further pollution, and involve communities in decision-making and risk education.

### 4.4.2 LOCAL SELF GOVERNMENT DEPARTMENT - GUIDELINES

The remediation of dumpsites is further directed by Honorable NGT in its order OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. Remediation of Legacy Waste Dumpsites through Bioremediation - G.O.(Rt)No.2629/2022/LSGD Dated, Thiruvananthapuram, 29-10- 2022

### 4.4.3 KSPCB - GUIDELINES FOR DUMPSITE REMEDIATION

The Kerala State Pollution Control Board (KSPCB) has established guidelines (PCB/HO/SEE2/Model City/Kozhikode corporation/2019 dated 09/09/2021) for dumpsite remediation to address the environmental and health impacts of waste disposal. The recommended steps include conducting a site assessment, developing a remediation plan based on risk assessment, selecting appropriate remediation technologies, implementing remediation activities under supervision, verifying the success of remediation, and ensuring long-term management and monitoring of the site. By following these guidelines, the KSPCB aims to mitigate the adverse effects of waste disposal, protect the environment, and safeguard public health.

### 4.4.4 CPCB GUIDELINES

Hon'ble NGT warned that due to incremental growth of Municipal Solid Waste (MSW), these MSW dumps are converting into virtual mountains. Hon'ble NGT further directed that every city/town should adhere to clause 'J' of Schedule–I (capping is not the first option for environmentally safe legacy waste management) of SWM Rules, 2016. Finally, Hon'ble NGT directed CPCB to propose Standard Operating Procedure (SOP) for implementation of Bio-mining and Bioremediation of legacy solid waste.

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### 4.4.5 SWACHH BHARAT MISSION (SBM) ADVISORY

The advisory on dumpsite bioremediation addresses the challenges of legacy waste and promotes sustainable waste management practices and emphasizes the importance of dumpsite bioremediation as a sustainable solution for managing legacy waste. By adopting these guidelines, municipalities can address the environmental and health risks associated with dumpsites and promote a cleaner and healthier living environment for communities.

### 4.4.6 CENTRAL PUBLIC HEALTH AND ENVIRONMENTAL ENGINEERING ORGANIZATION (CPHEEO) GUIDELINES

The guidelines aim to provide a comprehensive approach to remediate dumpsites in a safe and environmentally sustainable manner. Key points from the guidelines include conducting site assessments, segregating waste, and implementing engineering and biological measures to control contamination, treating leachate to prevent groundwater contamination, and conducting post-remediation monitoring. These guidelines are crucial to ensure effective and environmentally sound dumpsite remediation that protects public health and the environment.

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# 5 SCOPE OF WORK

Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at Kasaragod includes the following steps.

- Conducting detailed field investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical, and Environmental Baseline Analysis by M/s Poluchem Laboratories.
- Assessment & Analysis of detailed investigation report submitted by the Laboratories.
- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.
- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the By-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation (land recovery – Biomining, Capping partially Biomining & Capping), Methods/Technologies (Stationary & Mobile- compact), Implementation mode, Forward linkages (Utilization/Management of By-products) and Environmental & Social categorization as per the Environmental Management Framework – Vol II Part A.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Baseline assessment, impact & risk assessment, mitigations measures and Environmental Management & monitoring plan and its budget.
- Social Safeguards - Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.
- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport, Environmental and social monitoring costs, Revenue from the project, Funding for project
- Project Implementation plan –contractual models and timelines.

## 5.1 OBJECTIVES:

- To remediate the legacy waste dumpsite of approximately 16735.68 Tons by 31st March 2024.
- To reclaim the legacy waste dump area and to develop recreational park facilities, thereby eliminating the chances of dump fires, leachate generation, and foul odor.
- To reduce greenhouse gas emissions, soil pollution, and groundwater contamination.
- To increase nearby real estate/social value and benefit the citizens.

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# 6 COMPOSITION, CHARACTERISTICS OF LEGACY WASTE AND ITS IMPACTS

## 6.1 DETAILED INVESTIGATION STRATEGY

To understand the nature and composition of the legacy waste and the existing baseline environmental conditions, samples from waste, surface and groundwater, leachate, soil, air, and noise were collected as per the requirements given in the Project Implementation Manual, considering the state and national guidelines. Samples were collected as mentioned below;

- ✓ Bore hole upto a depth of 9 m and collection of 3 (nos) samples from the soil at interval of 1.5 m.
- ✓ Waste analysis viz., leachate sample from 1 (nos) locations and physical analysis from 2 (nos) location, and chemical analysis from 1 (nos) location.
- ✓ Environmental baseline analysis surface water 1 (nos) location and ground water samples from 3 (nos) location (Well Water Samples -1 up gradient, 2 down gradient) and Air sampling from 2 (nos) locations and noise sampling from 1 (nos) location

## 6.2 DETAILED INVESTIGATIONS

The detailed investigations carried out for the legacy waste dumpsite is given in the table below:

*Table 8 Investigation details*

| S.No | Parameters | Sampling Nos. |
|---|---|---|
| I | Geotechnical Investigation | |
| A | Boreholes up to 10m depth (as per CPHEEO Manual) | 1 |
| B | Permeability test- (as per CPHEEO Manual) standard penetration test SPT and collection of undisturbed samples - Soil Investigation - Classification, gradation, Atterberg's limit, Bulk density, dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, strength, compressibility (vertically-3 samples per borehole) | 1 |
| 2 | Waste & Environmental Analysis | |
| A | Leachate Analysis (TCLP usepa 1311) (SCHEDULE II of SWM rules, 2016), Suspended solids, Dissolved solids (inorganic),pH, Ammonical nitrogen (as N), Total Kjeldahl nitrogen (as N), BOD, COD, Arsenic (as As), Mercury, Lead, Cadmium, Copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds | 3 |
| B | Physical Analysis of waste (As per CPHEEO manual) including Density, Bulk Density, Moisture Content, Size of waste Constituents, Calorific Value | 2 |
| C | Chemical Analysis of waste/soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), total Carbon, C/N ratio, calorific value, Bio-chemical - biodegradable factor | 1 |
| D | Ground Water (Well Water Samples -1 up gradient, 2 down gradient) - (shallow and deep wells): pH, Colour, EC, Turbidity, SS, TDS, TOC, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, | 3 |


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| | | |
|---|---|---|
| | TKN, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total Coliforms (IS 10500 – 2012) | |
| E | Surface Water (pH, Colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, TKN, Total Alkalinity, Total hardness, Ecoli and Total Coliforms (IS 10500 – 2012) | 1 |
| F | Ambient Air Quality (Sulphur Dioxide (So2), Nitrogen Dioxide (No2), Particulate Matter 2.5, Particulate Matter 10, Ozone (O3), Lead (Pb), Carbon Monoxide (CO), Ammonia (NH3), Benzene (C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | 2 |
| G | Ambient Noise Level (E(p)Rules) for 24 hours | 1 |
| Note: Detailed Technical Investigations conducted as per PIM | | |

## 6.3 METHODOLOGY OF SAMPLING

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed sampling methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat/Long) were considered. The following table shows the strategic location details of samples selected for the detailed investigation.

*Table 9 Details of sampling location*

| S.No | Description | Sampling location | Justification |
|---|---|---|---|
| 1 | Air sampling (2 Locations) | Within the dumpsite<br>Dumpsite entry point | As per the wind direction and speed of the wind are determined and based on the existing wind-rose data the air sampling location fixed at two locations |
| 2 | Noise (1 Location) | Within the dumpsite | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. |
| 3 | Surface water (1 Location) | Surface water near to the dumpsite [stream] | Considering the sites geographical features, it is situated in a predominantly flat terrain. Nearby surface water available at the distance of 250 m in the Northe East Direction. |
| 4 | Ground water (3 Locations) | 3 wells identified near the dumpsite area | Considering the sites geographical features, it is situated in a predominantly flat terrain. Based on the possible infiltration and slope direction, two ground water samples are collected in the east direction and one of the west direction |
| 5 | Bore Hole (1 Location) | Within the dumpsite area | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. |
| 6 | Legacy Waste | Within the dumpsite area | Not Applicable |


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*Table 10 Direction and Distance of the sampling location*

| S.No | Description | Direction | From Dumpsite (m) | From Boundary (m) |
|---|---|---|---|---|
| 1 | Surface Water | North East | 251 | 230 |
| 2 | Ground water-1 | South West | 93 | 60 |
| 3 | Ground water-2 | East | 92 | 63 |
| 4 | Ground water-3 | South West | 189 | 115 |
| **Note: Air and Noise Monitoring are monitored inside the dumpsite** | | | | |

*Table 11 Quantity of sampling & location*

| S. No | Items | Quantity of sample collected | Location |
|---|---|---|---|
| 1 | Solid Waste | 25 kg | Location -1: N- 12°30'58.224" E -74°59'09.455"<br>Location -2: N- 12°30'56.597" E -74°59'12.52" |
| 2 | Surface Water | 1.5 Litres | Location -1:N- 12°31'06.571" E -74°59'12.616" |
| 3 | Ground Water | 1.5 litres | Location -1:N- 12°30'55.788"E -74°59'11.213"<br>Location -2:N- 12°31'0.402"E -74°59'12.516"<br>Location -3:N- 12°30'57.964"E -74°57'16.399" |
| 4 | Leachate | 1.5 litres | Location -1:N- 12°30'58.110" E -74°59'09.272" |
| 5 | Ambient Air Quality | 2 Nos | Location -1:N- 12°30'59.01" E -74°59'11.099"<br>Location -2:N- 12°30'58.032" E -74°59'09.533" |
| 6 | Ambient Noise Quality | 1 Nos | Location -1:N- 12°30'58.146" E -74°59'10.283" |


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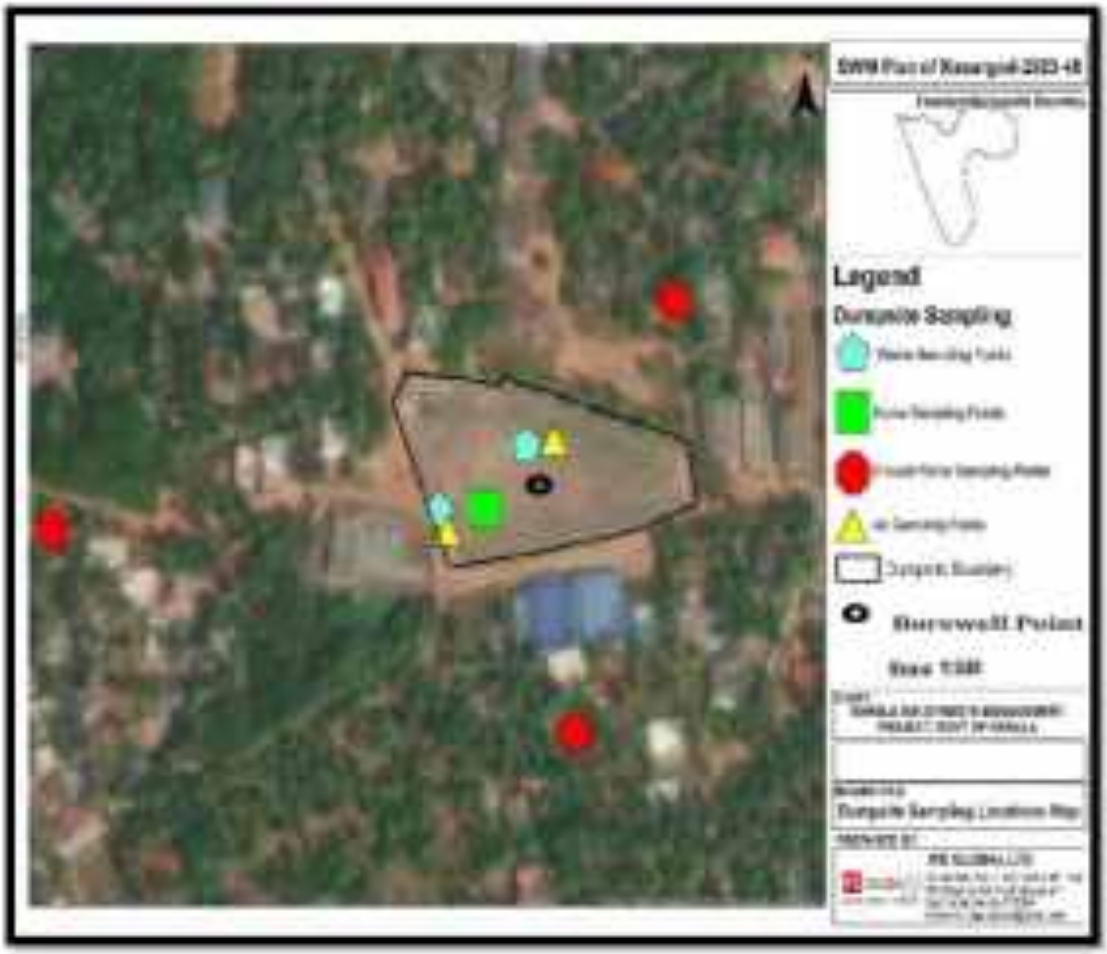



*Figure 7 Sampling Locations – Borehole & legacy waste sample*

### 6.4 ANALYSIS AND INTERPRETATION OF EXPLORATORY DATA

As part of the feasibility study, Technical Support Consultants (IPE Global Ltd) has entrusted the geotechnical investigation & Environmental baseline assessment to M/s Matter Material Testing & Research Laboratory (P) Ltd and M/s Polluchem Laboratories (P) Ltd respectively.

The initial site visit was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd on 20th May 2023 along with the experts of TSC and PIUs. Field Geotechnical investigation to collect the soil samples after drilling through the legacy waste was started on 09th June 2023 and was completed on 20th June 2023. Positioning of Air samplers & Noise monitoring equipment, sampling of surface/groundwater, leachate, and legacy waste were done on 12th June 2023 by M/s Polluchem Laboratories (P) Ltd. The lab analysis reports were submitted by the investigation agencies to TSC. The lab analysis reports are provided in Annexures – A & B

#### 6.4.1 GEOTECHNICAL EXPLORATORY DETAILS

For assessing the depth of legacy waste and contamination of the soil below the legacy waste, bore hole samples were collected using rotary drill. The exploratory data of the bore hole revealed a maximum depth of 4.50 m for waste and 4.50 m for the soil. Lateritic rock was encountered below the soil stratum. The Geotechnical investigation was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. The details of the exploratory data of the bore hole is provided below.


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*Table 12 Exploratory Data of Bore Log*

| S. No | Borehole location | Total Depth of the Borehole (m) | Depth of Soil (m) | Depth of Legacy Waste (m) | Remarks |
|---|---|---|---|---|---|
| 1 | N- 11°35'38.862"<br>E -75°36'20.735" | 9 | 4.5 | 4.5 | Lab Analysis Report provided in Annexure A |
| Note: Bore hole terminated at the depth of 4.5 m below ground level due to Laterite rock. | | | | | |

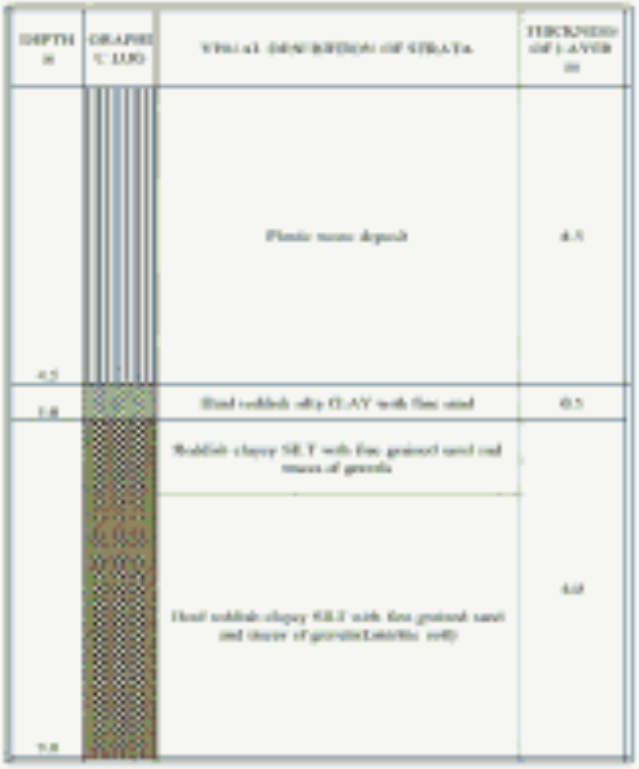



*Figure 8 Soil Profile & Geotechnical Investigation*

### 6.4.2 ESTIMATED TOTAL QUANTITY OF WASTE

The total quantity of waste is estimated based on the contour/topography survey profile of the waste over the ground level and exploratory data of the bore log (Geotechnical investigations). The details of the estimated total quantity of waste is provided below:

*Table 13 Quantity of waste below ground level*

| Level | Volume of Legacy Waste (m3) | Density of Waste (t/m3) | Total Quantity of Waste (T) | Remark |
|---|---|---|---|---|
| Below & Above | 20115 | 0.832 | 16735.68 | *As per the Contour Survey Report by ULB + Below Ground quantity ( approx – 9000 cu.m) |


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*Table 14 Estimated total quantity of waste*

| Estimated total quantity of waste | |
|---|---|
| Total Quantity of Legacy Waste ($m^3$) | 20115 |
| Total Quantity of Legacy Waste (T) | 16735.68 |
| Total Quantity of Legacy Waste (T) Approximately | 16736 |


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### 6.4.3 LEGACY WASTE CHARACTERIZATION

The characteristics of the legacy waste were assessed by collecting e samples of 25 kg from 2 (nos) locations within the dumpsite. The legacy waste samples were collected on 06th June 2023 by M/s Polluchem Laboratories (P) Ltd. The assessment of waste characteristics. was done based on the results of the analysis. The details of the characteristics viz., composition, physical & chemical characteristics, heavy metals, and estimated quantity of by-products are provided in the tables below:

| S. No | Items | Quantity of sample collected | Location |
|---|---|---|---|
| 1 | Solid Waste | 25 kg | Location -1: N- 12°30'58.224" E -74°59'09.455"<br>Location -2: N- 12°30'56.597" E -74°59'12.52" |

**Physical Composition:**

*Table 15 Physical Composition for Location- 1, 2 & Average*

| S. NO | Total Quantity of legacy waste (T) | Parameters | Parameters | Location – I | | Location – II | | Average | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Avg. Percentage (%) | Quantity (T) | Avg. Percentage (%) | Quantity (T) | Avg. Percentage (%) | Quantity (T) |
| 1 | 16735.68 | Bio Earth (-4.75mm) | (-4.75mm) | 34 | 5690.13 | 35 | 5857.49 | 34.50 | 5857.49 |
| | | Bio Earth (+4.75 to 8 mm) | (+4.75 to 8 mm) | 18 | 3012.42 | 13 | 2175.64 | 15.50 | 2175.64 |
| 2 | | C&D (+8mm) | C&D (+8mm) | 22 | 3681.85 | 20 | 3347.14 | 21.00 | 3347.14 |
| 3 | | Plastics | | 17 | 2845.07 | 20 | 3347.14 | 18.50 | 3347.14 |
| 4 | | Paper | | 4 | 669.43 | 4.28 | 716.29 | 4.14 | 716.29 |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 5 | | Cloths | | 2 | 334.71 | 3.6 | 602.48 | 2.80 | 602.48 |
| 6 | | Glass | | 1.2 | 200.83 | 2 | 334.71 | 1.60 | 334.71 |
| 7 | | Metals | | 1.1 | 184.09 | 1.6 | 267.77 | 1.35 | 267.77 |
| 8 | | Rubber | | 0.68 | 113.80 | 0.5 | 83.68 | 0.59 | 83.68 |
| 9 | | Other | | 0.01 | 1.67 | 0.01 | 1.67 | 0.01 | 1.67 |
| 10 | | Leather | | 0.01 | 1.67 | 0.01 | 1.67 | 0.01 | 1.67 |

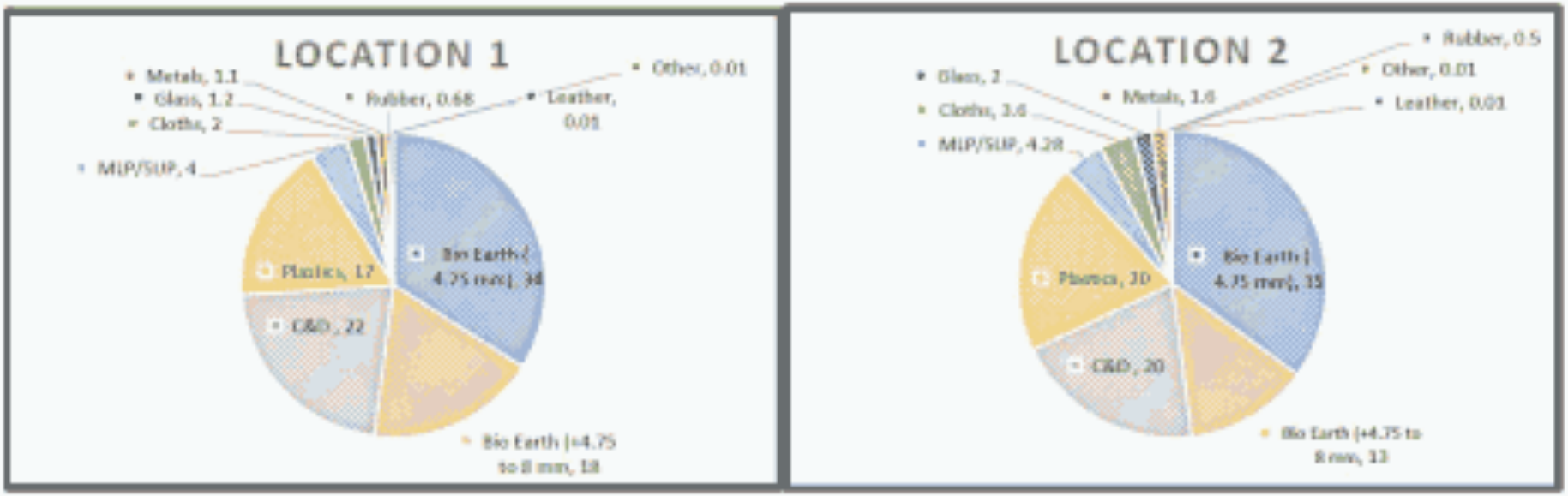



*Figure 9 Physical Analysis of Waste – Location 1 & 2*

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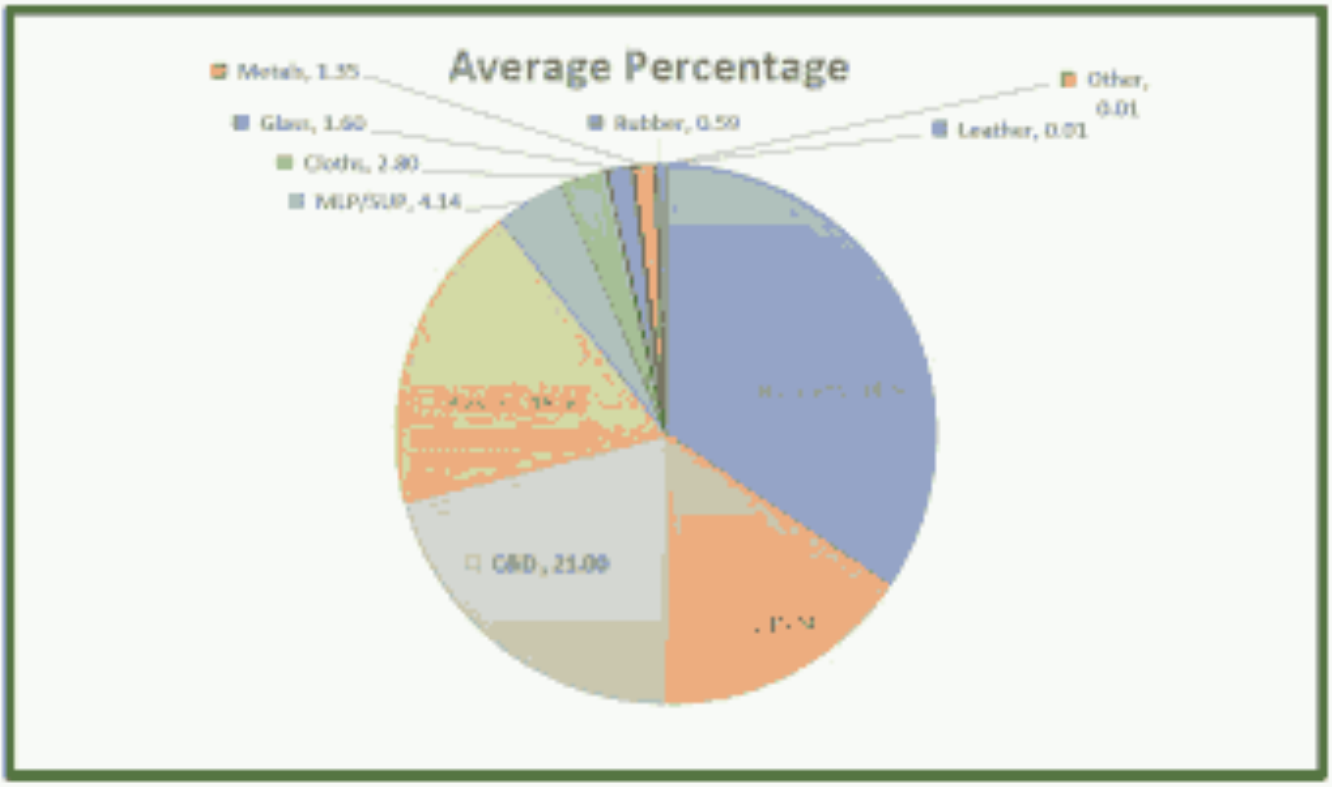



*Figure 10 Physical analysis of Waste - Average*

**Physical Analysis:**

*Table 16 Physical Analysis*

| S. No | Parameters | | | Test Method | Unit | Location 1 | Location 2 | Avg. | Limit as per FCO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Moisture@105°C | | | ASTM D 2216 | % | 24.3 | 27.72 | 26.01 | 15.0-25.0 |
| 2 | Bulk Density | | | USEPA | kg/m³ | 865 | 823 | 844 | |
| 3 | Density | | | USEPA | g/cm³ | 0.852 | 0.8125 | 0.83225 | <1 |
| 4 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 1267 | 1054 | 1160.5 | -- |
| 5 | Size of waste Constituent | Sieve Size(mm) | ASTM No | Retained | Retained 68.67 | Retained | Retained | Retained | |
| | | 75 | -- | 36.5 | 16.4 | 52.585 | 1.6 | 0.8 | |
| | | 40 | -- | 17.4<br>18.5 | 3.12<br>1.93 | 16.9 | 8.7 | 5.5 | |
| | | 20 | -- | 14.6 | 1.44 | 10.81 | 9.8 | 8.2 | |
| | | 8 | -- | 4.6 | 4.1 | 8.265 | 8.3 | 10.4 | |


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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 4.75 | 4 + | 8.4 | 2.3 | 3.02 | 4.05 | 5.8 | |
| | | 2.36 | 8 | 0 | 2.04 | 6.25 | 8.6 | 7.5 | |
| | | 1.18 | 16 | 0 | 0 | 1.15 | 12.4 | 14.4 | |
| | | 0.6 | 30 | 0 | 0 | 1.02 | 18.6 | 24.9 | |
| | | 0.3 | 50 | 0 | 0 | 0 | 19.53 | 16.1 | |
| | | 0.15 | 100 | 0 | | 0 | 6.54 | 5.5 | |
| | | 0.09 | 170 | | | 0 | 1 | 0.5 | |
| | | 0.075 | 200 | | | 0 | 0.88 | 0.4 | |
| | | 0.045 | 325 | | | 0 | 0 | 0.0 | |
| Lat/Long: Location -1: N: 12°30'58.224"E-74°59'09.455" and Location -2: N: 12°30'56.097", E: 74°59'12.52" | | | | | | | | | |

**Chemical Analysis:**

*Table 17 Chemical Analysis*

| S. No | Parameters | Test Method | Unit | Location - 1 |
|---|---|---|---|---|
| 1 | pH@25°C | USEPA | - | 6.59 |
| 2 | Biodegradable Factor | USEPA | % | 2.3 |
| 3 | Total carbon | USEPA 9060A | % | 2.5 |
| 4 | Phosphorus(P) | USEPA | % | 0.019 |
| 5 | Nitrogen(N) | USEPA | % | 0.20 |
| 7 | Potassium(K) | USEPA | % | 0.029 |
| 8 | C/N Ratio | USEPA | - | 12.5:1 |
| 9 | Calorific Value | ASTM D 5865 | Kcal/kg | 1318 |

**Heavy Metal Analysis:**

*Table 18 Heavy Metal Analysis*

| S. No | Parameters | Test Method | Unit | Location - 1 | Limit as per Organic Compost (FCO 2009) |
|---|---|---|---|---|---|
| 1 | Iron (Fe) | USEPA 3050 | % | 1.6 | – |
| 2 | Arsenic (As) | USEPA 3050 | mg/kg | <0.1 | 10 |
| 3 | Selenium (Se) | USEPA 3050 | mg/kg | <0.1 | – |
| 4 | Nickel (Ni) | USEPA 3050 | mg/kg | 8.17 | 50 |
| 5 | Zinc (Zn) | USEPA 3050 | mg/kg | 108.1 | 1000 |


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| S. No | Parameters | Test Method | Unit | Location -1 | Limit as per Organic Compost (FCO 2009) |
|---|---|---|---|---|---|
| 6 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 | 5 |
| 7 | Copper (Cu) | USEPA 3050 | mg/kg | 25.2 | 300 |
| 8 | Chromium (Cr) | USEPA 3050 | mg/kg | 8.17 | 50 |
| 9 | Lead (Pb) | USEPA 3050 | mg/kg | 27.04 | 100 |
| 10 | Mercury (Hg) | USEPA 3050 | mg/kg | <0.1 | .15 |
| 11 | Manganese (Mn) | USEPA 3050 | mg/kg | 152.03 | -- |

**By-Products:**

*Table 19 By-Products*

| By-Products | Bio Earth | C&D Waste | RDF | Recyclable |
|---|---|---|---|---|
| Percentage (%) | 50% | 21% | 26.05% | 2.95 % |
| Quantity (cu.m) | 10057.50 | 4224.15 | 5239.96 | 593.39 |

### 6.4.4 ENVIRONMENTAL BASELINE

The environmental baseline was assessed from the analytical results of air, surface & groundwater, noise and leachate from the location as mentioned in the section 6.3. The samples were collected on 06th June 2023 by M/s Polluchem Laboratories (P) Ltd. The Environmental baseline was analyzed with reference to the lab analysis reports. The details of analysis & inferences are provided in the tables below:

**Surface Water Analysis:**

*Table 20 Surface water Analysis*

| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 – 1983RA2017 | 5.63 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 15 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 8.7 NTU | -- | -- |


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| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 170 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 110.5 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 6 mg/l | --- | -- |
| Total Hardness as CaCO3 | IS 3025 (P) 21 – 1983RA2014 | 18 mg/l | 200 mg/l | -- |
| Total Alkalinity as CaCO3 | IS 3025 (P) 23 – 1986RA2014 | 10 mg/l | -- | -- |
| Chloride as Cl- | IS 3025 (P) 32 – 1988RA2014 | 29.45 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as SO4 | IS 3025 (P) 24 – 1986RA2014 | 6.12 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 – 1989RA2014 | 3.1 mg/l | 6 mg/l | 4 mg/l |
| B.O.D ( 3 days at 27$^{0}$ C ) | IS 3025 (P) 44 - 1993RA2014 | 3.7 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 - 2006RA2017 | 10 mg/l | --- | -- |
| TOC | APHA5310 | BDL(MDL-0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 5.1 mg/l | --- | -- |
| Nitrate as NO3 | IS 3025 (P)34 – 1988RA2014 | BDL(MDL- 1 mg/l) | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 - 2008RA2014 | 0.12 mg/l | 1.5 mg/l | 1.5 mg/l |
| Nickel as Ni | IS 3025(P) 54 - 2003RA2014 | BDL(MDL-0.01mg/l) | -- | -- |


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| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Cadmium as Cd | IS 3025(P) 41-1992RA2014 | BDL(MDL-0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47-1994RA2014 | BDL(MDL-0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42-1992RA2014 | BDL(MDL-0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59-2006RA2017 | BDL(MDL-0.01mg/l) | 0.5 mg/l | — |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL-0.001mg/l) | 0.001 mg/l | — |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL-0.01mg/l) | 15 mg/l | 15 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.36 mg/l | 0.3 mg/l | 0.5 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL-0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37-1988RA2014 | BDL(MDL-0.01mg/l) | 0.05 mg/l | 0.2 mg/l |
| Location | Inference | | | |
| 1 | The analysis reveals that all the parameter within the acceptable limit except it is slightly acidic. Color also not in permissible limit means either water have some organic material in dissolved form or suspended particles and the dissolved oxygen content is less than prescribed limit, so also the BOD3 is greater than the allowable limit. Indicating that the water is containing biodegradable waste | | | |

**Note:** The sampling location and its respective distance from the dumpsite have been incorporated into Table 10. The stream is not use for any public use.


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**Ground Water Analysis:**

*Table 21 Groundwater Analysis*

| Parameter | Test Method | Location -1 | Location -2 | Location -3 | Acceptable Limit As per IS-10500-2012 |
|---|---|---|---|---|---|
| pH | IS 3025 (P) 11 – 1983RA2017 | 28 | 18 | 16 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 46 Hazen Unit | 228 Hazen Unit | 96 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 48 NTU | 96 NTU | 104 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 11.4 mg/l | 93.1 mg/l | 17.1 mg/l | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 4 mg/l | 68.46 mg/l | 12.7 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 7 mg/l | 20 mg/l | 16 mg/l | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | BDL(MDL-1mg/l) | 1.6 mg/l | 2.86 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | 4.67 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | BDL(MDL-0.1mg/l) | 0.28 mg/l | 0.28 mg/l | 200 mg/l |
| COD | IS 3025 (P) 58 - 2006RA2017 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | --- |
| TOC | APHA5310 | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 - 1988 RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | — |
| Nitrate as $NO_3$ | IS 3025 (P)34 - 1988RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 - 2008RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 1.0 mg/l |
| Nickel as Ni | IS 3025(P) 54- 2003RA2014 | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41 - 1992RA2014 | 0.12mg/l | 1.3 mg/l | BDL(MDL-0.01mg/l) | 0.003 mg/l |


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| Parameter | Test Method | Location -1 | Location -2 | Location -3 | Acceptable Limit As per IS-10500-2012 |
|---|---|---|---|---|---|
| Lead as Pb | IS 3025(P) 47-1994RA2014 | 0.10 mg/l | 1.1 mg/l | 2.54 mg/l | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42-1992RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59-2006RA2017 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 - 1994RA2014 | 20 mg/l | 18 mg/l | 16 mg/l | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | 46 mg/l | 228 mg/l | 96 mg/l | 5.0 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 48 mg/l | 96 mg/l | 104 mg/l | 1.0 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | 11.4 mg/l | 93.1 mg/l | 17.1 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37-1988RA2014 | 4 mg/l | 68.46 mg/l | 12.7 mg/l | 0.01 mg/l |
| Lat/Long: Location -1: [N- 12°30'55.788", E -74°59'11.2137"], Location -2 [N- 12°31'0.402", E -74°59'12.516"], Location -3 [N- 12°30'57.964", E -74°57'16.399"] | | | | | |

| Location | Inference |
|---|---|
| 1 | Color range of ground water is very higher than permissible limit , means either chances of having organic matter in the dissolved form or suspended particles or both. But due to high range of turbidity founded in ground water, there may be chances of more suspended impurities found in ground water. |
| 2 | The analysis reveals that all the parameter within the acceptable limit except it is slightly acidic. Color range of ground water is very higher than permissible limit , means either chances of having organic matter in the dissolved form or suspended particles or both. But due to high range of turbidity founded in ground water, there may be chances of more suspended impurities found in ground water. |
| 3 | Color range of ground water is very higher than permissible limit , means either chances of having organic matter in the dissolved form or suspended particles or both. But due to high range of turbidity founded in ground water, there may be chances of more suspended impurities found in ground water. |

**Note** : The sampling location and its respective distance from the dumpsite have been incorporated into Table 10.


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**Ambient Air Quality:**

*Table 22 Ambient Air Quality*

| Parameters | Test Method | Location - 1 | Location -2 | Limits as per NAAQS |
|---|---|---|---|---|
| Particulate Matter ($PM_{10}$) | IS 5182 Part 23 2006RA2012 | 38.6 µg/m3 | 66.8 µg/m3 | 100 µg/m³ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 16.3 µg/m3 | 21.3 µg/m3 | 60 µg/m³ |
| Sulphur Dioxide ( $SO_2$) | IS 5182 Part 2 2001 RA 2017 | 3.4 µg/m3 | 8.6 µg/m3 | 80 µg/m³ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 5.6 µg/m3 | 12.7 µg/m3 | 80 µg/m³ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | <1 mg/m3 | 1.3 mg/m3 | 4 mg/m³ |
| Ammonia ( $NH_3$) | CPCB | < 1 µg/m3 | < 1 µg/m3 | 400 µg/m³ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m3 | < 0.1 µg/m3 | 1 µg/m³ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m3 | <0.1 ng/m3 | 6 ng/m³ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m3 | <0.1 ng/m3 | 20 ng/m³ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m3 | < 1 µg/m3 | 180 µg/m³ |
| Benzene ($C_6H_6$) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m3 | < 0.1 µg/m3 | 5 µg/m³ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m3 | < 0.1 ng/m3 | 1 ng/m³ |
| Lat/Long: Location -1 [N- 12°30'58.032", E-74°59'09.533"], Location -2 [N-12°30'59.01", E-74°59'11.099"] | | | | |
| **Location** | **Inference** | | | |
| 1 | The analysis on ambient air reveals that all parameters are within the acceptable limits as per NAAQS. | | | |
| 2 | The analysis on ambient air reveals that all parameters are within the acceptable limits as per NAAQS. | | | |
| NOTE: The contractor is required to implement all necessary protective measures during the hardening process to ensure that air quality levels are maintained within permissible limits. | | | | |

**Note** : The sampling location and its respective distance from the dumpsite have been incorporated into Table 18.


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**Ambient Noise Level:**

*Table 23 Ambient Noise level*

| Date | Hourly Interval | Unit | Result | Limits in dB(A) Leq |
|---|---|---|---|---|
| 12.06.2023 | 11.00 Hrs | dB (A) | 52.5 | Commercial Area: Day time |
| | 12.00 Hrs | dB (A) | 57.8 | -75 dB(A) Leq |
| | 13.00 Hrs | dB (A) | 55.0 | Night time -70 dB(A) Leq |
| | 14.00 Hrs | dB (A) | 50.0 | |
| | 15.00 Hrs | dB (A) | 48.3 | |
| | 16.00 Hrs | dB (A) | 50.8 | |
| | 17.00 Hrs | dB (A) | 49.5 | |
| | 18.00 Hrs | dB (A) | 50.1 | |
| | 19.00 Hrs | dB (A) | 51.0 | |
| | 20.00 Hrs | dB (A) | 58.4 | |
| | 21.00 Hrs | dB (A) | 51.6 | |
| | 22.00 Hrs | dB (A) | 51.5 | |
| 13.06.2023 | 00.00 Hrs | dB (A) | 51.9 | |
| | 01.00 Hrs | dB (A) | 51.6 | |
| | 02.00 Hrs | dB (A) | 51.8 | |
| | 03.00 Hrs | dB (A) | 52.3 | |
| | 04.00 Hrs | dB (A) | 51.1 | |
| | 05.00 Hrs | dB (A) | 52.3 | |
| | 06.00 Hrs | dB (A) | 53.7 | |
| | 07.00 Hrs | dB (A) | 52.1 | |
| | 08.00 Hrs | dB (A) | 53.4 | |
| | 09.00 Hrs | dB (A) | 54.7 | |
| | 10.00 Hrs | dB (A) | 48.5 | |
| | 11.00 Hrs | dB (A) | 54.7 | |
| Avg. Leq Day – 52.4 dB (A) | | | | |
| Avg. Leq Night – 51.8 dB (A) | | | | |

| Location | Inference |
|---|---|
| 1 | The analysis reveals that noise levels are within the acceptable limits |


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**Leachate Analysis:**

*Table 24 Leachate Analysis*

| Parameters | Test Method | L1 | Limits for disposal to inland surface water |
|---|---|---|---|
| pH | IS 3025 (P) 11-1983 RA2017 | 5.64 | 5.5 to 9.0 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16-1984 RA2017 | 746 mg/l | 2100 mg/l |
| Total Suspended Solids | IS 3025 (P) 15-1984 RA2017 | 102 mg/l | 100 mg/l |
| Chloride as Cl | IS 3025 (P) 32-1988 RA2014 | 247.5 mg/l | 1000 mg/l |
| COD | IS 3025 (P) 58-2006 RA2017 | 320 mg/l | 250 mg/l |
| BOD( 3 days at 27 deg.cel) | IS 3025 (P) 44-1988 RA2014 | 112.6 mg/l | 30 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34-1988 RA2014 | 36.5 mg/l | 100 mg/l |
| Ammonical Nitrogen as N | IS 3025 (P) 34-1988 RA2014 | 17.4 mg/l | 50 mg/l |
| Phenolic Compound as C6H5OH | IS 3025 (P) 43-1992RA2014 | 1.2 mg/l | 1 mg/l |
| Fluoride asF | IS 3025 (P) 60-2008RA2014 | BDL(MDL-0.1 mg/l) | 2 mg/l |
| Cynadie as CN | IS 3025 (P) 27-1986 RA2014 | BDL(MDL-0.01 mg/l) | 0.2 mg/l |
| Nickel as Ni | IS 3025 (P) 54-2003 RA2014 | BDL(MDL-0.01 mg/l) | 3 mg/l |
| Cadmium as Cd | IS 3025 (P) 41-1992 RA2014 | BDL(MDL-0.001 mg/l) | 2 mg/l |
| Lead as Pb | IS 3025 (P) 47-1994 RA2014 | 0.87 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025 (P) 42-1992 RA2014 | 2.3 mg/l | 3 mg/l |
| Mercury as Hg | IS 3025 (P) 48-1994 RA2014 | BDL(MDL-0.001mg/l) | 0.001 mg/l |
| Zinc as ZN | IS 3025 (P) 49-1994 RA2014 | 5.2 mg/l | 5 mg/l |
| Total Arsenic as As | IS 3025 (P) 37-1988 RA2014 | BDL(MDL-0.01 mg/l) | 0.2 mg/l |

| Location | Inference |
|---|---|
| 1 | The analysis reveals that all the parameters fall within the acceptable limit except Zinc, Total Suspended Solids and Phenolic compounds were slightly higher than the allowable limit. The BOD is very higher than the allowable limit, indicating that the leachate is containing biological contents.. |


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## 6.5 RISK ASSESSMENT

**Surface Water:** Dumpsites can release pollutants into nearby surface water bodies through leachate, which is generated when rainwater or other liquids come into contact with the waste. Leachate can contain various contaminants such as heavy metals, organic compounds, and pathogens. Proper containment and management of leachate are essential to prevent water pollution.

In Kasaragod dumpsite, the analysis of surface water reveals that all the parameter are within the acceptable limit, except BoD, pH and colour value slightly surpasses the permissible limit and does not have any effect.

*Table 25 Risk Assessment- surface water*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite – BoD content & pH[Slightly surpassing the limit] |
| **Pathway** | Water / Run off |
| **Receptor** | Humans, Animals, Aquatic life and flora & fauna |
| **Risk** | No effect on receptor |

**Groundwater:** Pollutants from dumpsites can infiltrate into the underlying groundwater, particularly if the dumpsite is not adequately lined or if waste disposal practices have caused contamination of the soil. Once pollutants enter the groundwater, they can spread over a wide area, affecting drinking water sources and ecosystems. Remediation techniques often focus on preventing or minimizing further groundwater contamination.

In Kasaragod dumpsite, the analysis of ground water samples at three different locations reveals that except pH, turbidity, colour and presence of coliform and E coil all other parameters are within the limit The pH values slightly acidic in range. This acidic water creates irritation in nose and being corrosive in nature it corrodes pipelines.

*Table 26 Risk Assessment - Ground water*

| **Risk Assessment** | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite – pH, turbidity, coliform and E coli [Slightly surpassing the limit] |
| **Pathway** | Water, Soil |
| **Receptor** | Humans, Animals and flora & fauna |


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| | |
|---|---|
| **Risk** | Negligible impact on the receptor is anticipated, and following the remediation of the site, the associated value is expected to decrease. |

**Air**: Dumpsites may emit pollutants into the air through processes such as open burning of waste or the release of gases from decomposing organic materials. Airborne pollutants can include particulate matter, volatile organic compounds (VOCs), dioxins, and other hazardous substances. These pollutants can have adverse effects on air quality and human health.

In Kasaragod dumpsite, the analysis of Air samples at two different locations reveals that the air is not polluted.

*Table 27 Risk Assessment - air*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Nil |
| **Pathway** | Air |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | Nil |

**Soil**: Dumpsites can contaminate the surrounding soil with a wide range of pollutants. Hazardous chemicals, heavy metals, and organic compounds can leach from the waste and accumulate in the soil, potentially posing risks to plants, animals, and humans.

*Table 28 Risk Assessment - soil*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Heavy metals etc. |
| **Pathway** | Soil |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | **Possible risks to Human health**<br>Soils if contain substances such as heavy metals, which may be toxic to humans, can pass those substances on to humans through crop uptake, leading to unsafe foods.<br>**Possible risks to Animals**<br>When farm animals consume the plants grown from contaminated soil it affects the health of animals in later stage.<br>**Possible risks to flora** |


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| Risk Assessment | |
|---|---|
| | Soil pollution may alter plant metabolism and reduce crop yields and cause trees and plants that may absorb soil contaminants to pass them up the food chain. |

**Bioaccumulation in Biota**: Pollutants from dumpsites can enter the food chain and bio accumulate in plants and animals. Contaminated soil or water can be taken up by plants, and these plants may then be consumed by animals. As pollutants move up the food chain, their concentrations can increase, leading to potential health risks for humans and wildlife.

*Table 29 Risk Assessment - Bioaccumulation in Biota*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite –, BoD, zinc, lead and pH [Slightly surpassing the limit] |
| **Pathway** | Air, water and soil |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | Negligible impact on the receptor is anticipated, and following the remediation of the site, the associated value is expected to decrease. |


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# 7 EVALUATION OF REMEDIATION TECHNIQUES

Although the term "legacy waste" has not been defined in any official government document in India, it typically refers to aged municipal solid waste in landfills or dumpsites. These legacy dumpsites are creating various irreversible environmental/health/livelihood hazards. The major sources of pollution are:

- ✓ Puddles of leachate flowing through the adjacent area and reaching the water table long-term issues of greenhouse gas emissions
- ✓ Surface water and groundwater pollution due to erosion and seepage
- ✓ Dumpsite fires
- ✓ Due to the faster urban development and increased waste generation per capita and mismanagement of generated waste.

The dumpsites have emerged as pollution hubs, especially those situated in human settlements, as cities have grown over the decades. It has, therefore, become a necessity for the city authorities to remediate the existing dumpsites in an environmentally sound and economically viable manner.

**Remediation of legacy waste dumpsite**

Remediation is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

1. Uplift of the environment- reduction in greenhouse gas emissions, soil pollution, ground water contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.
2. Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in nearby real state value and rental values.
3. Land - Dumpsite land becomes available for public use or for setting up SWM facility on the reclaimed land.
4. Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled, or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels.

For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- ✓ A total station survey for assessment of volumetric quantity of legacy waste above the ground level.
- ✓ Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- ✓ History of the site, Physical features of site, as –is/current situation and compositional analysis of waste.
- ✓ Baseline study of heavy metals in surface;

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- ✓ water, rainfall, soil type, surface hydrology, topography, wind direction etc. shall be studied before and after bioremediation.
- ✓ Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area.

The details of the remediation techniques for the remediation of the legacy waste dumpsite remediation are as follows

## 7.1 BIO-MINING – RECLAMATION/RECOVERY OF LAND

Bio- mining is the scientific technique to extract materials of economic interest from legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) and followed by sustainable management through recycling, co-processing, road construction etc.

*Table 30 Phases of Bio-mining*

| Phases of Bio-mining | |
|---|---|
| Phase 1: Stabilization | The legacy waste is formed into equal-sized windrows, and which are turned frequently, bio-culture is added and de-odourizer (an odour-controlling agent) sprayed. This phase removes stench, reduces moisture and eliminates pathogens. |
| Phase 2: Sorting & Segregation | In this phase, stabilized legacy waste is sorted/segregated into bio earth, recyclables, refused derived fuel (RDF) and C&D through series of various sizes of Trommels/circular rotatory sieves and manpower. |
| Phase 3: Disposal & Utilization | In this phase, the non-combustible fractions such as soil and stones are disposed of for further processing into finer aggregates or for earth filling. The combustible fractions are called refuse-derived fuel (RDF) are sent for co-processing in cement industries. |

| | |
|---|---|
| Salient Aspects | land recovery, increase in value of land and available for public use/habitation with immediate effect.<br>Ensures long-term sustainability and environmentally sound treatment of legacy waste and present lucrative revenue-generating opportunities.<br>Bio products/aggregates generated from the process can be used as alternative construction material, fuel and recyclables.<br>Compliance to SWM Rules and NGT orders.<br>Improvement in aesthetics and quality of life & health. |
| Applicability | The ownership is well defined.<br>Working space is available in the dumpsite.<br>Linkage for utilization by-products is available |

## 7.2 CAPPING WITHOUT LAND RECOVERY


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Capping is a scientific process of profiling legacy waste and covering with barrier layers consisting of soil, high density polyethylene (HDPE) liner, gas collection system surface drainage system, and a vegetative cover to minimize the percolation of rainwater into the legacy waste.

| | |
|---|---|
| Salient Aspects | The capped area becomes a green space and can be developed into parks/recreational areas.<br>Capped area will be equipped with environmental monitoring systems for post-closure maintenance to monitor pollution levels in groundwater and surface-water sources and air (especially methane emissions) at least 15 years.<br>Capped area needs to be inspected periodically for settlement due to physical, chemical and biological transformation, leachate generation, erosion and naturally occurring invasion by deep-rooted vegetation. Recurring expenditure will be incurred for regular maintenance.<br>On July 17, 2019, the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested bio-mining as environmentally safe and the most preferable approaches to dumpsite remediation.<br>SWM rules do not permit habitation over it for at least 15 years because of the danger posed by toxic gases release by the waste. |
| Applicability | Capping could be a solution for legacy waste where bio-mining is not possible because of steep terrain, inaccessible ravines and narrow valleys.<br>Lack of linkage for utilization/ disposal of segregated components<br>Lack of working space & resources |

## 7.3 CAPPING WITH PARTIAL LAND RECOVERY

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can linked to relevant buyers and the inert material will be capped to prevent further degradation of the environment.

| | |
|---|---|
| Salient Aspects | The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.<br>Ensures short -term sustainability and environmentally sound treatment of legacy waste.<br>Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area |
| Applicability | Legacy waste dumpsite area partial of steep terrain, inaccessible ravines and narrow valleys.<br>Lack of linkage for disposal of inert<br>Recovery land for public use is not a priority |


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## 7.4 SELECTION OF REMEDIATION OPTION

Selection of the applicable method/type or technique is based on the factors like., salient aspects & applicability of remediation types viz., Capping without land recovery, Bio-mining – reclamation/recovery of land & capping with partial land recovery and also available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for land recovery and forward linkages/utilization of processed aggregates/by-products.

Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. It may be noted that the bio-earth and C&D material which will be recovered by remediation is proposed to be used for development of the reclaimed legacy waste dumpsite as recreational park/facility (for site development work/ profiling). The bio-earth and C&D material recovered will be subjected to bi-weekly sampling and conform to the parameters mentioned in Schedule II of SWM Rules 2016 before using the material. Considering the same, there won't be any leachate generation using this material. There won't be any capping done and hence the question of erosion etc. doesn't arise.

**Salient parameters for opting the Bio-mining – reclamation/recovery of land.**

1. Based on the assessment from the chemical analysis report from the M/s. Polluchem, all the heavy metals are within the permissible limits as prescribed by the regulatory authorities Soil is free of contamination viz., heavy metals, chemical and other toxic substances.
2. Land recovery, increase in value of land and available for public use/setting of SWM facility with immediate effect. An area of 1.1 acres will be reclaimed through bio-mining
3. Adequate downstream linkages for the management/disposal waste viz., Bio-earth and C&D waste will be utilized for development of the reclaimed legacy dumpsite as recreational park/facility, recyclables will be sold to the authorized recyclers & will be collected from the project site and RDF will be sent to Cement industries for co-processing viz., as supplement to the conventional fuel.
4. By products/aggregates generated from the process can be used as alternative construction material (after processing), fuel and recyclables.
5. The Solid Waste Management Rules, 2016 and several National Green Tribunal (NGT) directives have mandated that urban local bodies opt for bio-mining over capping.

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# 8 TECHNICAL DESCRIPTION OF THE SELECTED OPTION

## 8.1 METHODOLOGY

The legacy waste dumpsite reclamation through bio-mining with recovery of land involves Phase 1: stabilization, Phase 2: sorting & segregation and Phase 3: disposal & utilization

The type of machinery, capacity and type of screens to stabilize of the legacy waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) will depend on the physical site conditions including quantity & characteristics of legacy waste and utilization of the aggregates/by-products/recovered material.

The type machinery available for the bio mining are as follows:

1. Stationary screening machinery and
2. Mobile/compact machinery.




### 8.1.1 STATIONARY SCREENING MACHINERY

A Stationary trommel is a specialized piece of equipment used in legacy waste bioremediation processes to separate and classify solid waste materials. It is designed to efficiently screen and sort different components of the waste based on size and other characteristics. Technical description of a Stationary Trommel used in legacy waste bioremediation are as follows:

- ✓ Structure: The Stationary trommel consists of a frame made of steel or other durable materials. It is designed to withstand the harsh conditions of waste treatment facilities. The frame supports a cylindrical drum that is inclined at an angle for optimal material flow.
- ✓ Drum: The drum is the main component of the Stationary Trommel and is typically made of perforated metal or mesh. It is cylindrical in shape and rotates on its axis using a motorized drive system. The drum's 3- 5 mtr diameter and 10 mtr length can vary depending on the specific requirements of the waste treatment process.
- ✓ Motor and Drive System: The Stationary Trommel is equipped with a motor and drive system that powers the rotation of the drum. The motor is typically electrically powered and is connected to the drum through a gearbox or direct drive mechanism. The rotational speed of the drum can be adjusted to optimize the screening process.
- ✓ Inlet and Outlet: The Stationary Trommel has an inlet where the legacy waste is fed into the drum for processing. The waste material enters the drum at one end, typically assisted by a conveyor or loader. The screened waste material is discharged from the opposite end of the drum through an outlet.


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- ✓ Screening Mechanism: As the drum rotates, the legacy waste inside it is subjected to a combination of tumbling and rolling actions. The perforated drum allows smaller-sized particles and materials to pass through, while larger items such as bulky waste, debris, and contaminants are retained inside the drum. The drum's perforation size can be customized to achieve the desired separation efficiency.
- ✓ Waste Sorting: The Stationary Trommel facilitates the separation of different components within the legacy waste. It effectively segregates organic waste, inert materials, recyclables, and other categories based on their size and physical properties. This sorting process prepares the waste for further treatment or disposal.

Source: DCC Infra., Gurugram Site



*Figure 11 Stationary Trommel Machine*

Salient Features of Stationary Screening Machinery:

- Land requirement high for setting of machinery and processing area.
- Erection, Installation and Commissioning is time consuming
- Cost Intensive – CAPEX & OPEX high
- Electrical Power Intensive and Consumption is high
- Breakdown of the Machinery is high, onsite technicians should be available.
- Manpower – skilled & unskilled Intensive

  Suitable for quantity more than 2,00,000 ton of legacy waste.
- Less suitability for reuse of the machinery/screenings for more than one site/location.

### 8.1.2 MOBILE/COMPACT SCREENING MACHINERY

The Mobile Trommel is a technical apparatus utilized in legacy waste bioremediation processes. Its primary function is to separate and sort various types of waste materials, such as solid waste and organic matter, for effective bioremediation.

**Structure:** The trommel consists of a cylindrical drum, typically made of heavy-duty metal, which is inclined at a slight angle. The drum is supported by a framework and set in motion by a motor

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or engine, causing it to rotate slowly. The rotation of the drum allows the waste materials to be fed into the trommel at one end, while simultaneously moving the materials along its length. Large screening area (9.5 sq m). Helps in good quality segregation & high productivity.

**Screening Mechanism:** The Mobile Trommel incorporates various mechanical features to facilitate waste separation. As the waste enters the drum, it encounters a series of screens or perforations arranged along the length of the drum. These screens have different mesh sizes, which allow for the separation of different-sized particles. The smaller particles, such as sand or fine soil, pass through the screens and fall through openings at the bottom of the trommel, while larger materials, such as plastics or larger debris, are retained and carried along by the rotation of the drum.

**Separation System:** Additionally, the Mobile Trommel may be equipped with paddles or lifters mounted inside the drum. These paddles help to agitate and tumble the waste materials, assisting in the separation process by ensuring proper contact between the waste and the screens. They also help to break up clumps or aggregates, aiding in the release of trapped organic matter. Four different screen inclination angles for operations between 20°-35° are available for selection provides flexibility.

**Treatment Process:** In the context of legacy waste bioremediation, the Mobile Trommel plays a crucial role in preparing the waste for subsequent treatment steps. By separating the waste into different fractions based on particle size, it allows for targeted bioremediation processes. For example, the fine fraction may be subjected to aerobic or anaerobic composting, while the larger fraction can undergo mechanical or physical treatments.

**Transport:** Quick and easy folding of conveyor helps in quick setup time.

**Discharge height:** Wider conveyor and higher discharge heights help in making bigger stockpile and eliminates the frequent loader usages.



*Source: Kleemann Mobile Screens (Piranna, Ahamadabad Site)*

***Figure 12 Compact Screening Machinery***

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**Salient Features of Mobile/Compact Screening Machinery:**

- Full Mobility: Plants are fully mobile like excavator. Plants can be moved across the most difficult of surfaces and terrain and can accommodate the most inaccessible locations.
- Quick Set up time: Track-Mobile plants can normally be set-up within 1 hour, as it normally does not require additional conveyors, feed hopper to link separate machines, thus increasing machine utilization.
- Versatility: Track-Mobile plants can be operated independently or in combination of two or three stage screening depending upon user requirements.
- No Civil works required: Plants do not require any civil works, can be erected & shifted quickly. Thus offer quicker return on investment.
- Manpower requirement is less.

## 8.2 SELECTION OF MACHINERIES

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by- products as per the requirements of the utilization/forward linkage.

Based on the detailed assessment of the selection parameters listed above, the site conditions, legacy waste characteristics, statutory requirements etc, mobile / compact screening shall be the optimum screening machinery for the Kasaragod Dumpsite. The 16735.68 tons legacy waste can be remediated within the stipulated time by NGT i.e. 31st March 2024

**Salient parameters for opting the Mobile/Compact screeners.**

1. Sorting/segregation of the stabilized legacy waste of 20115 $m^3$/ 16735.68 Tons within the stipulated timeline of 31st March 2024.
2. The remediation process will be guided by National, State Regulations & EIA/EMP in line with KSWMP ESMF.
3. Salient Features of Mobile/Compact Screening Machinery – details are in the section 8.1.2

## 8.3 SYSTEM REQUIREMENTS

### 8.3.1 CAPACITY SIZING OF MOBILE COMPACT SCREENER

The capacity of the Mobile compact screener is assessed as **100 TPH.** The calculation shown is only indicative and the contractor is required to propose own design and capacity to complete the works in the stipulated time and standards. The details of plant capacity sizing are provided in the table below:

*Table 31 Capacity sizing of Mobile Compact Screener*

| Description | Quantity |
|---|---|
| Quantity of waste (Tons) | 16735.68 |
| Mobilization and site preparation (days) | 60 |
| Weekends & Holidays | 20 |


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| Description | Quantity |
|---|---|
| Rainy Days | 20 |
| Break downs (Days) | 15 |
| No of days (Dec 2023 - Mar 2024) | 60 |
| Effective processing days | 30 |
| Processing per day (16735/30) (Tons) | 557 |
| Capacity of the Plant - Considering working 8 hrs/day | 70 |
| Proposed Capacity of plant TPH | 100 |

### 8.3.2 MACHINERIES & VEHICLES

Detailed assessment of quantity (nos) of machinery, vehicles, auxiliary items required for effective processing of the legacy waste are provided in the Annexure – E. The summary of machineries and vehicles requirements are provided in the table below:

*Table 32 Machineries & Vehicles*

| S. No. | Description | Quantity(Nos) | Remarks |
|---|---|---|---|
| 1 | Mobile Trommel @ 100TPH | 1 | Detailed Specifications are provided at Annexure –F |
| 2 | Baling Machine @ 50TPD | 1 | |
| 3 | Ballistic Separator @ 30TPH | 1 | |
| 4 | Magnetic Separator | 1 | |
| 5 | Front End Loader @ Bucket Capacity 1Cum | 2 | |
| 6 | Chain Mounted Excavator @ Bucket Capacity 1.1 Cum | 2 | |
| 7 | Weighing bridge - 40 Ton | 1 | |
| 8 | Tipper @ 8 Cum | 5 | |
| 9 | Truck @ 22 Cum ( For RDF) | 2 | |
| 10 | Tractor - Trolley shift of Materials | 1 | |
| 12 | Tractor -Trolley Water Tanker | 1 | |
| 13 | Mechanical Sprayer | 2 | |
| 14 | Office - Portable cabin (1 Nos) | 1 | |
| 15 | GPS (5 Nos) & Tracking System (1 Nos) | 5 | |
| 16 | CCTV System (Cameras 5 Nos) | 5 | |
| 17 | Fire Safety System - Fire Extinguisher ABC type 4 Kg/cm2 | 10 | |

Note: Considering the size of the site, it is required that the contractor liaisons with the Fire Department and deploys a fire tender at the site during the period of the contract works to manage any fire incident as part of Fire Safety Plan.


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## 8.4 OPERATIONS AND MAINTENANCE

### 8.4.1 MANPOWER:

Detailed assessment manpower required for effective processing of the legacy waste are provided in the Annexure – I. The summary of manpower required are provided in the table below:

*Table 33 Manpower details*

| S. No | Manpower | Nos |
|---|---|---|
| 1 | Site In-charge/Head | 1 |
| 2 | Environmental, Social and Health & Safety (ESHS) Officer | 1 |
| 3 | Security (3 X 8 Hrs) | 3 |
| 4 | Operations Supervisor & Accountant | 2 |
| 5 | Machine Operator, Mechanic & Electrician | 2 |
| 6 | Labors for stone removal | 2 |
| 7 | Labors for spraying Bio culture | 2 |
| 8 | Labors near Screening machinery | 4 |
| 9 | Labors at Baling facility | 2 |
| 10 | Drivers for tipper trucks, excavators, backhoe loaders and tractors | 11 |

### 8.4.2 ELECTRICAL POWER:

*Table 34 Electrical Power details*

| Machineries | Required Electrical Load (KW) | Working Hr. | Total Units (KW-Hr) |
|---|---|---|---|
| Bailing Machine | 5 | 4 | 20 |
| Ballistic Separator | 15 | 6 | 90 |
| Magnetic Separator | 5 | 6 | 30 |
| Weigh bridge | 5 | 6 | 30 |
| **Total** | **30** | | **170** |


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### 8.4.3 FUEL/DIESEL FOR VEHICLES:

*Table 35 Fuel/Diesel for Vehicles*

| Description | Liters per Day |
|---|---|
| Fuel - Diesel Mobile Trommel (12 liters/hour) | 96 |

### 8.4.4 WATER REQUIREMENTS:

*Table 36 Water Requirements*

| Description | Liters per Day |
|---|---|
| Water Requirements For Workers and Other uses | 5000 |
| (Source – Municipality water Supply – At site, no provision for water supply.) | |

Note: The calculation shown above is only indicative and the contractor is required to propose own design and capacity to complete the works in the stipulated time and guidelines as per tender. The responsibility of availing necessary power and water connection shall be with the contractor as condition precedent before starting the work.

Further, considering the size of the site, it is required that the contractor liaisons with the Fire Department and deploys a fire tender team at the site during the period of the contract works to manage any fire incident as part of Fire Safety Plan. Alternatively, general SOPs for fire safety detailed herewith are to be followed:

a) Fire Fighting System including fire hydrant, pressure pumps, 5000 Ltr (min) water storage, adequate hose reel and fire extinguishers to be provided at site.
b) Alternate source of power (DG)
c) Manual Fire Alarm System with evacuation plan
d) Regular check, maintenance of equipment's for firefighting (before initiating work and then at interval of 1 months thereof)
e) Training to all men. (Before initiating work and then at interval of 3 months thereof).
f) Maintaining fire line while storage of material (RDF). RDF to not exceed 10% of total estimated waste at site at any given time.
g) Any other requirement in consultation with local Fire & Rescue Services office.


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# 9 SCOPE OF DISPOSAL INCLUDING LOCATION OF DISPOSAL FOR RDF, BIO SOILS, C & D WASTE, AND OTHERS AS PER LOCAL DEMANDS

## 9.1 UTILIZATION OF BY PRODUCTS

The details of the utilization of aggregates/by-products screened out by processing of the stabilized legacy waste are provided in the table below

*Table 37 Utilization RDF, bio soils, C & D waste*

| S.No | Component | Quantity (Cu.m) | Utilization/Linkage/Usage |
|---|---|---|---|
| 1 | Bio earth and C&D Waste | 14281.65 | The bio earth and C&D from waste will be utilized for development of the reclaimed legacy waste dumpsite as recreational park/facility. |
| 2 | RDF | 5239.96 | RDF will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel. Currently the indicative nearest location for the RDF disposal is at Dalmia Cements, Trichy which has the necessary infrastructure for co-processing of RDF. |
| 3 | Recyclables & others | 593.39 | Recyclables will be sold to CKCL/recyclers authorized by KSPCB/CPCB. |
| Note: The contractors engaged in biomining will be responsible for ensuring this disposal of Bio Earth, RDF, recyclables, and others. | | | |


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## 10 ESTIMATED PROJECT COST

The details of the estimated cost for bio-mining - recovery of land by remediating legacy waste dumpsite is provided in the table below:

*Table 38 Details of Estimated Project Cost*

| Estimate for Dumpsite remediation considering Forward Linkage | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sr. No. | Activity | Details | Rate/ m3 | Cost Index @ 1.35 * A | COP @ 1.15 * C | % weightage consideration | Round off (INR) | Quantity (m3) | Amount (Rs) |
| | | | A | B | D | | | | |
| 1 | Remediation/ Biomining | Rate adopted from Calculation from Suchitwa Mission (DSR 2018 including baling) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 2 | Transportation of RDF | The average distance to cement factories works out to be 400 km. [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 3 | Disposal of recyclable | Considering that the recyclable will be sold at rate of [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 4 | Disposal of Inert | Considering the disposal cost of [redacted] (market rate) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 5 | Disposal of Compost / Soil enricher | Considering the disposal cost of [redacted] (market rate) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| | | | | | | | | | [redacted] |
| | Environmental & Social Safeguard estimated amount for the implementation and monitoring | | | | | | | | [redacted] |
| | Grand Total | | | | | | | | [redacted] |

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| | |
|---|---|
| | The above rates are for each line item identified to be quoted by the bidders for various activities. [redacted] |
| NOTE | |
| 1 | [redacted] |
| 2 | [redacted] |
| 3 | [redacted] |
| 4 | The estimate is based on the information available. The actual cost may vary from site to site based on results of dumpsite investigations report and contractors forward linkages |

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## 10.1 REVENUE FROM THE PROJECT

The anticipated sources of revenue from the processing of the legacy waste dumpsite viz., by sale Bio earth & C&D waste, organic compost, RDF and recyclables. But due to the following reasons mentioned below no revenue from the project is considered

- Bio earth & C&D waste will be utilized within the remediated dumpsite as filler material for development of recreational park.
- RDF is utilized as fuel (co – processing) in the cement industries, presently most cement industries are only accepting the RDF at no cost whereas transportation cost is required to be borne by the contractor sending the RDF to the cement factory/ WtE facility.
- The uncertainty of quantity and quality of the recyclables from legacy dumpsite due to burnt or crushed or disintegrated, rusted and additional money is required for cleaning of the recyclables for saleable.

## 10.2 FUNDING FOR PROJECT

The estimated cost of [redacted]/- for the project Dumpsite Remediation which equals to [redacted]/- per $m^3$. The sources and funding pattern is given below:

*Table 39 Funding for the project*

| Item | External (70%) Rs. | State Govt.(30%) Rs. | Total cost Rs |
|---|---|---|---|
| Bioremediation | [redacted] | [redacted] | [redacted] |


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# 11 PROJECT IMPLEMENTATION PLAN

## 11.1 PROPOSED OPERATIONAL PLAN

The bioremediation of Kasaragod dumpsite will be done with the land recovery and will be executed through an outsourcing model. The proposed operational plan is provided at the Annexure - I

## 11.2 TIMELINE

In compliance with the National Green Tribunal (NGT) orders, it is mandatory to remediate all dumpsites in Kerala by March 2024. To ensure timely completion and compliance with the deadline, timeline for the implementation of project is provided below.

| S No | Description | Indicative Time frame |
|---|---|---|
| 1 | Start date | 01/12/2023 |
| 2 | End date | 31/03/2024 |



## 11.3 CONTRACT MODEL

**Execution Method:**

- Item Rate Contract and disposal/Management of by-products/aggregates with land recovery and redevelopment of the site with inert/ soil enricher. The work shall be carried out in compliance with SWM Rules 2016 and CPCB Guidelines for the disposal of legacy waste 2019.

**Working Model:**

- 100% work to outsourced to selected private contractor
- Technical Support Consultants (TSC) will assess the quantity of waste and the ULB will hand over the land for setting up the plant to the Contractor.
- Cost of Electricity connection to be provided by ULB for the plant.
- Electricity charges for the usage of the plant to be paid by contractor
- Contractor is responsible for disposal of RDF, recyclables, and aggregates


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## 12 BENEFITS OF THE PROJECT

Remediation of legacy waste dumpsite in the Kasaragod leads to the following anticipated benefits:

- **Reclamation of Land**: An area of 1.1 acres will be reclaimed and will be developed into a recreational park for public use. A contamination assessment is to be carried out before any public use project is taken up at the location.
- **Environmental Protection**: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By cleaning up contaminated sites, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity. The project shall arrest GHG emissions from the legacy dumpsite.
- **Health Improvement**: Remediation projects reduce these risks, leading to improved public health outcomes and a reduction in waterborne and airborne diseases.
- **Enhanced Water Quality**: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to the safe drinking water.
- **Aesthetic and Social Benefits**: Remediation of legacy waste dumpsite can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents. Uncontrolled waste dumping will be stopped.
- **Operational & Life cycle Aspects**

  Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through bio-mining process.
- **Employment**

  During remediation & post- remediation period, requirement of un-skilled labor will be fulfilled by s local sourcing.

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# 13 CONCLUSION

- The activities of the bio-mining will be commenced from Dec 2023 to Mar 2024. An area of 1.1 acres will be reclaimed and will be developed into a recreational park for public use after contamination assessment.
- Through the process of bio mining the dumpsite, complete land reclamation and recovery, while prioritizing environmental safeguards. This means that the land will be reclaimed and put to use.
- Considering site conditions and quantum, screening of the 20115 $m^3$ of legacy waste, mobile / compact screening machinery will be preferred.
- Favorable site conditions for bio-mining:
    1. Optimum width (5 m) of the road is available for movement of the vehicles.
    2. Electrical power infrastructure viz., power lines & electrical transformer is available adjacent to the boundary of the dumpsite.
    3. At the dumpsite plot, a vacant land parcel of approx. 0.20 acres is available for the installation of auxiliary infrastructures, supporting conditions movement of processing machinery and vehicles.
- The project activity requires to obtained "Site Authorization, Consent to Establish and Consent to Operate" from KSPCB
- By-products utilization/forward linkages/Usage
    1. The bio earth & C&D quantity of 10057.50 m3 & 4224.15 m3 respectively is proposed to be utilized after testing for the contamination for development of the reclaimed land as recreational park/facility. The contraction shall level the site in consultation with the PIU/TSC/DPMU.
    2. Refused derived fuel (RDF) of 5239.96 m3 will be to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the processes. The indicative location of cement plant is Dalmia Cements, Trichy.
    3. Recyclables of 593.39 m3 will be sold to CKCL /Private recyclers authorized by KSPCB/CPCB
- The implementation/execution of the project activities shall be conforming to SWM Rules 2016, NGT orders, KSPCB norms, CPCB guidelines and KSWMP ESMF and other regulatory rules & norms.
- Environmental & Social safeguards:
    1. The project attracts E2 Environmental category based on the Environmental Screening and Exclusions mentioned in the Environmental and Social Framework Guidelines.
    2. Site specific Environmental Assessment and Environmental Management Plan has been developed.
    3. The project attracts moderate risk social category based on the social mapping & transect walk to understand the settlements/habitations/establishments etc., and consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.
- Total cost of the project is Rs. [redacted]/- (INR [redacted]). The cost per $m^3$ for processing and disposal of the legacy waste is [redacted]/- per $m^3$.

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ANNEXURES

*Table 40 List of Annexures*

| Annexures | Description |
|---|---|
| Annexure A | GEOTECHNICAL TEST REPORT |
| Annexure B | ENVIRONMENTAL TEST REPORT |
| Annexure C | PHOTOGRAPHS –SAMPLING |
| Annexure D | VOLUMETRIC ANALYSIS |
| Annexure E | SITE PLAN |
| Annexure F | SURVEY CONTOUR PLAN |
| Annexure G | REQUIREMENT OF VEHICLE & MACHINERY |
| Annexure H | SPECIFICATION OF MACHINERIES & VEHICLES |
| Annexure I | PROPOSED OPERATIONAL PLAN |
| Annexure J | LSGD GUIDELINES FOR REMEDIATION OF LEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION |


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Annexure-A

# GEOTECHNICAL TEST REPORT

MatterLab
Where Quality Matters

Report Number: **ML/GT/2223/240/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE D OF KSWMP AT KELUGUDDE, KASARAGOD, KASARAGOD DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | Project Manager, IPE Global Ltd. |
| Address | : | 2nd Floor, 16/3878-3879, Kavanatt Building, Kanayancoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact Person | : | - |
| Project No | : | GT-234 |
| Project Name | : | Geotechnical examination of dumpsite under package D of KSWMP at Kelugudde, Kasaragod, Kasaragod District. |
| Owner | : | KSWMP |
| Project Location | : | Kelugudde, Kasaragod |
| Tel / Fax No | : | - |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 13-07-2023 | 1st Submission | Dr. Gautham Adapa | |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Dr. Jimmy Thomas | Geotechnical Expert, Consultant, MatterLab | |
| Approved by: | Freddy Soman | General Manager, MatterLab | |



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1 INTRODUCTION ..... 3

2 SCOPE OF WORK ..... 3

3 OBSERVATIONS FROM SITE VISIT ..... 3

4 GEOTECHNICAL INVESTIGATIONS ..... 4

5 LABORATORY ANALYSIS ..... 6

6 SUMMARY ..... 7

## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results

# 1 INTRODUCTION

Matter Material Testing and Research Laboratory Pvt. Ltd has been set-up as a result of increased demand locally from various industries for a multidisciplinary testing, materials consultancy & investigation facility in alignment with global standards and technology advancements. MatterLab is an independent professional and technical services provider to all who are concerned with quality and performance of materials & products.

IPE Global Ltd. which provides technical support consultancy services to the Urban local bodies in different municipalities for the Kerala State Waste Management Project (KSWMP) has entrusted the geotechnical investigative works as part of their DPR study for the remediation of dumpsite in Kelugudde, Kasaragod, Kasaragod district to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was bored using a rotary drill. The initial site visit was done on 20th May 2023. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 09th June 2023 and was completed on 20th June 2023. Standard Penetration test (SPT) was conducted within the borehole as required. Representative and undisturbed soil samples were collected to conduct relevant laboratory tests to acquire the necessary parameters. This report presents results of the geotechnical investigation of the ground encountered after drilling through the waste at the dumpsite.

# 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil samples and performing necessary laboratory tests on the collected samples to obtain the desired parameters of the ground profile.
- Preparation of report with laboratory test results.

# 3 OBSERVATIONS FROM SITE VISIT

Matterlab has deputed a team from our geotechnical department along Mr. Kamal Kishore Jha of IPE Global during the third week of May 2023, in order to collect the information regarding the site prior to mobilizing the equipment for drilling.




**Figure 1** : Location of the borehole drilled at the dumpsite.

## 4 GEOTECHNICAL INVESTIGATIONS

### 4.1 Rotary drilling

Rotary drilling technique was adopted for advancing and clearing out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste at the dumpsite.

### 4.2 Drilling equipment

Mechanical rigs of rotary drilling machine were used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The borehole of 150mm diameter was formed using a drag bit (Soil Cutter) in soil. The drag bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by drilling mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

### 4.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as representative samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log the commencement and completion date, location of borehole, elevation of top and bottom of boring, ground water table, boundaries of each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelog is attached as **Appendix-I.**

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant Standard Codes. A summary of laboratory tests carried out is shown below in **Table 1** and the complete results of laboratory testing are presented in **Appendix II**.



**Figure 2 :** Laboratory tests performed at MatterLab.

**Table 1: Details of various laboratory tests and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 1 | Soil | Grain-Size Analysis | IS: 2720(Part-4)-1985 |
| 2 | | Atterberg's Limit | IS: 2720(Part-5)-1976 |
| 3 | | Moisture Content | IS 2720(Part 2)-1973 |

## 6 SUMMARY

The geotechnical examination on the soil samples collected after boring through the waste at the dumpsite at Kelugudde, Kasaragod, Kasaragod district was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a single borehole was bored using a rotary drilling method. The maximum depth of investigation was 9.0 m (4.5 m in waste and 4.5 m in the ground). SPT and collection of undisturbed samples were carried out at regular intervals. Various laboratory tests were carried out on the SPT and undisturbed soil samples.

Based on the investigations carried out, it was observed that the original ground below the waste comprises of a 2.5m thick sandy layer underlain by a 2.0 m thick clayey layer until the depth of termination. The tests mentioned in the above table were performed on the samples in the laboratory following the respective codes to obtain the necessary parameters. The laboratory results on samples obtained from the site are appended in **Appendix II**.

# APPENDIX-I

# BORELOGS

Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT** | **: Geotechnical Investigation at Dumpsite in Kelugudde, Kasaragod.** | **SHEET NO.** | **: 1 of 1`** | **START DATE** | **: 09/06/2023** |
| **CLIENT** | **: Project Manager, IPE Global.** | **BORE DIAMETER (mm)** | **: 150** | **END DATE** | **: 20/06/2023** |
| **Proposed Structure :** | **Dumpsite remediation** | **BORING TYPE** | **: Rotary** | **REDUCED LEVEL (m)** | **: -** |
| **LOCATION** | **: Kelugudde, Kasaragod, Kasaragod District.** | **TERMINATION DEPTH (m)** | **: 9** | **EASTING (m)** | **: 74.986396** |
| **BOREHOLE NO.** | **: BH-01** | **WATER LEVEL** | **: -** | **NORTHING (m)** | **: 12.516302** |

| DEPTH m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM N1 | N2 | N3 | SPT N VAL | DEPTH V/S N VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.5 | | Plastic waste deposit | 4.5 | | | | | | | | |
| 5.0 | | Hard reddish silty CLAY with fine sand | 0.5 | 4.5 | SPT-1 | 7.0 | 8 | 50 | >5 | | |
| | | Reddish clayey SILT with fine grained sand and traces of gravels | | 5.0 | UDS-1 | | | | | | |
| | | Hard reddish clayey SILT with fine grained sand and traces of gravels(Lateritic soil) | 4.0 | 6.0 | SPT-2 | 40 | > | > | >5 | | Balance- 28cm |
| | | | | 6.5 | SPT-3 | >50 | > | >50 | >5 | | Balance-27cm |
| | | | | 7.0 | SPT-4 | 22 | 30 | > | >5 | | Balance-17cm |
| | | | | 7.5 | SPT-5 | 18.0 | >50 | > | >5 | | Balance-29cm |
| | | | | 8.0 | SPT-6 | 19 | 32 | >50 | >5 | | Balance-10cm |
| | | | | 8.5 | SPT-7 | 15 | 17 | 13 | 30 | | |
| 9.0 | | | | 9.0 | SPT-8 | 16 | 20 | 15 | 35 | | |
| | | **Bore hole terminated at the depth of 9.00m below top of waste (4.5m below original ground level)** | | | | | | | | | |

Abbreviations
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
CR- Core Recovery, RQD- Rock Quality Designation

Sd/-
Site Supervisor

# APPENDIX-II

# LABORATORY TEST RESULTS

# SUMMARY OF LABORATORY TEST RESULTS

**Report Number : ML23/R-02242 Report Date:05/07/2023**

**Project : Geotechnical Investigation at Dumpsite in Kelugudde, Kasaragod**

**Borehole ID : BH-01**

| N value | MatterLab ref | Depth (m) | Type of sample (SPT/UDS/RC) | Soil description | IS Classification | Atterberg Limit | | | Grain size distribution | | | | | | | Water content (w), % | Bulk Density, gm/cc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit,% | Plastic Limit,% | Plasticity Index | Coarse Gravel,% | Fine Gravel,% | Coarse Sand,% | Medium Sand,% | Fine Sand,% | Silt,% | Clay,% | | |
| 6 | ML23/W-02242/S1 | 4 5 | SPT | Silty sand with gravel | SM | | | | | 19 | 8 | 14 | 14 | 24 | 21 | | |
| | ML23/W-02242/S2 | 5 0 | UDS | Poorly graded sand with gravel and silt | SM | | | | 7 | 33 | 21 | 22 | 6 | 11 | | 14 | 2 10 |
| >50 | ML23/W-02242/S3 | 6 0 | SPT | Poorly graded sand | SP | | | | | | 29 | 65 | 3 | 3 | | | |
| >50 | ML23/W-02242/S5 | 7 0 | SPT | Clay of high plasticity with sand | CH | 69 | 29 | 40 | | | | | | | | 26 | |
| >50 | ML23/W-02242/S6 | 7 5 | SPT | Clay of high plasticity with sand | CH | | | | | 2 | 2 | 11 | 12 | 41 | 32 | | |
| >50 | ML23/W-02242/S7 | 8 | SPT | Clay of high plasticity with sand | CH | 51 | 26 | 25 | | | | | | | | | |
| 30 | ML23/W-02242/S8 | 8 5 | SPT | Sandy clay of high plasticity | CH | | | | | 11 | 9 | 11 | 9 | 29 | 31 | 28 | |
| 35 | ML23/W-02242/S9 | 9 | SPT | Sandy clay of high plasticity | CH | 62 | 27 | 35 | | | | | | | | | |

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Mini Bypass Road, Thiruvannur Nada (PO) Thiruvannur,
Kozhikode, Kerala, 673028.

# Grain Size Distribution of Soil Test Report

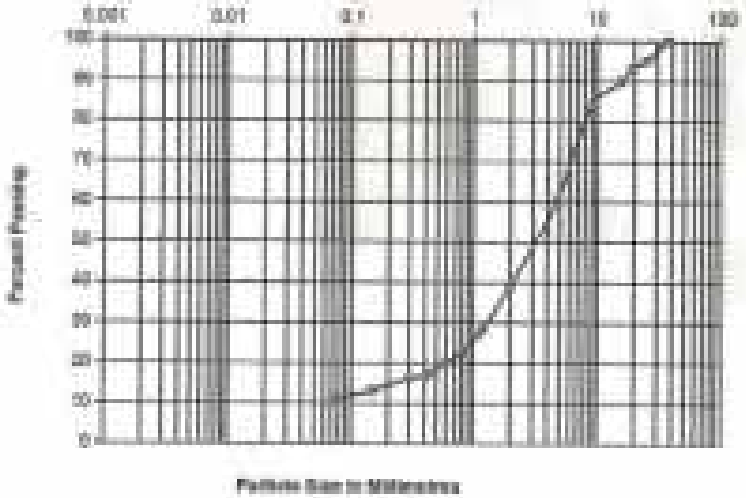
Report No: ML/2023/07/0170
Issue No : 1
Report Date: 05/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 15/3878 - 3879, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalugundde, Kasargod |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalugundde, Kasargod |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 27-06-2023 | Client Sample Ref.*): | Soil (UDS); BH 01, Depth 5.00m |
| Work Order ID: | ML23/W-02242 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02242/02 | Source*): | BH 01, Depth 5.00m |
| Date Sampled: | 20/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*): | Kalugundde, Kasargod | Date Tested : | 28/06/2023 - 30/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS); BH 01, Depth 5.00m |
| Tested By: | SK | Client Sample Desc.*): | Soil (UDS); BH 01, Depth 5.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution - Wet and Dry Sieving

Method: IS: 2720 (Part 4)-1985




| Sieve Size (mm) | % Passing | Project Limit |
|---|---|---|
| 37.50 | 100 | - |
| 25.00 | 96 | - |
| 19.00 | 93 | - |
| 10.00 | 90 | - |
| 9.500 | 85 | - |
| 4.750 | 80 | - |
| 2.000 | 38 | - |
| 1.180 | 28 | - |
| 0.850 | 23 | - |
| 0.600 | 20 | - |
| 0.425 | 17 | - |
| 0.300 | 16 | - |
| 0.150 | 13 | - |
| 0.075 | 11 | - |

For and on behalf of MatterLab

Comments
*Information provided by client

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These results relate only to the samples tested.



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Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur Nada (PO) Thiruvannur,
Kozhikode, Kerala, 673028.

# Grain Size Distribution of Soil Test Report

Report No: ML23/R-0234202
Issue No.: 1
Report Date: 03/07/2023

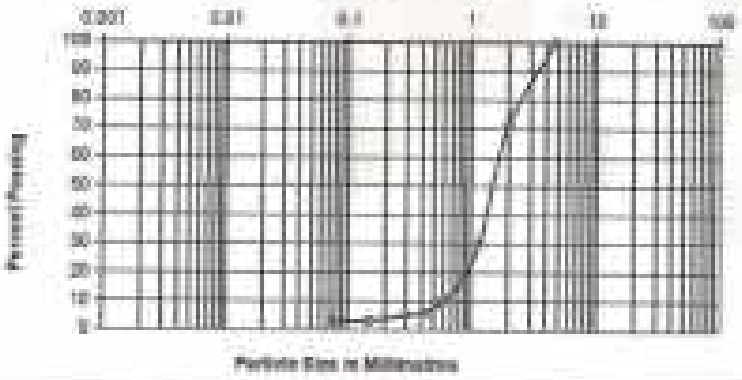
| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 1673/678 - 3679, Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-629000 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kelugoddu, Kasargod |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kelugoddu, Kasargod |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27-06-2023 | Client Sample Ref.*: | Soil, BH 01, Depth 6.00m |
| Work Order ID: | ML23/W-02242 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02242/03 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 20/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kelugoddu, Kasargod | Date Tested : | 28/06/2023 - 30/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 6.00m |
| Tested By: | GR | Client Sample Desc.*: | Soil, BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution - Wet and Dry Sieving

Method: IS: 2720 (Part 4)-1985




| Sieve Size (mm) | % Passing | Project Limit |
|---|---|---|
| 4.750 | 100 | - |
| 2.000 | 71 | - |
| 1.180 | 30 | - |
| 0.850 | 17 | - |
| 0.600 | 10 | - |
| 0.425 | 6 | - |
| 0.300 | 5 | - |
| 0.150 | 3 | - |
| 0.075 | 3 | - |

For and on behalf of MatterLab

**Comments:**
*Information provided by client

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These results relate only to the samples tested.



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Mini Bypass Road, Thiruvannur Nada (PO) Thiruvannur,
Kozhikode, Kerala, 673020.

# Water Content of Soil Test Report

Report No: ML23/R-022402
Issue No : 1
Report Date: 05/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 19/3878 - 3879, Kaveraat Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kelugoddi, Kasargod |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kelugoddi, Kasargod |
| Tel / Email: | - |

IN-TC107423308E485IF

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil (UDS), BH 01, Depth 5.00m |
| Work Order ID: | ML23/AN-02242 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/AN-02242/02 | Source*: | BH 01, Depth 5.00m |
| Date Sampled: | 22/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx. |
| Sample Location*: | Kelugoddi, Kasargod | Date Tested : | 28/06/2023 - 29/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No./ Lot Size: | - | Lab Sample Desc.: | Soil (UDS), BH 01, Depth 5.00m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS), BH 01, Depth 5.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w) % | 14 | - |

For and on behalf of Matter Lab

Comments:
*Information provided by client

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Kozhikode, Kerala, 673029.

# Water Content of Soil Test Report

Report No: ML23R-02342/W
Issue No: 1
Report Date: 04/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 1503/B - 3879, Kawanat Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalluputide, Kasargod |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalluputide, Kasargod |
| Tel / Email: | - |

ULR-TC437623000088452F

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*): | Soil, BH 01, Depth 7.00m |
| Work Order ID: | ML23W-02342 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02342/08 | Source*): | BH 01, Depth 7.00m |
| Date Sampled: | 20/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*): | Kalluputide, Kasargod | Date Tested : | 28/06/2023 - 29/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 7.00m |
| Tested By: | GK | Client Sample Desc.*): | Soil, BH 01, Depth 7.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content, (w),% | 26 | - |

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Kozhikode, Kerala, 673328

## Water Content of Soil Test Report

Report No: ML23/R-023435
Issue No: 1
Report Date: 03/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 19/3878 - 3879, Kaveratt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kalugumala, Kasargod |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kalugumala, Kasargod |
| Tel / Email: | - |

ULR-TC107481230300048535F

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 8.50m |
| Work Order ID: | ML23/W-02342 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02342/58 | Source*: | BH 01, Depth 8.50m |
| Date Sampled: | 20/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kalugumala, Kasargod | Date Tested : | 28/06/2023 - 28/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 8.50m |
| Tested By: | GK | Client Sample Desc.*: | Soil, BH 01, Depth 8.50m |
| Test Location: | MatterLab - Kozhikode | | |

### Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 39 | - |

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Kozhikode, Kerala, 673029.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-0224205
Issue No : 1
Report Date: 05/07/2023

| | |
|---|---|
| **Client:** | Project Manger, IPE Global |
| **Address:** | 2nd Floor, 16/3879 - 3879, Kaveratt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-628030 |
| **Contact:** | - |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kelugudde, Kasargod |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kelugudde, Kasargod |
| **Tel / Email:** | - |

UR-TC102423000000454F

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 27/06/2023 | **Client Sample Ref.*:** | Soil, BH 01, Depth 7.00m |
| **Work Order ID:** | ML23/W-02242 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02242/55 | **Source*:** | BH 01, Depth 7.00m |
| **Date Sampled:** | 20/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2131 - 1981 | **Sample Size(kg):** | 5 Approx |
| **Sample Location*:** | Kelugudde, Kasargod | **Date Tested :** | 29/06/2023 - 01/07/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil, BH 01, Depth 7.00m |
| **Tested By:** | VY | **Client Sample Desc*.:** | Soil, BH 01, Depth 7.00m |
| **Condition of Soil:** | Natural | **Period of Soaking:** | 24 Hrs |
| **Test Location:** | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3 Mechanical Method | Liquid Limit,% | 69 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 29 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 40 | - |

For and on behalf of MatterLab

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Kozhikode, Kerala, 673028.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-0234207
Issue No : 1
Report Date: 05/07/2023

| | |
|---|---|
| **Client:** | Project Manger, IPE Global |
| **Address:** | 3rd Floor, 16/3878 - 3879, Kavarati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| **Contact:** | - |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kelugudda, Kasargod |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kelugudda, Kasargod |
| **Tel / Email:** | - |

ULR-TC507423000004855F

## Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 27/06/2023 | **Client Sample Ref.*:** | Soil, BH 01, Depth 8.00m |
| **Work Order ID:** | ML23/W-02242 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02242/S7 | **Source*:** | BH 01, Depth 8.00m |
| **Date Sampled:** | 20/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2131 - 1981 | **Sample Size(kg):** | 5 Approx |
| **Sample Location*:** | Kelugudda, Kasargod | **Date Tested :** | 28/06/2023 - 01/07/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil, BH 01, Depth 8.00m |
| **Tested By:** | VY | **Client Sample Desc*.:** | Soil, BH 01, Depth 8.00m |
| **Condition of Soil:** | Natural | **Period of Soaking:** | 24 Hrs |
| **Test Location:** | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3: Mechanical Method | Liquid Limit,% | 51 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 26 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 25 | - |

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Kozhikode, Kerala, 673029.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-02342/B
Issue No : 1
Report Date: 05/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 16/3878 - 3879, Kaveratt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kelugudde, Kasargod |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kelugudde, Kasargod |
| Tel / Email: | - |

UW-TC70343 2 3 0 0 0 0 1 0 5 6 P

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 9.00m |
| Work Order ID: | ML23/W-02342 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02342/S9 | Source*: | BH 01, Depth 9.00m |
| Date Sampled: | 20/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kelugudde, Kasargod | Date Tested : | 29/06/2023 - 01/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 9.00m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 9.00m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720(Part 5)-1985-Cl.3: Mechanical Method | Liquid Limit,% | 62 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 27 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 35 | - |

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Thiruvannur, Kozhikode, Kerala, 673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/W-02242/02
Issue No: / 1
Report Date: 05/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 19/3878 - 3879, Kavarati Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Kaliguddie, Kasargod |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kaliguddie, Kasargod |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil (LDS), BH 01, Depth 5.00m |
| Work Order ID: | ML23/W-02242 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02242/02 | Source*: | BH 01, Depth 5.00m |
| Date Sampled: | 20/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Kaliguddie, Kasargod | Date Tested : | 28/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (LDS), BH 01, Depth 5.00m |
| Tested By: | GK | Client Sample Desc.*: | Soil (LDS), BH 01, Depth 5.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2): 1990 | Bulk Density of Soil, g/ml | 2.10 | - |
| | | | |

SREELESH T.V
Assistant Civil Laboratory

For and on behalf of MatterLab

**Comments**

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Thiruvannur, Kozhikode, Kerala, 673029

## Hydrometer Analysis Test Report

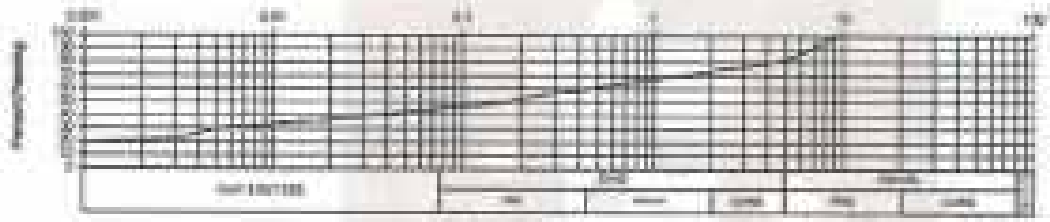
| | | | |
|---|---|---|---|
| Client: | Project Manger, IPC Global | Consultant: | - |
| Address: | 2nd Floor, 1978/B - 1978, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 | Owner: | KSHWP |
| Contact: | - | Contractor: | - |
| Project No: | - | Project Location: | Kakugulida, Kasargod |
| Project Name: | Geotechnical Investigation at Dumpsite in Kakugulida, Kasargod | Tel / Email: | - |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 21/05/2025 | Client Sample Ref.*): | Soil, BH 01, Depth 4.50m |
| Work Order ID: | ML/25/01-02342 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML/25/01-02342/01 | Source*): | BH 01, Depth 4.50m |
| Date Sampled: | 21/05/2025 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2132 - 1981 | Sample Size(kg): | 1 Approx |
| Sample Location*: | Kakugulida, Kasargod | Date Tested: | 21/05/2025 - 22/05/2025 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 4.50m |
| Tested By: | RH | Client Sample Desc.*): | Soil, BH 01, Depth 4.50m |
| Test Location: | Matterlab - Kozhikode | | |

### Particle Size Distribution

Method: IS: 2720 (Part 4) 1985, Cl.9.5



Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 91 |
| 2.000 | 73 |
| 1.000 | 58 |
| 0.600 | 53 |
| 0.425 | 50 |
| 0.300 | 47 |
| 0.150 | 42 |
| 0.075 | 40 |
| 0.047 | 40 |
| 0.039 | 38 |
| 0.028 | 36 |
| 0.014 | 34 |
| 0.010 | 33 |
| 0.007 | 32 |
| 0.005 | 29 |
| 0.004 | 26 |
| 0.003 | 22 |
| 0.001 | 19 |

| | |
|---|---|
| Gravel % | 10 |
| Sand % | 50 |
| Silt % | 29 |
| Clay % | 11 |

For and on behalf of MatterLab

### Comments

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# Hydrometer Analysis Test Report

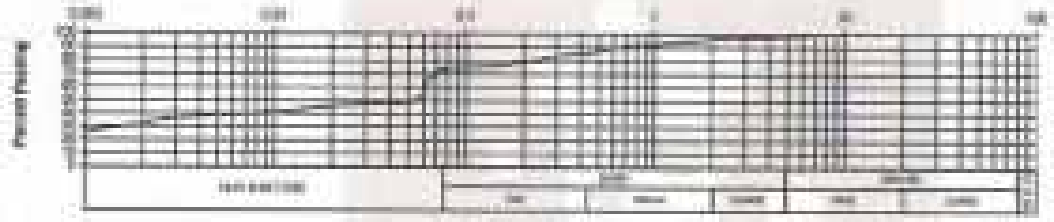
| | | | |
|---|---|---|---|
| Client: | Project Manger (PE) Global | Consultant: | - |
| Address: | Shd Floor, 1676/B - 3070, Ravenall Building, Kanapparoor Village , Kakkanad, Ernakulam, Kerala 682030 | Owner: | KSIDC |
| Contact: | - | Contractor: | - |
| Project No: | - | Project Location: | Kotuguddo, Kasargod |
| Project Name: | Geotechnical Investigation at Dumpsite in Kotuguddo, Kasargod | Tal / Block: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 21/03/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 7.50m |
| Work Order ID: | ML/22MY/02240 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML/22MY/02240/08 | Source*: | BH 01, Depth 7.50m |
| Date Sampled: | 20/03/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2720 – 1987 | Sample Quantity: | 5 Approx |
| Sample Location*: | Kotuguddo, Kasargod | Date Tested : | 21/03/2023 - 03/07/2023 |
| Sample Cont. No: | - | Test Method Variations: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 7.50m |
| Tested By: | Rini | Client Sample Desc.*: | Soil, BH 01, Depth 7.50m |
| Test Location: | Matterlab - Kozhikode | | |

## Particle Size Distribution

Reference: IS: 2720 (Part 4)-1985, Cl.9.5




Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 98 |
| 2.000 | 96 |
| 0.850 | 91 |
| 0.600 | 89 |
| 0.425 | 88 |
| 0.300 | 86 |
| 0.150 | 78 |
| 0.075 | 75 |
| 0.060 | 48 |
| 0.050 | 47 |
| 0.031 | 45 |
| 0.014 | 43 |
| 0.010 | 41 |
| 0.007 | 39 |
| 0.005 | 38 |
| 0.003 | 36 |
| 0.002 | 34 |
| 0.001 | 31 |

| | |
|---|---|
| Gravel % | 2 |
| Sand % | 23 |
| Silt % | 41 |
| Clay % | 34 |

For and on behalf of MatterLab

Comments

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Thiruvannur, Kozhikode, Kerala, 673028

# Hydrometer Analysis Test Report

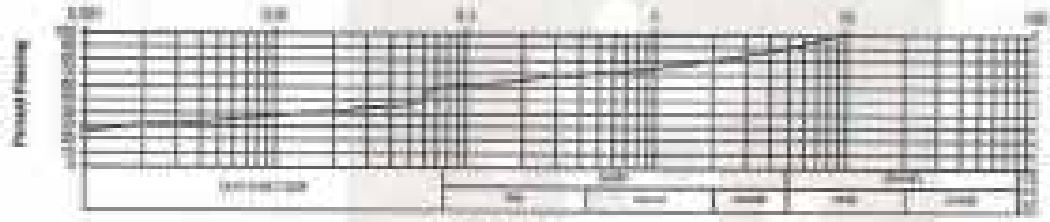
| | | | |
|---|---|---|---|
| Client: | Project Manger, PS Global | Consultant: | - |
| Address: | Shiv Flats, 103B1B - 3B1B, Kaveriatt Building, Kizhuppanoor Village, Kakkanad, Ernakulam, Kerala-682030 | Owner: | KSWMP |
| Contact: | - | Contractor: | - |
| Project No: | - | Project Location: | Kokuguddu, Kasargod |
| Project Name: | Geotechnical Investigation at Dumpsite in Kokuguddu, Kasargod | Tal / Block: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/08/2020 | Client Sample Ref.*: | SS2, BH-01, Depth-6.00m |
| Work Order ID: | ML20WV-03242 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML20WV-03242/01 | Source*: | BH-01, Depth-6.00m |
| Date Sampled: | 26/08/2020 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2720 - 1991 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kokuguddu, Kasargod | Date Tested : | 01/09/2020 - 03/09/2020 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH-01, Depth-6.00m |
| Tested By: | Ravi | Client Sample Desc.*: | Soil, BH-01, Depth-6.00m |
| Test Location: | Matterlab.in - Kozhikode | | |

## Particle Size Distribution

Method: IS: 2720 (Part 4)-1985, 23.3.1




| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 98 |
| 2.000 | 92 |
| 1.000 | 73 |
| 0.600 | 71 |
| 0.425 | 68 |
| 0.300 | 66 |
| 0.150 | 63 |
| 0.075 | 60 |
| 0.052 | 47 |
| 0.037 | 45 |
| 0.026 | 43 |
| 0.019 | 42 |
| 0.014 | 40 |
| 0.010 | 38 |
| 0.007 | 36 |
| 0.005 | 34 |
| 0.003 | 32 |
| 0.002 | 31 |
| 0.001 | 30 |

| | |
|---|---|
| Gravel % | 11 |
| Sand % | 29 |
| Silt % | 30 |
| Clay % | 31 |

EXCELLENT TV
Test Laboratory

For and on behalf of Matterlab.in

**Observations**

*Information provided by client



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Annexure-B

# ENVIRONMENTAL TEST REPORT

# POLUCHEM LABORATORIES (P) LTD.

CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY
PALLATH BUILDING, N. KALAMASSERY P. O., ERNAKULAM - 683104
Phone: 0484 2544030, 8281982522, 9747400085, 9747400086, www.poluchem.com, poluchem@gmail.com

## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/144/2023 (LA.R.NO:TC6584210000000001440) |
|---|---|---|
| M/s Program Manager IPE Global Ltd Kavanam Building Kakkanad Ernakulam (TSC Package D, KSWMP ) | Date of issue | 22/06/2023 |
| | Date of monitoring | 12/06/2023 |
| | Date of sample received | 14/06/2023 |
| | Date of analysis Started | 14/06/2023 |
| | Sample Code | G/F/144/2023 |
| | Sample description | Ambient air –Kasaragod-Kelugadde |
| | Sample Location | Gps Reading : N- 12°30'59.01" E -74°59'11.099" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 66.8 µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 21.3 µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 8.6 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 12.7 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/CDA/17 | 1.3 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD

SREEJA RAMESH
AUTHORIZED SIGNATORY
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

# POLUCHEM LABORATORIES PVT LTD

CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

Phone : 0484-2544030, 8281982322, 9747400085,www.poluchem.com, poluchem@gmail.com

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5241/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 22/06/2023 |
| | Date of monitoring | 12/06/2023 |
| | Date of sample received | 14/06/2023 |
| | Date of analysis Started | 14/06/2023 |
| | Sample Code | G/F/5241/2023 |
| | Sample description | Ambient air –Kanacagod-Kelugudde |
| | Sample Location | Gps Reading : N- 12 °30'59.01"<br>E -74°59'11.099" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 µg/m$^3$ | 400 µg/m$^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m$^3$ | 1 µg/m$^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 6 ng/m$^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 20 ng/m$^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m$^3$ | 180 µg/m$^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m$^3$ | 5 µg/m$^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m$^3$ | 1 ng/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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AUTHORIZED SIGNATORY

SREERAM SHENOY
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/143/2023 (ULR NO: TC618923000000011F) |
|---|---|---|
| M/s Program Manager<br>IPE Global Ltd<br>Kavanat,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of Issue | 22/06/2023 |
| | Date of monitoring | 12/06/2023 |
| | Date of sample received | 14/06/2023 |
| | Date of analysis Started | 14/06/2023 |
| | Sample Code | G/F/143/2023 |
| | Sample description | Ambient air –Kasaragod-Kelugadde |
| | Sample Location | GPS Reading : N- 12°30'58.032"<br>E -74°59'09.533" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 38.6 $\mu g/m^3$ | 100 $\mu g/m^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 16.3$\mu g/m^3$ | 60 $\mu g/m^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 3.4 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 5.6 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | <1 $mg/m^3$ | 4 $mg/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5240/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanat,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 22/06/2023 |
| | Date of monitoring | 12/06/2023 |
| | Date of sample received | 14/06/2023 |
| | Date of analysis Started | 14/06/2023 |
| | Sample Code | G/E/5240/2023 |
| | Sample description | Ambient air -Kasaragod-Kelugadda |
| | Sample Location | GPS Reading : N- 12°30'58.032"<br>E -74°59'09.533" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 $\mu g/m^3$ | 400 $\mu g/m^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 $\mu g/m^3$ | 1 $\mu g/m^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 6 $ng/m^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 20 $ng/m^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 $\mu g/m^3$ | 180 $\mu g/m^3$ |
| Benzene ($C_6H_6$) | IS 5182 Part 11 2006 RA2014 | < 0.1 $\mu g/m^3$ | 5 $\mu g/m^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 $ng/m^3$ | 1 $ng/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

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**TEST REPORT** 

| | | |
|---|---|---|
| **Client Name & Address** | **Certificate No:** | PL/RT/SD/5242/2023(ULR NO-TC618920000000503F) |
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanat,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 22/06/2023 |
| | Date of monitoring | 12/06/2023 |
| | Monitoring Location | Kusungad- Kelugolde<br>GPS Reading : N- 12°30'58.146"<br>E -74°59'10.283" |
| | Sample Description | Ambient Sound Level |

| HOURLY INTERVAL | | RESULT | HOURLY INTERVAL | RESULT |
|---|---|---|---|---|
| 12.06.2023 | 11.00 Hrs | 52.5 dB (A) | 05.00 Hrs | 52.3 dB (A) |
| 12.00 Hrs | | 57.8 dB (A) | 06.00 Hrs | 53.7dB (A) |
| 13.00 Hrs | | 55.0 dB (A) | 07.00 Hrs | 52.1 dB (A) |
| 14.00 Hrs | | 50.0 dB (A) | 08.00 Hrs | 53.4 dB (A) |
| 15.00 Hrs | | 48.3 dB (A) | 09.00 Hrs | 54.7 dB (A) |
| 16.00 Hrs | | 50.8 dB (A) | 10.00 Hrs | 48.5 dB (A) |
| 17.00 Hrs | | 49.5dB (A) | 11.00 Hrs | 54.7 dB (A) |
| 18.00 Hrs | | 50.1dB (A) | | |
| 19.00 Hrs | | 51.0 dB (A) | | |
| 20.00 Hrs | | 58.4 dB (A) | | |
| 21.00 Hrs | | 51.6 dB (A) | | |
| 22.00 Hrs | | 51.5 dB (A) | | |
| 13.06.2023 | 00.00 Hrs | 51.9 dB (A) | | |
| 01.00 Hrs | | 51.6 dB (A) | | |
| 02.00 Hrs | | 51.8 dB (A) | | |
| 03.00 Hrs | | 52.3 dB (A) | LeqDay | 52.4 dB (A) |
| 04.00 Hrs | | 51.1 dB (A) | LeqNight | 51.8 dB (A) |

Limits: Industrial Area Day Time-75dB(A),Night Time- 70dB(A),Commercial area Day Time-65 dB(A),Night Time55dB(A),
Residential area Day Time -55 dB(A),Night Time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm.& Night Time from 10.00 pm to 06.00 am

*End of the Report *

For Poluchem Laboratories (P) Ltd.

Authorised Signatory

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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## TEST REPORT



**Ref.No: PL/RT/5247/2023** **Date of Issue: 22/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Leachate
Sample Location : Kasaragod-Kelugudde
Gps Reading : N-12 °30'58.118" E -74°59'09.272"

Sample code : F/5247/2023
Date of sample collected : 12/06/2023
Date of receipt of sample : 14/06/2023
Date of analysis started : 14/06/2023
Date of completion of analysis : 22/06/2023

| Parameters tested | Test method | Results | Limit for disposal to inland surface water |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.64 | 5.5-9.0 |
| Total Dissolved Solids(Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 746 mg/l | 2100 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 102 mg/l | 100 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 247.5 mg/l | 1000 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 320mg/l | 250 mg/l |
| B O D (3 days at 27° C) | IS 3025 (P) 44 – 1993RA 2014 | 112.6 mg/l | 30 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 36.5 mg/l | 100 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 17.4 mg/l | 50 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 1.2 mg/l | 1 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 2 mg/l |
| Cyanide as $CN^-$ | IS 3025 (P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) | 0.2 mg/l |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) | 3 mg/l |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) | 2 mg/l |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | 0.87 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 2.3 mg/l | 3 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 5.2 mg/l | 5.0 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) | 0.2 mg/l |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

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## TEST REPORT



| Client Name & Address | | |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Emakulam<br>(TSC Package D, KSWMP ) | Certificate No: | PL/RT/3627/2023 |
| | Date of issue: | 22/06/2023 |
| | Date of sample collection | 12/06/2023 |
| | Date of sample received: | 14/06/2023 |
| | Date of analysis | 14/06/2023 |
| | Sample Received From | Kasaragod- Kelugudde |
| | Sample description | Waste Segregation |
| | Sample Location | GPS Reading : N- 12°30'56.597"<br>E -74°59'12.52" |

**PHYSICAL COMPOSITION**

| SL NO | Parameters | | Result | |
|---|---|---|---|---|
| | | | Weight | Percentage |
| 01 | BioEarth | (-4.75mm) | 8.5 | 34 |
| | | (+4.75 to 8 mm) | 4.5 | 18 |
| 02 | C&D | C&D (+8mm) | 5.5 | 22 |
| 03 | Plastics | Plastics | 4.25 | 17 |
| 04 | MLP/SUP | MLP/SUP | 1.0 | 4 |
| 05 | Cloths | Cloths/ Rags | 0.5 | 2 |
| 06 | Glass | Glass | 0.3 | 1.2 |
| 07 | Metals | Metals | 0.275 | 1.1 |
| 08 | Rubber | Rubber | 0.17 | 0.68 |
| 09 | E-Waste | E-waste | 0.0025 | 0.01 |
| 10 | Leather | Leather | 0.0025 | 0.01 |
| Total Weight Of sample -25 kg | | | | |

* End of the Report*

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AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5634/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 22/06/2023 |
| | Date of sample collection | 12/06/2023 |
| | Date of sample received: | 14/06/2023 |
| | Date of analysis | 14/06/2023 |
| | Sample Received From | Kasaragod- Kelugudde |
| | Sample description | Waste Segregation |
| | Sample Location | Gps Reading : N- 12 °30'58.224"<br>E -74°59'09.455" |

PHYSICAL COMPOSITION

| SL NO | Parameters | | Result | |
|---|---|---|---|---|
| | | | Weight | Percentage |
| 01 | BioEarth | (-4.75mm) | 8.75 | 35 |
| | | (+4.75 to 8 mm) | 3.25 | 13 |
| 02 | C&D | C&D (+8mm) | 5 | 20 |
| 03 | Plastics | Plastics | 5 | 20 |
| 04 | MLP/SUP | MLP/SUP | 1.075 | 4.3 |
| 05 | Cloths | Cloths/ Rags | 0.9 | 3.6 |
| 06 | Glass | Glass | 0.5 | 2 |
| 07 | Metals | Metals | 0.4 | 1.6 |
| 08 | Rubber | Rubber | 0.12 | 0.5 |
| 09 | E-Waste | E-waste | 0.0025 | 0.01 |
| 10 | Leather | Leather | 0.0025 | 0.01 |
| Total Weight Of sample -25 Kg | | | | |

* End of the Report*

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5350/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavamatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 22/06/2023 |
| | Date of monitoring | 12/06/2023 |
| | Date of sample received: | 14/06/2023 |
| | Date of analysis | 14/06/2023 |
| | Sample Description | Waste Analysis –Kasaragod-Kelugudde |
| | Sample Location | Gps Reading : N- 12 °30'56.597"<br>E -74°59'12.52" |

**CHEMICAL PARAMETERS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 6.59 |
| 02 | Biodegradable Factor | USEPA | % | 2.3 |
| 03 | Total carbon | USEPA 9060A | % | 2.5 |
| 04 | Phosphorus(P) | USEPA | % | 0.019 |
| 05 | Nitrogen(N) | USEPA | % | 0.20 |
| 07 | Potassium(K) | USEPA | % | 0.029 |
| 08 | C/N Ratio | USEPA | .. | 12.5:1 |
| 09 | Calorific Value | ASTM D 5865 | K.cal/kg | 1318 |

Contd.....

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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5250/2023 |
|---|---|---|
| M/s. IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 22/06/2023 |
| | Date of monitoring | 12/06/2023 |
| | Date of sample received: | 14/06/2023 |
| | Date of analysis | 14/06/2023 |
| | Sample Description | Waste Analysis –Kasaragod-Kelugudde |
| | Sample Location | Gps Reading : N- 12 °30'56.597"<br>E -74°59'12.52" |

**TOXICITY ANALYSIS- HEAVY METALS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 10 | Iron (Fe) | USEPA 3050 | % | 1.6 |
| 11 | Arsenic(As) | USEPA 3050 | mg/kg | <0.1 |
| 12 | Selenium(Se) | USEPA 3050 | mg/kg | <0.1 |
| 13 | Nickel(Ni) | USEPA 3050 | mg/kg | 8.17 |
| 14 | Zinc (Zn) | USEPA 3050 | mg/kg | 108.1 |
| 15 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 |
| 16 | Copper (Cu) | USEPA 3050 | mg/kg | 25.2 |
| 17 | Chromium(Cr) | USEPA 3050 | mg/kg | 8.17 |
| 18 | Lead(Pb) | USEPA 3050 | mg/kg | 27.04 |
| 19 | Mercury(Hg) | USEPA 3050 | mg/kg | <0.1 |
| 20 | Manganese(Mn) | USEPA 3050 | mg/kg | 152.03 |

* End of the Report*

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SREEJA RAMESH
QUALITY MANAGER
AUTHORISED SIGNATORY

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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5248/2023 |
|---|---|---|
| Mr.Program Manager<br>IPE Global Ltd<br>Kavanat,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 22/06/2023 |
| | Date of monitoring | 12/06/2023 |
| | Date of sample received: | 14/06/2023 |
| | Date of analysis | 14/06/2023 |
| | Sample Description | Waste Analysis –Kasaragod-Kuhgudde |
| | Sample Location | Gps Reading : N- 12°30'56.597"<br>E -74°59'12.52" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 27.72 |
| 02 | Bulk Density | | | USEPA | kg/m³ | 823 |
| 03 | Density | | | USEPA | g/cm³ | 0.8125 |
| 04 | Calorific Value | | | ASTM D 5865 | Kcal/kg | 1054 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 75 | – | | | 68.67 |
| | | 40 | – | | | 16.4 |
| | | 20 | – | | | 3.12 |
| | | 8 | – | | | 1.91 |
| | | 4.75 | 4 | | | 1.44 |
| | | 2.36 | 8 | | | 4.1 |
| | | 1.18 | 16 | | | 2.3 |
| | | 0.6 | 30 | | | 2.04 |
| | | 0.3 | 50 | | | 0 |

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QUALITY MANAGER

# POLUCHEM LABORATORIES PVT LTD

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

Phone : 0484-2544030, 8281982022, 9747400085, www.poluchem.com, poluchem@gmail.com


**ACCREDITED BY KSPCB AS "A" GRADE LABORATORY**

**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5249/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kanamat,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 22/06/2023 |
| | Date of monitoring: | 12/06/2023 |
| | Date of sample received: | 14/06/2023 |
| | Date of analysis | 14/06/2023 |
| | Sample Description | Waste Analysis –Kasaragod-Kelugudda |
| | Sample Location | Gps Reading : N- 12°30'38.224"<br>E -74°59'09.455" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 24.3 |
| 02 | Bulk Density | | | USEPA | kg/m³ | 865 |
| 03 | Density | | | USEPA | g/cm³ | 0.852 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 1287 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 75 | -- | | | 26.3 |
| | | 40 | -- | | | 17.4 |
| | | 20 | -- | | | 18.3 |
| | | 8 | -- | | | 14.6 |
| | | 4.75 | 4 | | | 4.6 |
| | | 2.36 | 8 | | | 8.4 |
| | | 1.18 | 16 | | | 0 |
| | | 0.6 | 30 | | | 0 |
| | | 0.3 | 50 | | | 0 |

* End of the Report*

The results are related only to the sample collected for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory

For and on behalf of
POLUCHEM LABORATORIES (P) LTD.

AUTHORIZED SIGNATORY

SREEJA RAMESH

# POLUCHEM LABORATORIES (P) LTD.

CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

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## TEST REPORT



Ref.No: PL/RT/GW/1444/2023
(U.D.R. NO:UC/0502/3000/0011444/23)

Date of Issue: 22/06/2023

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kaveeatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Kasaragod- Kelugudde
Gps Reading : N- 12°30'55.788"
E -74°59'11.213"

Sample code : F/1444/2023
Date of Sample Collected : 12/06/2023
Date of receipt of sample : 14/06/2023
Date of analysis started : 14/06/2023
Date of completion of analysis : 22/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.53 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 35 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 26.1 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 140 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 91 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 28 mg/l | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 46 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 48 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 11.4 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 4 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 3.28 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

Contd...

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QUALITY MANAGER
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Continuation of Test Certificate No: 1444/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 16500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | Absent | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorised Signatory

*End of the report*

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## TEST REPORT



Ref.No: PL/RT/GW/5243/2023

Date of Issue: 22/06/2023

Name & address of customer : M/s:Program Manager
IPE Global Ltd
Kavanatt Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Kasaragod-Kelugudde
Gps Reading : N- 12°30'55.788"
E -74°59'11.213"

Sample code : F/5243/2023
Date of Sample Collected : 12/06/2023
Date of receipt of sample : 14/06/2023
Date of analysis started : 14/06/2023
Date of completion of analysis : 22/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 – 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | 0.12 mg/l | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 7 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | --- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

SREEJA RAMESH
QUALITY MANAGER

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Continuation of Test Certificate No: 5261/2021

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

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QUALITY MANAGER
For POLUCHEM LABORATORIES (P) LTD.

*End of the report*

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## TEST REPORT



Ref.No: PL/RT/GW/1445/2023 (ULR NO:TC630892000000444IN)

Date of Issue: 22/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector

Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014

Sample Description : Ground water-2

Sample Location : Kasaragod-Kelugadde
Gps Reading : N- 12°31'0.402"
E -74°59'12.516"

Sample code : F/1445/2023

Date of Sample Collected : 12/06/2023

Date of receipt of sample : 14/06/2023

Date of analysis started : 14/06/2023

Date of completion of analysis : 22/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.17 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 25 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 4.7 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 730 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 474.5 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 18 mg/l | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 228 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 96 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 93.1 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 68.46 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 1.1 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 45 mg/l |
| Fluoride as $F^-$ | IS 3025 (P) 60 -2008RA2014 | 0.28 mg/l | 1.0 mg/l |

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Continuation of Test Certificate No: 1445/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 110 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorised Signatory

INDULA M
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



Ref.No: PL/RT/GW/5244/2023 Date of Issue: 22/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-2
Sample Location : Kasaragod- Kelugudde
Gps Reading : N- 12 °31'0.402"
E -74°59'12.516"

Sample code : P/5244/2023
Date of Sample Collected : 12/06/2023
Date of receipt of sample : 14/06/2023
Date of analysis started : 14/06/2023
Date of completion of analysis : 22/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | 1.3 mg/l | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 20 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 1.6 mg/l | --- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level, MDL- Minimum Detection Level

Contd..

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Continuation of Test Certificate No: 5244/2023

## RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd




Authorized Signatory.

*End of the report*

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## TEST REPORT



Ref.No: PL/RT/GW/1446/2023
(ULR NO TC698220000001446F)

Date of Issue: 22/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : Kasarngod- Kelugudde
Gps Reading : N- 12°30'57.964"
E -74°57'16.399"

Sample code : P/1446/2023
Date of Sample Collected : 12/06/2023
Date of receipt of sample : 14/06/2023
Date of analysis started : 14/06/2023
Date of completion of analysis : 22/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.60 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 25 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 19.5 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 300 µS/cm | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 187 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 16 mg/l | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 96 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 104 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 17.1 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 12.7 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 2.54 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 4.67 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.28 mg/l | 1.0 mg/l |

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

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Continuation of Test Certificate No: 1446/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 170 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

Microbiologist

Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



Ref.No: PL/RT/GW/5245/2023 Date of Issue: 22/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP ).

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : Kasaragod-Kelugadde
Gps Reading : N- 12 °30'57.964"
E -74°57'16.399"

Sample code : F/5245/2023
Date of Sample Collected : 12/06/2023
Date of receipt of sample : 14/06/2023
Date of analysis started : 14/06/2023
Date of completion of analysis : 22/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 16 mg/l | — |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | — |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 2.86 mg/l | — |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

SREEJA RA[illegible]

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CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY
PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104
Phone : 0484-2544030, 8281992322, 9747400585, www.poluchem.com, poluchem@gmail.com
ACCREDITED BY KSPCB AS "A" GRADE LABORATORY



Continuation of Test Certificate No: 845/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophus | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

*End of the report*

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## TEST REPORT



Ref.No: PL/BET/SW/1447/2023
(ULR NO TC658923000000148IN)

Date of Issue: 22/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water
Sample Location : Kasaragod- Kelugadde
Gps Reading : N- 12°31'06.571"
E -74°59'12.616"

Sample code : F/1447/2023
Date of Sample Collected :12/06/2023
Date of receipt of sample :14/06/2023
Date of analysis started :14/06/2023
Date of completion of analysis :22/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 – (983RA2017 | 5.63 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 –1983RA2017 | 15 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 8.7 NTU | — | — |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 170 µS/cm | — | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 110.5 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 6 mg/l | — | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 18 mg/l | 200 mg/l | — |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 10 mg/l | — | — |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 29.45 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 6.12 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 –1989RA2014 | 5.1 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.36 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.12 mg/l | 1.5 mg/l | 1.5 mg/l |

SREEJA RAM
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

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Continuation of Test Certificate No: 1447/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 280 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | — | — |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorised Signatories

Poluchem Laboratories (P) Ltd.

*End of the report*

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Phone : 0484-2544030, 8281982322, 9747400585, www.poluchem.com, poluchem@gmail.com

ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


## TEST REPORT



Ref.No: PL/RT/SW/5246/2023 Date of Issue: 22/06/2023

Name & address of customer :M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water
Sample Location : Kasaragod- Kelugudde
Gps Reading : N- 12 °31'06.571"
E -74°59'12.616"

Sample code : F/5246/2023
Date of Sample Collected :12/06/2023
Date of receipt of sample :14/06/2023
Date of analysis started :14/06/2023
Date of completion of analysis :22/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54- 2003RA2014 | BDL(MDL- 0.01mg/l) | — | — |
| Cadmium as Cd | IS 3025(P) 41- 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47- 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42- 1992RA2014 | BDL(MDL- 0.01mg/l ) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59- 2006RA2017 | BDL(MDL- 0.01mg/l ) | 0.5 mg/l | — |
| Mercury as Hg | IS 3025(P) 48 - 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | — |
| Zinc as Zn | IS 3025(P) 49 - 1994RA2014 | BDL(MDL- 0.01mg/l ) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27° C ) | IS 3025 (P) 44 -1993RA2014 | 1.7 mg/l | 2 mg/l | 3 mg/l |
| C.O.D | IS 3025 (P) 58 -2006RA2017 | 10 mg/l | --- | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | — | — |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 5.1 mg/l | --- | --- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37- 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

*End of the report*

The above results are related only to the sample submitted for analysis. This test report shall not be reproduced except in full, without the written approval of the laboratory.

Annexure-C

# PHOTOGRAPHS –SAMPLING




*Figure 13 Geotechnical Survey*




*Figure 14 Ground Water Sampling*



*Figure 15 Ambient Air Sampling*




*Figure 16 Surface Water Sampling*



*Figure 17 Ambient Noise Sampling*

Annexure-D

# VOLUMETRIC ANALYSIS

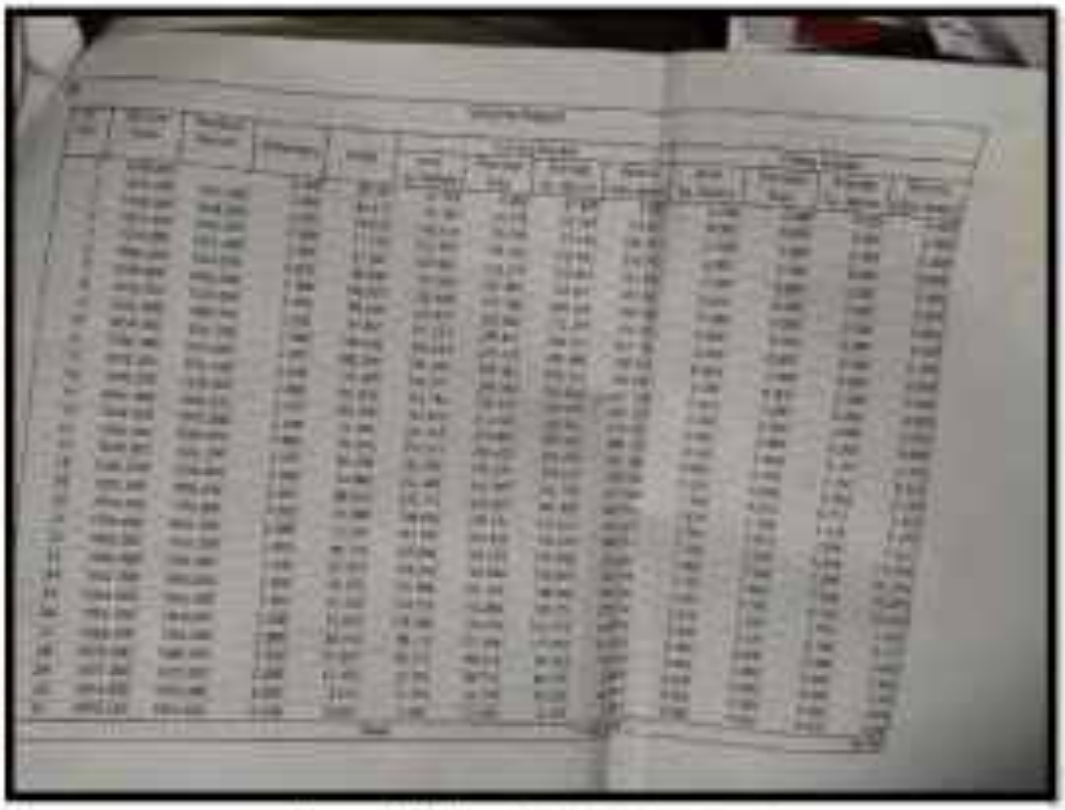


*Figure 18 Volumetric Analysis Report*

Annexure-E

# SITE PLAN




*Figure 19 Site Management Plan*

Annexure-F

# SURVEY CONTOUR PLAN

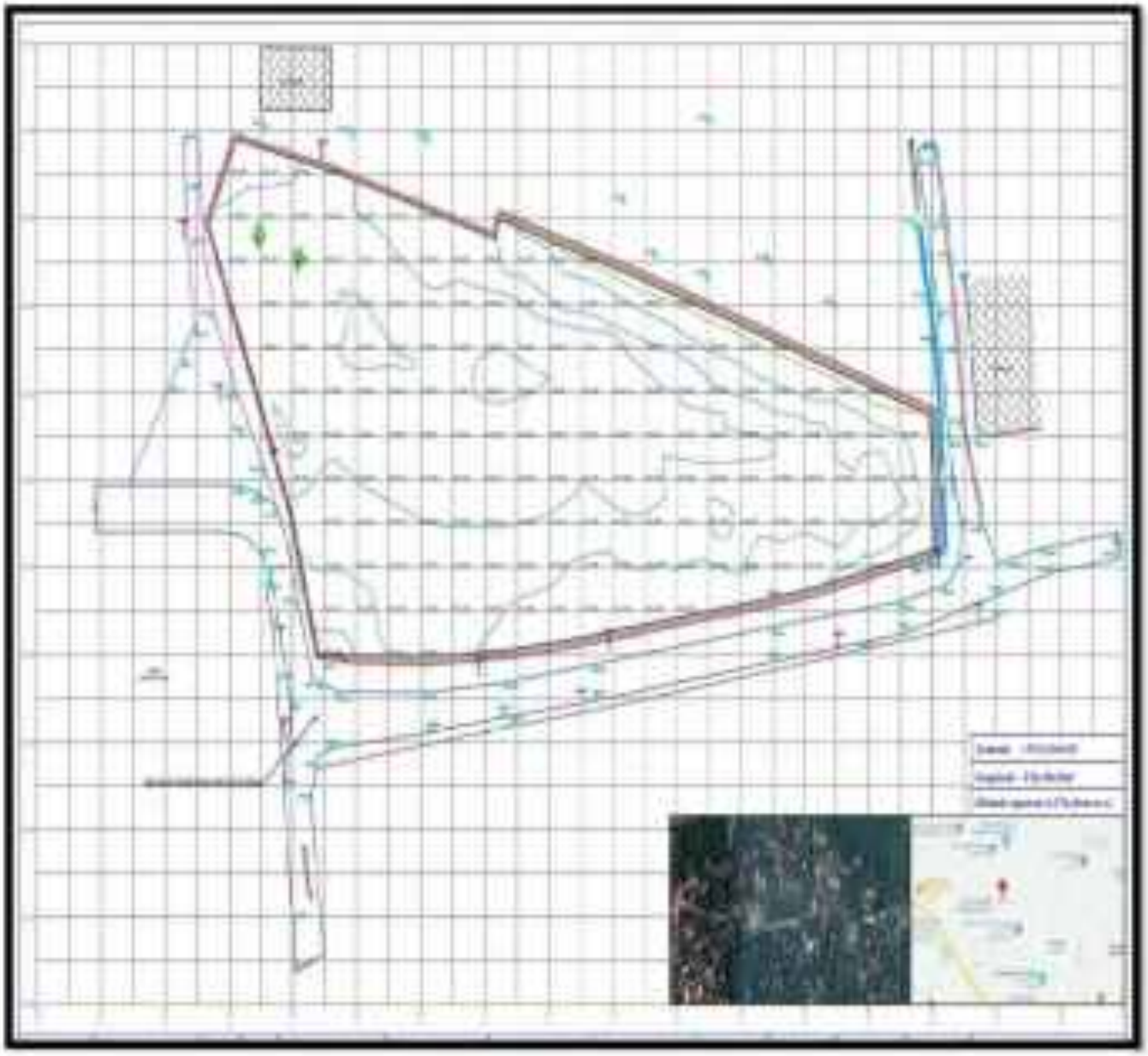


*Figure 20 Contour Plan*

Annexure-G

# REQUIREMENT OF VEHICLE & MACHINERY

*Table 41 Details Analysis*

| S.No | Machinery & Vehicles | Qty | Units |
|---|---|---|---|
| 1 | Excavation Process | | |
| | Design capacity | 800 | TPD |
| | Required Material to be Excavated per hour | 100 | TPH |
| | Capacity of front-end loader with backhoe per hour | 40 | TPH |
| | No of front-end loader with backhoe required | 3 | Nos |
| 2 | Vehicles Needed for Site movement | | |
| | Tipper capacity per Trip | 5 | Tons |
| | No of trips Per hour | 3 | |
| | No of tippers required | 5 | |
| 3 | No of Tipper required for transporting Byproducts of Biomining ( Earth,RDF, Inerts & Recyclables) | 6 | |
| 3 | Windrow formation and turning | | |
| | Front end loader required for formation of Windrow from the material dropped by the tipper trucks and for turning of waste | 2 | Nos |
| 4 | Feeding to sieving and baling operations | | |
| | Quantity of waste to be fed to sieving machines | 800 | TPD |
| | Quantity of RDF material to be fed to baling machine | 96 | TPD |
| | Capacity of front-end loader to feed in a day to feeders (20 TPH X 10 hours) | 200 | TPD |
| | No of front-end loaders required for feeding sieving and baling machines | 2 | Nos |
| 5 | Water Tanker | 1 | Nos |
| 6 | Tractor | 1 | Nos |
| 7 | Backhoe Loader | 2 | Nos |

Annexure-H

# SPECIFICATION OF MACHINERIES & VEHICLES

*Table 42 Machineries Details*

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| 1 | Mobile Trommel | 1 | Model – Kleemann Scalper MS5 802 |
| | | | Crawler Chassis – Chassis B3HD |
| | | | Drive – KYB MAG 85 NF, Speed 0.98 km/h |
| | | | Fuel Tank holding Capacity – 330 litres |
| | | | Feed Capacity (up to approx.) – 500 t/h |
| | | | Screen Size (W*L) – 1,550 *4,880 mm |
| | | | Machine Weight – 30,000 - 36,000 Kg |
| | | | Drive Output – 99 kW at 1800 rpm |
| | | | Screen Slope – 15.4 - 20 Degree |
| | | | Screen Slpoe Conveyor – 12.5 Degree |
| | | | Fine-grain Conveyor Belt Width – 1200 mm |
| | | | Hopper Discharge Capacity – 9.1 cum |
| | | | Screen Pore Size – Less than 900 * 7760 mm |
| | | | Between 900*7760 mm and 1550*4880 mm |
| | | | Greater Than 1550*4880 mm |
| | | | Warranty – 12 months, however max. 2.000 operation hours from setting into operation, however 15 months after the reported date of readiness for shipment resp. |
| 2 | Baling Machine | 1 | Model – FLT-BMPO 25MT |
| | | | Capacity – 25 Tonnes |
| | | | Cylinder – Single Cylinder (140mm*80mm@3000psi) |
| | | | Oil Tank Capacity – 250 Literes Lifetime Oil |

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| | | | Bale Size – 600*600*600 - 900mm |
| | | | Bale Weight = 50-75 Kg |
| | | | Cycle Time – 15-20mm per Bale |
| | | | Power – 7.5 HP |
| | | | Production Capacity – 1000-1500 Kg/8hr Shift |
| | | | Feed Type – PET, HDPE, MLP, PAPER, CLOTHS, BAGS, CHAPPAL |
| 3 | Weighing bridge | 1 | Model – Modular U Shape Weighbridge, Load Capacity: 10t To 150 |
| | | | Capacity = 30 Tonne (10-150 Tonnes) |
| | | | Size = 5 to 10 m |
| | | | Power Supply 90V to 270V |
| | | | Shape = S Shape |
| | | | Accuracy = 5 Kg |
| 4 | Ballistic Separator | 1 | Drive Power (15 HP) – 1 No.<br>Blower- 1 No.<br>Screen Size – 70*70 MM<br>Material of Construction – IS:2062 ( MS )<br>Throughput Capacity - 30 TPH<br>Output Material - 3 Fraction ( RDF , Inert, Compost)<br>Automatic Feeding Conveyor<br>Drive Power (7.5HP)<br>Feeding Conveyor Inclined<br>Drive Power (7.5HP)<br>Inert Conveyor<br>Drive Power (3.0HP)<br>RDF Conveyor |

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| | | | Drive Power (3.0HP)<br>Compost Conveyor<br>Drive Power (3.0HP)<br>Material of Construction – IS:2062 ( MS )<br>Electrical Control Panel Complete With Wiring |
| | | | |

*Table 4.3 Vehicle Details*

| tt | Vehicle | Nos | Technical Specification |
|---|---|---|---|
| 1 | Back Hoe Loader | 2 | Type – BS 6<br>Bucket min. Capacity – 0.6 cum<br>Gross Power – 84 HP<br>Fully power shift transmission source from the internationally renowned ZF, with heavy duty cluth packs for smooth and easy click of the knob gear shift as per approved design standard |
| 2 | Tipper | 5 | Type – BS 6<br>Hydraulic Lifting Capacity – 10 cum single stock front end hydraulic system<br>Wheel consist of heavy duty steel radials with spare wheel along with 6 cylinder engine, inter cooled as per approved design standard with current pollution |
| 3 | Tractor (separately) | 2 | Mahindra 275 Eco Tractor (BS-6)<br>Fuel Tank Capacity – 45L<br>Brake Type – Oil Brakes<br>Engine Rated RPM – 1900 r/min<br>Main Cluth Type – Single Clutch Heavy Duty Diaphragm type<br>Tyre – 13.6 * 28 / 12.4 *28 (Front / Rear) |
| 4 | Trolley for tractor (separately) | 1 | Janta Enterprise Trolley Making<br>Material – MS |

| B | Vehicle | Nos | Technical Specification |
|---|---|---|---|
| | | | Size of Trolley = 1700*825*1200 |
| | | | Capacity = 7 Tonne |
| | | | Weight = 900 Kg |
| 5 | Water Tanker for tractor (separately) | 1 | Brand = QEE |
| | | | Capacity = 500-10000 Litres |
| | | | Materials = MS |
| 6 | Front End Loader | 1 | Types = BS 6 |
| | | | Minimum Capacity = 1 cum |
| | | | Gross Power = 125 HP |
| | | | Fully power shift transmission source from the internationally renowned ZF, with heavy duty clutch packs for smooth and easy click of the knob gear shift. |

*Table 44 Equipment Details*

| C | Equipment | No.S | Technical Specification |
|---|---|---|---|
| 1 | CCTV | 5 | 4 MP IP Bullet Colour Camera with Mic EA4IL2C-GP (Nos. -4) |
| | | | 4CH NVR 104-FI |
| | | | 1 TB HDD |
| | | | 4+2POE Switvh CP-DNW- GPU4G2-48 |
| | | | 6U Rack 600Depth |
| | | | 2.2 KV UPS |
| | | | RJ45 Connector |
| | | | COBOX |
| | | | CAT6 Cable |
| | | | Monitor Cell 22"inch |
| 2 | GPS System For Vehicle | 5 | Vehicle Type = truck, Bus, Ship, Generator |
| | | | Model Name = RT wireless Fuel sensor |
| | | | Available Accessories = Wires |

Annexure-I

# PROPOSED OPERATIONAL PLAN

## Proposed Operational Plan

The project of the Bio-mining with land recovery will be implemented through 100% outsourcing model. The detailed operations of land recovery is provided below:

1. **Project Kick-off**

The existing legacy waste dumpsite should be visited jointly by representative of implementation agency, officials ULB and experts of PMU/PMC & TSC for the following

- ✓ For assessment of ***As –Is Situation*** of local settings viz., human settlement & environmental settings etc.,
- ✓ For validation of profile, quantity & physical characterization of legacy waste.
- ✓ Available services viz., electrical power, source of water and access road etc.,
- ✓ For ground truthing the sampling locations of baseline environmental parameter, locations where monitoring will conduct during operation phase and post reclamation phase
- ✓ For sensitizing/awareness of the upcoming the project activity to the stakeholders within the vicinity of the dumpsite.
- ✓ For understanding the sensitive of environmental & social aspects/social considerations viz., educational institutions, religious places and settlements settings.
- ✓ For ensuring that the implementation agency understands and to complies with all local and national regulations related to project activities.

2. **Site Management Plan**

The position of the machineries and other auxiliary machineries/equipment's in-line with the defined process of bio-mining with land recovery play imperative role in effective implementation of the project activities.

A detailed site management plan is prepared including the details of excavation & pre stabilization area in phases (1 to 4), machineries, weigh bridge, area allocation for by-products storage, vehicle parking area and position of CCTV cameras. The detailed site Management plan is provided as Annexure E.

3. **Site Preparation**

The portion of the legacy waste dumpsite will be clear vegetation and levelling the area to create a stable & level platform for positioning of bio-mining machineries/equipment's and for processing of legacy waste.

4. **Procurement of Machinery & Vehicles and Equipment's**

An indicative list of Machineries &Vehicles and equipment's are proposed to for effective processing the quantity of existing legacy waste in-tune to the timeline of NGT orders. The indicative list of the Machinery & Vehicles and equipment's are provided in the Section 8.3.2

5. **Mobilization of Manpower**

For effective management of the project activities, an indicative list Manpower provided in the Section 8.4.1 shall be mobilize required.

6. **Statutory Approvals**

The implementation agency is responsible for obtaining all required permission/consent/approvals from the competent authorities. The ULB/DPMU/DPMC will only facilities implementation agency in obtaining the approvals etc. The indicative list of statutory approvals required for the project is provided below.

a. Site Authorization from KSPCB in conforming to SWM Rules 2016 and Consent to Establish/Operate KSPCB.
b. Dept. of mining and geology
c. Necessary permission for storage of process materials and chemicals
d. NOC from Dept. of Fire and Rescue
e. Segregated Hazardous waste disposal arrangement (eg: KEIL Ambalmedu, Kochi)
f. NOC from Heritage/Archeology if the site is in regulated zone of heritage/protected building
g. Any other statutory approvals/ permissions

### 7. Establishment of forward linkages

The By-products from the bio-mining process/operations viz., Bio earth/ C&D waste (Inert), RDF and Recyclables will be stored in the designated place (as indicated in the site management plan) within the dumpsite. The contractor is responsible for management/establishment of forward linkages. Utilization of Bio earth/C&D (inert) may be finalized in consultation with ULB. An indicative forward linkage is provided in the Section 9.1. The compost should conform to Schedule II of SWM Rules 2016, and RDF should conform to the Guidelines on Usage of RDF in various Industries issued by MoHUA. Bi-weekly sampling will be carried out to confirm the same.

**Bio-mining operations**

- Step-1 – Waste Stabilization

The initial step involves the use of a front-end loader to excavate the legacy waste, allowing for the leachate to dry out through exposure to solar radiation and for the removal of trapped methane from the heap. To ensure the decomposition of biodegradable waste such as discarded food, fruits, flowers, and garden waste, proper aeration is necessary to prevent the generation of leachate and odors. The top layer of the legacy waste, approximately 150 mm in depth, is repeatedly loosened using the front-end loader. Additionally, the waste is lightly mist-sprayed with bio-cultures to manage odors and disperse decomposing microbes throughout the waste. The loosened legacy waste forms windrows.

- Step-2 – Windrow Formation

The second step involves creating windrows of the legacy waste using backhoe. Composting bio-cultures are added to accelerate decomposition and generate biological heat within the waste, aiding in drying it out and reducing its volume. These windrows are turned every 3 days to ensure proper biological treatment and moisture loss. After 1-2weeks, when the heaps have reached a suitable consistency for screening, the material is weighed and transferred to a Mobile Trommel, which consists of rotating cylinders with different-sized perforations.

- Step-3 – Sorting and Segregation by Mobile Trommel

The third step is to move stabilized waste to mobile trommel to get 3 different sizes of fractions

✓ Fraction 1 – (minus 30 mm) – Bio Soil/earth -Used for side development/ filling.
✓ Fraction 2 – (30-80) mm – Mixed fraction – Plastics with C&D (send to Ballistic Separator)

- ✓ Fraction 3 – (80 +) mm – Mixed fraction – (send to Ballistic Separator)

The Fraction-2 & Fraction-3 (30-80) mm & (80 +) mm is required to move for further separation process through ballistic separator.

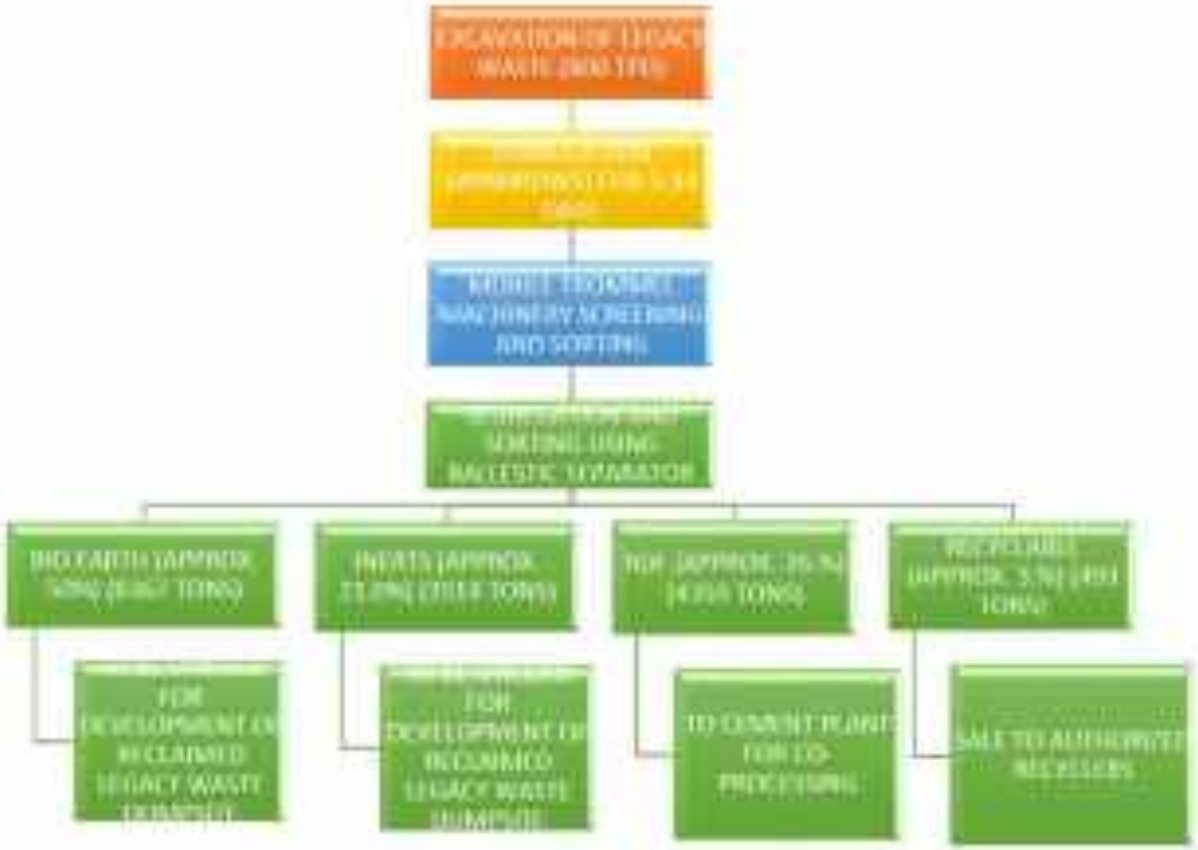
- Step-4 – By - products – C&D materials



In the fourth step, the fraction-2 and fraction-3 are sorted into three types based on their shape and weight: heavy and rolling fraction (referred to as 3D) - C&D Material, light fraction (referred to as 2D) - RDF, and the sieved fraction (or under-screen fine fraction) - Plastic.

- Step-5 - Byproducts – RDF

In the fifth step, the RDF sorted by the ballistic separator (30TPH) is moved to the baling machine (50TPH) for packaging the RDF fractions. The baled RDF is then transported to Cement plants via a weigh bridge (30Tons), where a co-processing facility is available.



## 8. Monitoring & Supervising Mechanism

Supervision and monitoring during dumpsite remediation by TSC/PIU/DPMU

## 9. Record keeping and Reporting

i. The Implementation agency shall maintain a record of the daily processed legacy waste and also keep proper record of all the recovered and disposed of materials.

ii. The Implementation agency shall maintain authorized weigh bridge records at the point of receipt by end designated agency. A consolidated weigh bridge records certified by the Plant Manager/competent authority of the authorized Cement plant/ WtE or such units certifying the total RDF received from the Project is a valid proof of compliance.

iii. The Implementation agency shall maintain all the statutory records, as per SWM Rules, 2016, and also conditions stipulated in Site Authorization/Consent to Establish/Operate by KSPCB if any, KSWMP/WB requirements and other project relevance statutory requirements.

iv. The site shall be operated in CCTV surveillance with data storage of entire contract period. For CCTV surveillance High-Definition IP based cameras in adequate numbers. As per the requirement of the ULB/KSWMP link with mobile compatibility may be provided for online monitoring of the project activities.

v. The vehicles engaged for the project activities shall be equipped with Vehicles Tracking System (VTS) by equipping with GPS and online monitoring system.

vi. The agency is required to maintain loading and unloading weighbridge slips, e-way bill, LR copy, RDF receipt acknowledgement letter from the cement factory/ WtE facility for complete traceability of the recovered fractions.

## 10. Land recovery/project closure

Land shall be reclaimed i.e. all the legacy waste will be removed till it reaches the surface of the earth/ soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the bidder to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to bi-weekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site

Annexure-J

# LSGD GUIDELINES FOR REMEDIATION OF LEGACY WASTE DUMPSITES THROUGH BIOREMEDIATION

# GOVERNMENT OF KERALA

## Abstract

Local Self Government Department - Guidelines for Remediation of Legacy Waste Dumpsites through Bio Remediation - orders issued.

## DEPARTMENT

G.O.(Rt)No.2629/2022/LSGD Dated,Thiruvananthapuram, 29-10-2022

Read 1 Letter No. 2683/C2/2022/SM dated 16.09.2022 from Executive Director Suchitwa Mission.

## ORDER

As per the letter read above, Executive Director, Suchitwa Mission had submitted draft guidelines for implementation of project for remediation of Legacy Waste Dumpsites through Bio Remediation.

2) Government have examined the matter in detail and are pleased to approve the guidelines enclosed herewith for implementation of project for reclamation of legacy waste dumpsites through bio remediation.

(By order of the Governor)
SHIBI ABRAHAM
DEPUTY SECRETARY

To:

Principal Director Local Self Government Department

Director Local Self Government(Urban) Department

Director, Local Self Government (Rural) Department

Executive Director, Suchitwa Mission

Principal Accountant General (A&E/Audit-I/Audit-II)Kerala, Thiruvananthapuram.

Executive Director, Information Kerala Mission.

The Information Officer (Web & New Media ) I&PRD

Stock File / Office Copy

G.O.(Rt)No.2629/2022/LSGD

Forwarded /By order

Signed by Prasanth C
Date: 29-10-2022 14:53:04

Section Officer

**Copy to:- PS to Minister LSGD**

**PA to ACS LSGD**

**CA to SS LSGD**

I/5470223/2022

**ബയോ**റെമഡിയേഷൻ വഴി തദ്ദേ**ശ** സ്വ**യംഭരണ** സ്ഥാപന**ങ്ങ**ളിലെ ലെഗ**സി മാ**ലിന്യ **നിക്ഷേപ** സൈ**റ്റുകൾ/ഭൂമികൾ** വീ**ണ്ടെടുക്കു**ന്നതി**ലേ**ക്കുള്ള പദ്ധതികൾ **ന**ടപ്പിലാ**ക്കുന്ന**തിന**ുള്ള** മാർഗ്ഗനിർദ്ദേശങ്ങൾ

ഖരമാലിന്യ സംസ്കരണ ചട്ടങ്ങൾ 2016-ലെ വ്യവസ്ഥകൾ അനുസരിച്ച കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ പുറപ്പെടുവിച്ച മാർഗ്ഗനിർദ്ദേശങ്ങളുടെ അടിസ്ഥാനത്തിൽ ലെഗസി മാലിന്യങ്ങൾ നിർമ്മാർജ്ജനം ചെയ്യുന്നതിനും അത്തരം ഭൂമി വീണ്ടെടുക്കുന്നതിനും തദ്ദേശ സ്ഥാപനങ്ങളെ ചുമതലപ്പെടുത്തിയിട്ടുണ്ട. ടി മാനദണ്ഡങ്ങൾ പ്രകാരം നിർമ്മാർജ്ജനം ചെയ്യേണ്ട മാലിന്യത്തിന്റെ സ്വഭാവവും അളവും വിലയിരുത്തൽ, ലെഗസി മാലിന്യ നിക്ഷേപങ്ങൾ ഇറക്കുന്നതിനുള്ള ഉത്ഖനന പ്രവർത്തനങ്ങൾ, മാലിന്യം തരംതിരിക്കുന്നതിനായി സ്ക്രീനിംഗ് സോർട്ടിംഗ്, വീണ്ടെടുക്കപ്പെട്ട വസ്തുക്കളുടെ പുനരുപയോഗം, വിൽപ്പന/വിപണനം, തിരസ്കൃത വസ്തുക്കളുടെ ശാസ്ത്രീയ നിർമ്മാർജനം എന്നിങ്ങനെ വിവിധ പ്രവർത്തനങ്ങൾ ആയതിൽ ഉൾപ്പെടുന്നു. കൂടാതെ ഇത്തരം സൈറ്റുകൾ/ഭൂമികൾ വീണ്ടെടുക്കേണ്ടതിന്റെ ആവശ്യകത 17.07.2019 ലെ OA 519/2019-ലെ ഉത്തരവിൽ ബഹു: ദേശീയ ഹരിത ട്രൈബ്യൂണൽ നിർദ്ദേശിച്ചിട്ടുണ്ട. ഇതിനെത്തുടർന്ന, പ്രവർത്തനങ്ങൾ വേഗത്തിലാക്കുന്നതിനായി 22.03.2020 ലെ സ.ഉ (സാധാ) നം 702/2020/തസ്വഭവ പ്രകാരം ബയോമൈനിംഗ വഴി ലെഗസി മാലിന്യ നിക്ഷേപ ഭൂമികൾ വീണ്ടെടുക്കുന്നതിന വിവിധ സ്റ്റേക്ക ഹോൾഡർമാരുടെ ഉത്തരവാദിത്തം ഉൾപ്പെടെയുള്ള നിർവ്വഹണ സ്ട്രാറ്റജി അംഗീകരിച്ച ഉത്തരവായിരുന്നു. എന്നാൽ, നാളിതുവരെ ഇത്തരം പദ്ധതികളുടെ നിർവ്വഹണത്തിൽ ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ പുരോഗതി കൈവരിച്ചിട്ടില്ലാത്തതാണ. ലെഗസി മാലിന്യ നിർമ്മാർജ്ജന പദ്ധതികൾക്ക പ്രോജക്ടിന്റെ അംഗീകാരം മുതൽ നടപ്പിലാക്കുന്ന രീതി (വീണ്ടെടുത്ത വസ്തുക്കളുടെ വിൽപ്പനയും സംസ്കരണവും ഉൾപ്പെടെ) വരെയുള്ള നടപടിക്രമങ്ങളിൽ വ്യക്തതയില്ലാത്തതാണ ഒരു പ്രധാന കാരണമായി കണക്കാക്കുന്നത. ഇത്തരം പദ്ധതികൾ പൊതു നിർമ്മാണ/സിവിൽ പ്രവൃത്തികൾക്ക സമാനമല്ലാത്തതിനാലും, നിലവിലുള്ള ഒരു ലെഗസി ഡംപസൈറ്റിൽ നിന്ന വീണ്ടെടുക്കാൻ കഴിയുന്ന വസ്തുക്കളുടെ സ്വഭാവം, ഗുണമേന്മ, അളവ എന്നിവ അത്തരം ഡംപസൈറ്റുകൾ ഇറക്കാതെ കൃത്യമായി മുൻകൂട്ടി നിർണ്ണയിക്കാൻ കഴിയാത്തതിനാലും, മറ്റ പൊതുമരാമത്ത പ്രവർത്തികൾ പോലെ ഇത്തരം പ്രവൃത്തികൾക്ക എസ്റ്റിമേറ്റ തയ്യാറാക്കുന്നത പ്രായോഗികമല്ല. ഈ പ്രശനങ്ങൾ പരിഹരിക്കുന്നതിനായി, സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-നും സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന "അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ (Adv sory on Landf Rec amat on)" പുറപ്പെടുവിച്ചിട്ടുള്ളതാണ. ആയതിലെ അനുയോജ്യമായ വ്യവസ്ഥകൾ കേരളത്തിൽ ഇത്തരം പദ്ധതികൾ നടപ്പിലാക്കുന്നതിന സ്വീകരിക്കാവുന്നതാണ. മേൽ സാഹചര്യത്തിൽ, സർക്കാർ ഇക്കാര്യം വിശദമായി പരിശോധിക്കുകയും തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ മുഖേന ലെഗസി മാലിന്യ നിർമ്മാർജ്ജന പദ്ധതികൾ നടപ്പിലാക്കുന്നതിന ഇനിപ്പറയുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങൾ പുറപ്പെടുവിക്കുന്നു.

പാ**ലി**ക്കേണ്ട **മാന**ദ**ണ്ഡ**ങ്ങളും **മാർ**ഗ്ഗനി**ർദ്ദേശ**ങ്ങ**ളും**

- കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ 2019-ൽ പുറത്തിറക്കിയ "ഗൈഡലൈൻസ ഫോർ ഡിസ്പോസൽ ഓഫ ലെഗസി വേസ്റ്റ (ഓൾഡ മുനിസിപ്പൽ സോളിഡ വേസ്റ്റ)"

- കേന്ദ്ര പാർപ്പിട-നഗരകാര്യ മന്ത്രാലയവും (MoHUA) സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന 2020ൽ പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ (SBM U - Adv sory on Landf Rec amat on)"

- പ്രസ്തുത വിഷയവുമായി ബന്ധപ്പെട്ട കാലാകാലങ്ങളിൽ കേരള സർക്കാർ പുറപ്പെടുവിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങൾ

**തദ്ദേശ** സ്വയം**ഭരണ** സ്ഥാപനങ്ങ**ൾ** മു**ഖേ**ന **ലെഗ**സി **മാ**ലിന്യ **നി**ർമ്മാർജന പദ്ധതികൾ നടപ്പി**ലാ**ക്കുന്നതിനുള്ള **മാതൃകക**ൾ

- 100% ഔട്ടസോഴസ ചെയത മോഡൽ (MoHUA-യും CPHEEO-യും പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഫിൽ റിക്ലമേഷൻ" പ്രകാരം)

**ലെഗസി മാ**ലിന്യ **നിർമ്മാർ**ജന പദ്ധതികളു**ടെ നിർവ്വഹ**ണ ഉദ്യോഗ**സ്ഥ**ൻ

- ലെഗസി മാലിന്യ നിർമാർജന പദ്ധതികളുടെ നിർവ്വഹണ ഉദ്യോഗസ്ഥൻ തദ്ദേശ സ്വയംഭരണ സ്ഥാപനത്തിന്റെ എഞ്ചിനീയർ ആയിരിക്കും

നിർമ്മാർജനം ചെയ്യേണ്ട ലെഗസി മാലിന്യ നിക്ഷേപങ്ങളുടെ അളവ തിട്ടപ്പെടുത്തൽ

- പൊതുവായി, നിർമ്മാർജ്ജനം ചെയ്യേണ്ട ലെഗസി മാലിന്യത്തിന്റെ അളവ (ക്യൂബിക മീറ്ററിൽ) ടോട്ടൽ സ്റ്റേഷൻ സർവേയിലൂടെ കണ്ടെത്താവുന്നതാണ. എന്നാൽ ടോട്ടൽ സ്റ്റേഷൻ സർവേ സാധ്യമല്ലാത്ത സാഹചര്യത്തിൽ, ഒരു ലക്ഷം ക്യൂബിക മീറ്റർ വ്യാപ്തിയിൽ കൂടുതലുള്ള വലിയ ഡംപസൈറ്റുകളുടെ കാര്യത്തിൽ ഡ്രോൺ സർവ്വേ രീതി സ്വീകരിക്കാവുന്നതാണ.

- ആവശ്യമുള്ള പക്ഷം, പുറമെയുള്ള സർവേ ഏജൻസികളെ നിശ്ചിത നടപടിക്രമങ്ങൾ പാലിച്ച ഇതിനായി ഏർപ്പെടുത്താവുന്നതും, അതിനുള്ള ചെലവ ലഭ്യമായ ഫണ്ടിൽ നിന്ന തദ്ദേശ സ്വയംഭരണ സ്ഥാപനം വഹിക്കേണ്ടതുമാണ.

- സൈറ്റിന്റെ കോണ്ടൂർ മാപ്പ തയ്യാറാക്കേണ്ടതും ആയത തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ പരിശോധിച്ച അംഗീകരിക്കേണ്ടതുമാണ.

എസ്റ്റിമേറ്റ തയ്യാറാക്കലും പദ്ധതി രൂപീകരണവും

- സൈറ്റിന്റെ നിലവിലെ അവസ്ഥ, മാലിന്യത്തിന്റെ സ്വഭാവം/തരം, മാലിന്യ നിക്ഷേപത്തിന്റെ കാലയളവ, മറ്റ അടിസ്ഥാന വിശദാംശങ്ങൾ എന്നിവയെക്കുറിച്ചുള്ള വിശദമായ റിപ്പോർട്ട അനുബന്ധം- I ൽ നൽകിയിരിക്കുന്ന പ്രൊഫോർമയിൽ തയ്യാറാക്കേണ്ടതാണ

- അനുബന്ധം-II ൽ നൽകിയിരിക്കുന്ന സ്പെസിഫിക്കേഷനും ഡാറ്റയും അനുസരിച്ച ബയോമൈനിംഗ മുഖേന പ്രവൃത്തി നടപ്പിലാക്കുന്നതിന എസ്റ്റിമേറ്റ തയ്യാറാക്കേണ്ടതാണ.

- പ്രൊപ്പോസൽ തയ്യാറാക്കുന്നതിന്റെ ഭാഗമായി പ്രസ്തുത പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള എല്ലാത്തരം ചെലവുകളും പരിഗണിക്കേണ്ടതാണ.

- വാർഷിക പദ്ധതിയുടെ ഭാഗമായി പ്രോജക്ട ഏറ്റെടുക്കേണ്ടതും ലഭ്യമായ സ്രോതസ്സുകളിൽ നിന്നും ഫണ്ട വകയിരുത്തേണ്ടതുമാണ.

സാങ്കേതിക അനുമതി

നിലവിലുള്ള സാമ്പത്തിക അധികാരങ്ങൾ അനുസരിച്ച തദ്ദേശ സ്വയംഭരണ വകുപ്പ(ലോക്കൽ ഇൻഫ്രാസ്ട്രക്ച്ചർ & എഞ്ചിനീയറിംഗ വിങ) ലെ ബന്ധപ്പെട്ട എഞ്ചിനീയർ പ്രോജക്ടിന സാങ്കേതിക അനുമതി നൽകുകയും മാനദണ്ഡങ്ങൾ പാലിക്കുന്നതിനായി ചീഫ ടെക്നിക്കൽ എക്സാമിനർക്ക (ഫിനാൻസ വിംഗ) ആവശ്യമായ റിപ്പോർട്ടിംഗ ഉറപ്പാക്കുകയും ചെയ്യേണ്ടതാണ.

തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ ലെഗസി മാലിന്യ നിക്ഷേപ സൈറ്റുകൾ/ഭൂമികൾ വീണ്ടെക്കുന്നതിനുള്ള പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള നടപടി ക്രമങ്ങൾ

ടെൻഡറിംഗ

- ലെഗസി മാലിന്യ നിക്ഷേപ സൈറ്റുകൾ വീണ്ടെടുക്കുന്നതിനുള്ള പ്രവൃത്തിയുടെ വിശദമായ സ്കോപ്പ ഓഫ വർക്ക, നിബന്ധനകളും വ്യവസ്ഥകളും മുതലായവ വ്യക്തമായി പരാമർശിക്കുന്ന 'ടു കവർ ബിഡ്സ താല്പര്യപത്രം'(Request for Proposa - wo Cover Bd) തയ്യാറാക്കേണ്ടതും ആയത നടപടിക്രമങ്ങൾ പാലിച്ച പ്രസിദ്ധീകരിക്കുകയും ചെയ്യേണ്ടതാണ.

- കേന്ദ്ര പാർപ്പിട-നഗരകാര്യ മന്ത്രാലയവും (MoHUA) സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ" ൽ നൽകിയിരിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങളെ

അടിസ്ഥാനമാക്കി RFP-യിലെ വ്യവസ്ഥകൾ/യോഗ്യതാ മാനദണ്ഡങ്ങൾ നിശ്ചയിക്കാവുന്നതാണ.

- കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ പുറപ്പെടുവിച്ച "ഗൈഡലൈൻസ ഫോർ ഡിസ്പോസൽ ഓഫ ലെഗസി വേസ്റ്റ (ഓൾഡ മുനിസിപ്പൽ സോളിഡ വേസ്റ്റ) " പ്രകാരം ലെഗസി മാലിന്യ നിക്ഷേപങ്ങൾ നിർമ്മാർജ്ജനം ചെയ്യേണ്ടതാണെന്ന നിബന്ധന പ്രവൃത്തിയുടെ 'സ്കോപ്പ ഓഫ വർക്കിൽ' ഉൾപ്പെടുത്തുന്നുണ്ടെന്ന ഉറപ്പ വരുത്തേണ്ടതാണ.

- ലഭ്യമാകുന്ന ടെക്നിക്കൽ ബിഡ്സുകൾ പരിശോധിച്ച വിലയിരുത്തേണ്ടതും സാങ്കേതിക യോഗ്യത നേടുന്ന ബിഡ്ഡർമാരെ ബിഡ/ടെൻഡർ അംഗീകാരത്തിന്റെ തുടർ ഘട്ടത്തിനായി ഷോർട്ടലിസ്റ്റ ചെയ്യേണ്ടതുമാണ. ടെക്നിക്കൽ ബിഡ്സുകളുടെ മൂല്യനിർണ്ണയം നടത്തുന്നതിനായി താഴെപ്പറയുന്ന അംഗങ്ങളെ ഉൾപ്പെടുത്തി തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ സാങ്കേതിക സമിതി രൂപീകരിക്കേണ്ടതാണ;

    - സെക്രട്ടറി
    - LSGD (LID & EW) എഞ്ചിനീയർ
    - ഹെൽത്ത വിഭാഗം ഉദ്യോഗസ്ഥൻ (നഗര തദ്ദേശ സ്ഥാപനങ്ങളുടെ കാര്യത്തിൽ)
    - ജില്ലാ ശുചിത്വ മിഷനിൽ നിന്നുള്ള സാങ്കേതിക വിദഗ്ധൻ
    - ജില്ലാ മലിനീകരണ നിയന്ത്രണ ബോർഡിന്റെ പ്രതിനിധി
    - അക്കാദമിക സ്ഥാപനങ്ങളിൽ നിന്നുള്ള മറ്റ വിദഗ്ധർ

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ സാങ്കേതികമായി ഷോർട്ടലിസ്റ്റ ചെയ്ത ബിഡഡർമാരുടെ ഫിനാൻഷ്യൽ ബിഡ്സുകൾ തുറക്കേണ്ടതും നടപടിക്രമങ്ങളും മാനദണ്ഡങ്ങളും പാലിച്ച അംഗീകരിക്കേണ്ടതുമാണ.

- തിരഞ്ഞെടുത്ത കരാറുകാരന/ഏജൻസിക്ക ലെറ്റർ ഓഫ അവാർഡ (L O A) നൽകുകയും കരാറിൽ ഏർപ്പെടേണ്ടതുമാണ.

നിർവ്വഹണം, മേൽനോട്ടം, ബില്ലുകൾ തയ്യാറാക്കൽ

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയറും മാലിന്യ പരിപാലന പ്രവർത്തനങ്ങളുടെ നിരീക്ഷണ ചുമതലയുള്ള ഉദ്യോഗസ്ഥനും അടങ്ങുന്ന ഒരു മേൽനോട്ട സമിതി (Superv s on Commttee) രൂപീകരിക്കേണ്ടതാണ

- R F P ഡോകുമെന്റിലും കരാറിലും ഉൾപ്പെടുത്തിയിട്ടുള്ള 'സ്കോപ്പ ഓഫ വർക്ക' കരാറുകാരൻ കൃത്യമായി പാലിക്കുന്നുണ്ടോ എന്ന നിരീക്ഷിക്കുന്നതിനായി തദ്ദേശ സ്വയംഭരണ സ്ഥാപനം മേൽനോട്ട സമിതിയെ ചുമതലപ്പെടുത്തേണ്ടതാണ.

- പ്രസ്തുത പ്രവൃത്തി 'സ്കോപ്പ ഓഫ വർക്കിൽ' നിഷ്കർഷിക്കുന്ന പ്രകാരമാണോ നടപ്പിലാക്കുന്നതെന്ന മേൽനോട്ട സമിതി കൃത്യമായും പരിശോധിക്കുകയും നിരീക്ഷിക്കുകയും ചെയ്യേണ്ടതാണ.

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ കരാറുകാരന/ ഏജൻസിയ്ക്ക സൈറ്റ ഹാൻഡ ഓവർ ചെയ്ത നൽകേണ്ടതും പ്രവൃത്തി നടപ്പിലാക്കുന്നതിനുള്ള/ നിർവഹിക്കുന്നതിനുള്ള പിന്തുണ നൽകുകയും ചെയ്യേണ്ടതാണ.

- മാലിന്യ പരിപാലന പ്രവർത്തനങ്ങൾ നിരീക്ഷിക്കുന്നതിന്റെ ചുമതലയുള്ള ഉദ്യോഗസ്ഥൻ പ്രസ്തുത പ്രവൃത്തിയിൽ ഉൾപ്പെടുന്ന മാലിന്യ പരിപാലനവുമായി ബന്ധപ്പെട്ട പ്രവർത്തനങ്ങളായ വിൻട്രോ ഫോർമേഷൻ, മാലിന്യം

തരംതിരിക്കൽ, മലിനീകരണ നിയന്ത്രണ മുൻകരുതലുകളും ആരോഗ്യപരമായ കാര്യങ്ങളും ഉറപ്പുവരുത്തൽ എന്നിവയ്ക്ക മേൽനോട്ടം വഹിക്കേണ്ടതും കരാറുകാരന/ഏജൻസിക്ക മേൽനോട്ട സമിതി മുഖേന ആവശ്യമായ നിർദ്ദേശങ്ങൾ നൽകേണ്ടതുമാണ.

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ എംബുക്കിൽ 'ഇനിഷ്യൽ', 'ഇന്റർമീഡിയറ്റ്', 'ഫൈനൽ' ലെവലുകൾ എന്നിവ എടുത്ത അളവുകൾ രേഖപ്പെടുത്തേണ്ടതും, തദ്ദേശ സ്വയംഭരണ വകുപ്പിന ബാധകമായ അധികാരമനുസരിച്ച ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ വകുപ്പ (എൽ.ഐ.ഡി & ഇ.ഡബ്ല്യു) എഞ്ചിനീയർ ചെക്ക മെഷർമെൻറ നടത്തുകയും ചെയ്യേണ്ടതാണ.

- കരാറിൽ വിശദമാക്കിയിട്ടുള്ള ജോലിയുടെ വിവിധ ഘട്ടങ്ങൾ പൂർത്തിയാക്കിയ ശേഷം കരാറുകാരൻ/ഏജൻസി ക്ലെയിം ചെയ്യുന്ന പ്രവൃത്തിയുടെ വർക്ക ബില്ലുകൾ തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ തയ്യാറാക്കേണ്ടതും തദ്ദേശ സ്വയംഭരണ സ്വയംഭരണ വകുപ്പിന ബാധകമായ അധികാരമനുസരിച്ച ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ വകുപ്പ (എൽ.ഐ.ഡി & ഇ.ഡബ്ല്യു) എഞ്ചിനീയർ ചെക്ക മെഷർമെൻറ നടത്തുകയും ചെയ്യേണ്ടതാണ.

- <u>GUIDELINES FOR IMPLEMENTATION OF PROJECTS FOR RECLAMATION OF LEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION (BIO MINING AND MANAGEMENT OF RECOVERABLES AND REJECTS)</u>

As per the provisions of Solid Waste Management Rules 2016, local bodies are mandated to remediate legacy waste dumpsites and reclaim the land based on the guidelines issued by CPCB. Remediation of legacy dumpsites involves various activities such as assessment of the nature and quantity of waste to be remediated, excavation works to open the dumps, screening and sorting to segregate the waste fractions, reuse and sale/marketing of recovered materials, scientific disposal of rejects as per the norms. The remediation of dumpsites is further directed by Honorable NGT in its order on OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. However, the progress of implementation of such projects has not been satisfactory so far. One of the main reasons is that there is a lack of clarity in the procedures to be followed for legacy waste remediation projects right from the approval of the project to the mode of execution (including sale and disposal of recovered materials) by LSGIs since the nature of such projects is not similar to the general public construction/civil works. Also, the nature, quality and quantity of material that can be recovered from an existing legacy dumpsite cannot be accurately predetermined without opening up such dumpsites and hence it is not practical to prepare a workable estimate for the same like other public works . In order to tackle these issues, Swachh Bharat Mission(Urban) and CPHEEO have issued an "Advisory on Landfill reclamation", and suitable provisions of this advisory can be adopted for the State of Kerala. In these circumstances, the Government has examined this matter in detail, and the following guidelines are issued for the implementation of projects for remediation of legacy dumpsites by Local Self Government Institutions.

**<u>Standards, guidelines and advisories to be followed</u>**

- "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" issued by Central Pollution Control Board
- "SBM-U Advisory on Landfill Reclamation" published by MoHUA and

CPHEEO

- Guidelines issued by Government of Kerala in this regard from time to time

**Models for implementing legacy waste dumpsite remediation by LSGI's**

- 100% outsourced model (As per "SBM -U Advisory on Landfill Reclamation" published byMoHUA and CPHEEO)

**Implementing officer for legacy waste dumpsite remediation projects**

The implementing officer for legacy waste remediation shall be the Engineer of the LSGI

**Quantification of legacy waste to be remediated**

- The volume of legacy waste (in m3) to be remediated shall be generally assessed through Total Station Survey. If a total station survey is not feasible, a drone survey may be adopted for large dumpsites having a volume of more than 1 (One) Lakh m3.
- If required, external survey agencies may be engaged following laid down procedures and the cost for the same shall be met by LSGI from available funds.
- Contour mapping of the site shall be prepared and approved by the Engineer of the LSG

**Project Cost Estimation and Formulation by LSGI**

- Detailed report regarding the site conditions, nature of dump, history of dumping and other basic details shall be prepared in the format given in **Annexure - I**
- The estimate for biomining shall be prepared as per the specification and data given in
  - **Annexure -II**
- The overall cost for the implementation of the project shall be considered as part of the proposal.
- Project shall be taken up as per annual projects and funds from available sources shall be ear marked

**Technical Sanction**

- Technical sanction for the project shall be issued by the concerned Engineer in LSGD (LID & EW) as per the existing financial powers and necessary reporting to the Chief Technical Examiner (Finance Wing) may be ensured for compliance as per norms

**Implementation steps for remediation of legacy waste dumpsites by LSGIs**

**Tendering**

- Request for Proposals (RFPs-Two cover bid) clearly mentioning the scope of work, terms and conditions for reclamation of legacy waste dump sites shall be prepared and published as per laid down procedures.
- Conditions/eligibility criteria in the RFP shall be fixed based on the guidelines given in"**SBM-U Advisory on Landfill Reclamation"** published by MoHUA and CPHEEO
- It shall be ensured to mention in the scope of work that remediation of legacy waste dumpsites shall be undertaken as per the **"Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)"** issued by Central Pollution Control Board.
- The technical proposals received should be evaluated and technically qualified bidders shortlisted for further stage of bid approval. A Technical committee shall be formed at LSGI level for evaluation of the technical bids with the following members;
    - Secretary
    - LSGD (LID & EW) Engineer
    - Health Official (in the case of Urban local bodies)
    - Technical expert from District Suchitwa Mission
    - Representative from District Pollution Control Board
    - Other experts from academic institutions if any
- Financial bids of the technically shortlisted firms should be opened at LSGI level and approved as per procedures and norms
- Letter of Award (LoA) is to be issued to the selected contractor/agency and agreement executed.

**Execution, Supervision and preparation of bills**

- LSGI shall constitute a supervision committee consisting of LSGI Engineer and the officer in charge of monitoring waste management activity
    - LSGI shall authorise the supervision committee to monitor that the contractor correctly follows the scope of work included in the RFP document and agreement.
- The supervision committee shall inspect and monitor that the work is being carried out as per the scope defined.
- LSGI Engineer shall hand over the site and provide support for execution of work at the site by the contractor/agency
- The officer in charge of monitoring waste management shall oversee the waste management related activities such as formation of windrows, segregation of waste into various streams,ensuring pollution control measures and health matters involved in the project and shall give direction to the contractor/agency through the supervision committee.

- LSGI Engineer shall measure, record quantities by taking initial, intermediate and final levels in M-book and Check measurements shall be done by the officials of LSGD (LID & EW) as per the powers vested with in the Local Self Government Department.
- LSGI Engineer shall prepare the work bills claimed by the contractor/agency after completing stages of work detailed in the agreement and check measurement shall be made by the officials of LSGD (LID & EW) as per the powers vested within Local Self Government Department.

അനുബന്ധം - I

PROPOSAL FOR BIO MINING / BIO REMEDIATION OF LEGACY WASTE DUMPSITE AT ..... CORPORATION /MUNICIPALITY/ GRAMA PANCHAYAT

BASIC DETAILS OF DUMPSITE

| | | |
|---|---|---|
| Name of LSGI | : | |
| Name of location of legacy dumpsite | : | |
| Extend of land (Acres) | : | |
| Survey No | : | |
| Land owned by | : | |
| Volume of waste (m3) | : | |
| Maximum depth below ground level (m) | : | |
| Maximum height above ground level (m) | : | |
| Approx. level of water table (m) | : | |
| GPS location (Co-ordinates & link to google map) | : | |
| Period from which dumping is done (in Years) | : | |
| Whether waste is still dumped at the site (Yes/No) | : | |
| Availability of water source for remediation process (Yes/No) | : | |
| Availability of Electricity (Yes/No) | : | |

I/5470223/2022

DE AILED REPOR

- Introduct on (Br ef about the s te nc udng s te photograph)
- Survey deta s (Methodo ogy adopted, Deta s of eve measurements and quant ty ca cu at on)
- Cost est mate
    - Abstract est mate
    - Deta ed est mate
    - Data

S gnat**ure**

Des**g**nat on **o**f E**ng**neer n **c**harg**e**

Nam**e o**f LSG**I**

അനുബന്ധം - II

SPECIFICA ION & OBSERVED DA A FOR RECLAMA ION OF LEGACY DUMPSI E HROUGH BIO R M DIA ION ( o m g, man gng ecove abe and eje t

Bo remedat on (Bo mnng, managng recoverab e and rejects) by

**a.** Excavat ng the ex st ng mxed compacted garbage wh ch underwent b o og ca degradat on n the and port on a ocated and spray ng w th m croba nocuum for san t s ng and stab s ng the excavated mass, s ev ng them us ng Mechan ca s ev ng mach ne or any other equ pment,

**b.** Contro of ma odour us ng deodor z ng agent and stab z ng the waste us ng Bo Cu ture for aerob c ompo t g

**c** o f e dy d o po t g po e o de to ed e t e mp t of d mp g te t e dj e t e

**d** eg eg te t e e v ted g b ge t e d po to e m ked, to m y k d d tego e poss b e by mechan ca means nc udng the cost of any power or fue consumpt on.

**e.** Creat on and mantenance of nfrastructure, fac t es and amen t es for s ev ng, the excavated garbage, stor ng the segregated mater a s.

**f.** Dep oyment of necessary manpower, mater a s, equ pment, too s and creat on of fac t es for hand ng, separat ng, segregat ng and stor ng for the operat on of the p ant.

**g.** Leve ng the earth's surface by bu -dosser or any other earth mov ng equ pment

h. Provding security arrangements for the plan project site, machineries, equipment etc.

DSR 2018 Cost Index- 1.00 (For reference)

| Code | Description of Items | Unit | Quantity | Rate | Amount |
|---|---|---|---|---|---|
| | *Details of cost for 50 m3/day* | | | | |
| | LABOUR | | | | |
| 115 | Cooli | day | 20.00 | 558.00 | 11160.00 |
| | MACHINERY | | | | |
| MR | Double stage screener with conveyor | day | 1.000 | 7200.00 | 7200.00 |
| MR | Magnetic separator- capacity 5HP | day | 1.000 | 600.00 | 600.00 |
| MR | Dust screenning remover | day | 1.000 | 900.00 | 900.00 |
| MR | Baling press | day | 1.000 | 450.00 | 450.00 |
| 17 | Hire and running charges of tipper 5 m3 | day | 2.000 | 1700.00 | 3400.00 |
| 20 | Hydraulic excavator 3D with driver and fuel | day | 1.000 | 7000.00 | 7000.00 |
| 18 | Hire and running charges of loader | day | 1.000 | 5000.00 | 5000.00 |
| 9999 | Deodorizer & Inoculum | L.S | 124.860 | 2.00 | 249.72 |
| | Total | | | | 35959.72 |
| | Market Rate cost | | | | 9150.00 |
| | Add water charges 1% on MR | | | | 91.50 |
| | Net Total ( A) | | | | 9241.50 |
| | Total excluding Market rate | | | | 26809.72 |
| | Add water charges 1% on this | | | | 268.10 |
| | Net Total (B) | | | | 27077.82 |
| | Total A + Cost Index B | | | | 36319.32 |
| | Add CPOH 15% | | | | 5447.90 |
| | Total for 50 m3 | | | | 41767.22 |
| | Hence for 1 m3 | | | | 835.34 |

NB:- **Rates shall be prepared based on the cost index applicable to each locality*

# Thankyou!

Local Self Government Department, Upper Ground Floor, Trans Towers,
Vazhuthacaud, Thiruvananthapuram – 695 014

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KELUGUDDE DUMPSITE IN KASARGOD MUNICIPALITY- KASARGOD DISTRICT

# PART B

# SOCIAL IMPACT ASSESSMENT

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# 1. Introduction

Dumpsite remediation refers to the process of mitigating the adverse effects of existing dumpsites and restoring them to a safe and environmentally sustainable state. The emphasis during the remediation of dump sites is primarily on social safeguard aspects, with a key focus on meaningful engagement with stakeholders, comprehension of stakeholders' risk perceptions, and the restoration of sites to a safe and environmentally sustainable condition. This involves a sequence of systematic social actions, encompassing social inclusion, efficient labor management, prevention of gender violence throughout the process, successive rehabilitation of affected individuals, and the reduction of health risks for the host community. The World Bank-supported KSWM Project has incorporated the bio-mining process for the Kelugudde dumpsite of Kasargod municipality.

## 1.1 Profile of ULB

The Kasaragod municipality is an Urban Local Body (ULB) in the Kasaragod district of Kerala, covering an area of 16.7 square kilometers (sq.m) and divided into 38 administrative wards. This municipality generates 35.60 tons per day (TPD) of solid waste. However, Kasaragod ULB does not possess adequate solid waste treatment and disposal facilities as mandated by the Solid Waste Management (SWM) Rules of 2016. Consequently, unsegregated waste was disposed of in an unscientific manner;essentially dumped at the ULBs trenching ground (where feceas/night soil used to be dumped from pit latrines) at Kelugudde in ward 4.

Socio-Economic profile of ULB is presented below in the table

| Socio Economic Profile Data | |
|---|---|
| **District Name** | Kasargod |
| **Town Name** | Kasargod |
| **Total Population of Town** | 61253 |
| **Total Male Population of Town** | 29615 |
| **Total Female Population of Town** | 31798 |
| **Total Scheduled Castes Population of Town** | 1729 |

| | |
|---|---|
| **Total Scheduled Castes Male Population of Town** | 819 |
| **Total Scheduled Castes Female Population of Town** | 910 |
| **Total Scheduled Tribes Population of Town** | 141 |
| **Total Scheduled Tribes Male Population of Town** | 77 |
| **Total Scheduled Tribes Female Population of Town** | 64 |

### 1.2 Profile of Dumpsite

The Biomining and Bioremediation at the Kasaragod ULB dumpsite is proposed as part of the Kerala Solid Waste Management Project (KSWMP) in collaboration with funding from the World Bank and the Asian Infrastructure Investment Bank. The dumpsite situated in Ward 4, Kasaragod, covers a total area of 1.16 acres and contains a legacy waste quantity of 16,736 tons. The waste at the site is approximately 50 years old, with dumping activities started in 1970 and stopped in 2010. Initially, the dumpsite served as a trenching ground for the disposal of sewage from pit latrines. The total volume of waste accumulated is approximately 20,115 cubic meters, and the dumpsite spans across an area of 1.16 acres. Over the years of past 50 years, Kelugudde dumpsite saw various types of wastes dumped there. In order to promote a healthy and sustainable environment, it is imperative to undertake the remediation of the dumpsite.

### 1.3 Socio economic baseline of Host community

The dump site is in land owned by ULB and shares a border with Madhur Grama Panchayath. It was a waste dumping site of Kasaragod Municipality from 1970 till 2010. When the composition of BDW and NBDW in the site became a menace to the public residing near the area, the public protest arose. The typical dumpsite impacts such as foul smell, flies, rodents, leachate etc were present in the dump site. Dumping was stopped in 2010 due to public protests and the site has been closed since then. Thus, the evident impact on habitation is being minimized and the dumped wastes are now covered with soil and vegetation.

The site is located 700 meters from National Highway 66. The access road to the site is of four - meter width. Mixed types of families of different socio-economic groups such as High-Income Groups (HIG), Middle-Income Groups (MIG), and Low-Income Group (LIG) reside within 200m radius making a cross section of the society. The main source of income are daily wage labour, working in gulf countries, nearby cashew factory etc Malayalam, Kannada, Konkani and Tulu languages are commonly used by the residents.

There are about 100 households residing within a 200-meter radius of this dumpsite. There are six families residing within 50 meters and 26 families within 100 meters near to the site. A Civil supplies warehouse (20m), KSEB substation (within 20m), Community Hall (50m), shops (100m) etc are also functioning near this dumpsite.

**1.4 Vulnerability mapping of Host community**

There are no scheduled tribes, rag pickers living near the dumpsite. The dumpsite is in close proximity to 6 households which are the people at high risk. An SC colony of 5 houses with 18 people belonging to Nalkattaya community is at 150ms.

| Sl.No | Particulars | Number |
|---|---|---|
| 1 | Number of Senior citizen residing Near dumpsite | 11 |
| 2 | Number of single women staying near the dumpsite | 6 |
| 3 | Number of persons with disabilities | 4 |
| 4 | Number of person with severe disease | 3 |
| 5 | Number of persons with respiratory issues | 7 |
| 6 | Number of Kids | 9 |

## 2. Output from Social Screening

### 2.1 Social Screening Checklist

Social screening of the dumpsite remediation, by a joint team of DPMU, DPMC, TSC and PIU, was carried out on 2.2.2023 with the screening checklist. Social screening was done to identify the potential social risks anticipated during dumpsite remediation. Major findings during the screening process are shown below.

- There are 100 households within 200 m radius of the dumpsite.
- The major institutions within 200ms are KSEB Substation, Civil supplies warehouse, firecracker store, grocery shop, two tea shops, tile godown, furniture shop and steel fabrication works.
- There is proper access to the dumpsite with a 4ms width road of 700meters from the National Highway. The major institution in the access road is a worship area, Shree Ayyappa Bhajana Mandiram which is at a distance of 210 meters from the dumpsite.
- No permanent or temporary loss of access to facilities, services, or natural resources during the sub project activity.
- There is no Loss of Land or livelihood due to the sub project activity.
- No rag pickers in the site and no ST community within 200ms.
- The site/location does not have any archaeological/historical importance
- There is a history of public protest and the site was closed in 2010 due to the protest.

### 2.2 Transect walk

To understand the social dynamics, demographic profile, livelihood patterns, social dynamics of the community and to understand the needs, concerns, and aspirations of the community, a transect walk was carried out on 02.02.2023, which was crucial for developing effective dumpsite remediation strategies that align with their priorities.

- A Scheduled Cast community Colony of 5 houses with 18 people belonging to Nalkattaya community was located and visited during the transect walk.
- A cracker storage store for wholesale was located. Its only for storage and wholesale of crackers. No production or retail sale is done there.
- A cashew factory is located beyond 200ms. The no. of employees varies from 120 to 150 based on season.
- Around 20 people living near the site, work in the cashew factory.
- 2 incidents of fire have reported in the site.

### 2.3 Key Informant Interview

A key informant interview was conducted with 5 persons. A predefined schedule was used to gather information. Open ended questions with sub questions were used to get maximum information and clarifications given. The interview was productive. The history and emergence of the dumpsite, people's protest, social and health issues and public views on the dumpsite were gathered as part of data collection. The major concerns and their expectations were delivered during the interview.

- The dumpsite was active from 1970 till 2010.
- The natives suffered lot of environmental and health issues when the site was active.
- There were several protests to close the dump site and as a result it was closed in 2010.
- 3 of the informants interviewed were suspicious about the future use of site.

### 2.4 Stakeholder Consultation

A Consultation Meeting was conducted on 10.11.2023, 10.30 am with the host community where around 50 people participated. There were 10 participants representing people living within 50ms. Employees of Civil Supplies warehouse and KSEB substation also participated which are the two major institutions within 50ms. Other participants were the tea shop owner, representation of SC colony, Kudumbsharee CDS, ADS, NHG representatives, local public etc. Three group discussions were carried out as part of identification of risks. Sri. PV Sureshkumar, (Environmental Expert) and Sri. Sreejith TM (Social Development Expert) of TSC explained about the bio mining process and its outcomes in detail.

- Group members concerned about foul smell, emission of gasses, dust during the bio-mining process.
- The group was suspicious about the reuse of remediated land again for waste management activities.
- They also suspected the further dumping of waste after the dumpsite remediation process.
- The group believes that the bio-mining would bring a positive impression and impact over the lives of local communities.
- The workers of Civil supply warehouse informed that about 10 -15 loads of food grains are handled by them in a single day.

- The demanded, the trucks coming with loads of food grains should not be stopped during the dumpsite remediation.
- The Necessary traffic arrangements may be made in this regard as the approach road is narrow by 4-meter width.
- KSEB staff also raised concern about the presence of foul smell & dust and chances of illness.
- Most of the households around use water connection. Open wells are not in used in many houses.

**Focus Group Discussion**

A focus group discussion was conducted on 10.11.2023 followed by the consultation meeting specifically for the SC colony residents. Twelve people from the colony participated in the FGD. The colony is located at a distance of 150ms. Sri.Suresh Kumar, Environmental Expert ,TSC Sri. Sreejith TM, Social Development Expert, TSC, moderated the discussion. The moderator explained about the proposed dump site remediation activities with a positive note on how the remediation activities are beneficial to the local community.

- The colony people belong to Nalkattaya community which is a Scheduled Cast.
- There are 5 houses in the colony with 18 people.
- Their mother tongue is Tulu.
- The participants asked questions regarding the process, duration, number of labors to be engaged at the time of operation and the type of machinery to be used.
- They believe that the lifelong negative image of the 'trenching ground' would get eliminated once the remediation is over.
- The participants were also concerned about the further usage of the land for dumping of waste even after the dumpsite remediation process got over.

## 2.5 Findings of Social Screening

Considering the facts and figures consolidated using social screening checklist and transect walk, the dumpsite is categorized as having a moderate social risk. The recent bio-mining conducted by the ULB at the dumpsite revealed no reported health issues, odor problems, or concerns about vehicle movements by stakeholders residing near the dumpsite. The dumpsite has sufficient road access through a side road, ensuring no disruption to public properties and commercial establishments near the site. There are no scheduled tribes, rag pickers, or other vulnerable

communities living near the dumpsite. Bio remediation activity required temporary installation of machineries, water supply system and separate toilets (if required). As the area has a high density of population with 100 households, 3 shops and 7 institutions within 200ms, the dumpsite can be categorized into "Substantial Risk".

| S.No | Social risks | Findings and Recommendations |
|---|---|---|
| 1 | Presence of 100 families, institutions, shops, establishments, and other public utilities near (200m) the dumpsite. | • Free movement of the residents needs to be ensured<br>• The livelihoods of the workers attached to these facilities should not be affected if the working hours of public utilities including shops and establishments are restricted, at any cost |
| 2 | Sound pollution, health issues and foul smell most affects 6 families residing very close to the site (50m). | SIA and SMP will consider the detailed impact and proper mitigation measures |
| 3 | Health risk of vulnerable groups residing near to the site (especially 6 families) which includes patients with breathing issues, pregnant women, children below the age of two and elderly above the age of seventy-five. | Health issues may aggravate during work operations.<br>These factors should strongly be considered especially for all vulnerable groups |

### 2.6 General Observations:

- The local residents are very supportive of the initial process of the proposed dump site remediation.
- All concerns related to the health care of the vulnerable communities residing near to the dumpsite need to be taken care of properly.

- Free movement of the residents needs to be considered while preparing the project. There should be adequate provision for necessary traffic regulations / arrangements to manage the movements of vehicles as well as machineries.
- The local residents requested an assurance from the municipal authorities that the remediated dumpsite should not be used for any kind of waste management activities.

### 2.7 Expected positive impacts on host community after remediation:

**Enhanced quality of life**

The remediation can restore the aesthetics of the area, reducing visual blights, foul odour and improving air and water quality. According to the opinion of people residing nearby the dumpsite, the project can contribute to an improved sense of well-being. Also it results to a clean and hygienic work environment for the workers engaged in MCF and RRF.

**Livelihood and employment of vulnerable community**

It is identified that no rag pickers are currently engaged in collecting waste from the dumpsite or making a living from it. Therefore, the proposed dumpsite rehabilitation project will have no impact on housing or livelihood of any rag pickers.

**Economic opportunities**

After remediating the site, the Municipality is planning to enhance the capacity of the MCF and RRF to process more non bio degradable waste and to set up a centralized waste management unit to process the bio degradable waste. These projects will create more job opportunities to the people who are looking for employment in waste management sector. Remediation creates new opportunities for economic development in the area. The cleaned-up land can potentially be used for new construction, commercial development, or recreational activities. Remediation process will help to increase property values for surrounding residents.

**Access to service**

It is observed that the project will not affect access to any facilities, services, or natural resources as there is enough space/land available in the existing site.

**Land availability**

The dumpsite is situated near the residential area. Living near a waste dump site can significantly impact the quality of life for residents. The removal of these sites can improve the aesthetics of the area and increase property values for surrounding residents.

## 3. Stakeholder Analysis

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| Service Providers | | |
| 1 | ULB Council | Providing ground support to the remediation process |
| 2 | Govt institutions like PCB,KSEB,KWA etc | To deliver necessary approvals and provide necessary services for remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | DPMU | Monitoring and Evaluation |
| 5 | TSC/PMC | Technical support and consultation |
| 6 | Contractor | Execution of the Remediation process |
| 7 | Service providers/HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| Community | | |
| 8 | Members of 100 HHs in the 200 m radius of the dumpsite | Support and cooperation for the remediation process |
| 9 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |

| | | |
|---|---|---|
| 10 | Rag Pickers | Participation in informal collection to strengthen the collection process to prevent further dumping |
| 11 | Waste Generator in Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |
| 12 | Institutions, offices and shops near the site and the personnel involved | Cooperating with the remediation process |
| 13 | Scrap dealers | Informal participation in NBD waste management to prevent further dumping after remediation |
| 14 | End recyclers | Process the inert and legacy waste safely after remediation |

## 4. Required Action plans

All the social risks were identified through the social screening and Transect walk conducted at site. Since there are families and institutions in the close proximity of the dumpsite, below shown action plans have been formulated to be followed at site

- **Labour Management Plan**

Maximum of 15 labours are expected to be engaged in remediation process at a time. A detailed labour Management plan has been prepared and attached as Annexure.

- **Labour Influx Management Plan**

Since 27 families are residing in 200 m Households there are chances of influx issues. A detailed labour Influx Management plan has been prepared and attached as Annexure.

- **Preventive GBV Action plan**

Since an MCF, RRF and Bio waste processing units are functioning inside the dumpsite and close proximity to households there are high chance of occurrence GBV incidents. A detailed GBV action plan has been prepared and attached as Annexure.

- **Citizen Engagement Plan**

Being a socially sensitive area with past protest history, public protest might have happened during the execution period of the project. A detailed citizen engagement plan has been prepared and attached as Annexure.

The assessment of potential social risk during the remediation process and the identification from social screening with screening checklist, transect walk and focus group discussion indicates that there will not be any impact on the livelihood of the community and service providers.

It is identified that land acquisition is not required as sufficient land is available.

## 5. Conclusion

The report on Social Screening, Transect walk and Consultation Meeting covers a comprehensive analysis on existing conditions and potential social impacts that may arise during the remediation of the Kelugudde dumpsite in Kasargod Municipality. The vulnerabilities identified, the risks to be mitigated, observations and suggestions raised during screening and transect walk are elaborated in this report. The dumpsite has proper road access, thus there will not be any disruption to the public properties and commercial establishments nearby the site. The assessment of social screening indicates that the dumpsite remediation can create a positive impact in the living conditions of the host community. As the area has a high density of population with 100 households, 3 shops and 7 institutions within 200ms a strong community engagement need to be ensured at each step and so the dumpsite can be categorized into “Substantial Risk”.

# LABOUR MANAGEMENT PLAN

## 1. INTRODUCTION

### 1.1 PROJECT TITLE:

Project for the remediation of dumpsite at ward 4 owned by Kasargod Municipality

### 1.2 PROJECT AREA

The Dumpsite of Kasargod Municipality is situated in ward 4 of the municipality, covering an area of 1.16 acres.

## 2. SCOPE AND STRUCTURE OF THE LABOUR MANAGEMENT PLAN

The scope of the LMP shall be as outlined in the World Bank's ESMF. The engagement will be planned as an integral part of the project's social assessment and project design and implementation. This document has 10 chapters. This chapter viz., chapter 1 served as introduction. Scope and structure of LMP is provided in chapter 2. An overview of labour use in the project is presented in chapter 3. Key potential labour risks are listed in chapter 4. Legislative framework governing labour employment in India/Kerala is discussed in chapter 5. Implementation Arrangements, policies and procedures follow in the subsequent chapter. Grievance redressal mechanism, contractor management are presented in the last chapters.

## 3. OVERVIEW OF LABOUR USE ON THE PROJECT

### 3.1 Details of Labours

The proposed remediation process requires following category and number labors

| S. No | Manpower | Nos |
|---|---|---|
| 1 | Site In-charge/Head | 1 |
| 2 | Environmental Health & Safety Engineer | 3 |
| 3 | Security (3 X 8 Hrs) | 2 |
| 4 | Operations Supervisor & Accountant | 2 |

| | | |
|---|---|---|
| 5 | Machine Operator, Mechanic & Electrician | 2 |
| 6 | Labors for stone removal | 2 |
| 7 | Labors for spraying Bio culture | 4 |
| 8 | Labors near Screening machinery | 2 |
| 9 | Labors at Baling facility | 6 |
| 10 | Drivers for tipper trucks, excavators, backhoe loaders and tractors | 1 |
| | **Total** | **25** |

## 4. ASSESSMENT OF KEY POTENTIAL LABOUR RISKS

### 4.1 Project Activities:

The bioremediation of the dumpsite includes the following activities.

- Mobilization of plant and machinery for bio-mining
- Waste excavation and forming of windrow
- Spraying with inoculum and waste stabilization
- Waste segregation and refinement
- Sorting materials into recyclable, RDF, compost and inert
- Transport to the authorized recyclers and end users

### 4.2 Key Labour Risks

It is assessed that key labour risks would be associated with health and safety risks related to the construction activities such as exposure to physical hazards during construction activities such as: use of heavy equipment, exposure to noise and dust, falling objects, exposure to hazardous materials and exposure to electrical hazards from the use of tools and machinery, lack of proper sanitation facilities, availability of separate toilet for women workers. As the construction activities will involve hazardous work, persons under the age of 18 will not be employed by the Project. Many workers will be exposed to occupational health and safety hazards, primarily including but not limited to.

- Injuries/accidents/ fatalities leading to even death, while at work.

- Inadequate accommodation facilities at work force camps, including inadequate sanitation and health facilities.
- Non-payment of wages by Employer.
- Non-payment of benefits (compensation, bonus, maternity benefits etc.) by Employer
- Discrimination in Employment (e.g., abrupt termination from employment, working conditions, wages or benefits etc.)
- Engagement of child labour.
- Sexual harassment at work sites.
- Forced labour or trafficking.
- Security of women workforce.
- Inadequate facilities for pregnant women and lactating mothers.
- Inadequate facilities for the children of the workforce at workforce camp sites
- Possibility of Gender based violence as the work is mostly carried out within the premises of the existing facilities like MCFs/ RRFs etc where female SWM workers are engaged.
- Absence or inadequate or in accessible emergency response system for rescue of labour/workforce.
- Health risks of labour relating to HIV/AIDS and other sexually transmitted diseases.
- Unclear terms and conditions of employment.
- Discrimination and denial of equal opportunity in hiring and promotions/incentives/training opportunities.
- Denial for workers' rights to form workers organizations, etc.
- Absence of a grievance redressal mechanism for labour to seek redressal of their grievances/issues.

## 5. BRIEF OVERVIEW OF LABOUR LEGISLATION: TERMS AND CONDITIONS

| Sl No | Applicable Acts | Details |
|---|---|---|
| 1. | Employees Compensation Act 1923: | The Act provides for compensation in case of injury, disease or death arising out of and during employment |
| 2. | Contract Labour (Regulation & Abolition) Act 1970 | The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. |

| | | |
|---|---|---|
| 3. | Minimum Wages Act 1948: | The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. |
| 4. | Payment of Wages Act 1936: | It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the workers. |
| 5. | Equal Remuneration Act 1976: | The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training, and promotions etc. |
| 6. | Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: | The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc. |
| 7. | Child Labour (Prohibition & Regulation) Act 1986: | The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in the Building and Construction Industry. |
| 8. | Employees State Insurance Act 1948: | The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the |

| | | |
|---|---|---|
| | | Central Government. The Act also provides for benefits to dependents of insured persons in case of death because of an employment injury. |
| 9. | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: | This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee |
| 10. | Industrial Disputes Act 1947: | the Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing the establishment. |
| 11. | Trade Unions Act 1926: | The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. |

## 6. RESPONSIBILITY MAPPING

The ULB (Urban Local Body) will award the proposed work to the contractor through competitive bids. The contractor will be responsible for hiring laborers for both civil and skilled work. In the recruitment process, the contractor is obligated to provide opportunities to members of the host community who possess the necessary skills and willingness to engage in the activities available at the dumpsite for remediation.

The contractor is required to adhere to existing labour laws in the state of Kerala while employing laborers, ensuring compliance with all applicable welfare measures mandated by the relevant labour legislation and rules. Additionally, the contractor is responsible for implementing measures to protect and assist vulnerable groups of workers, including individuals with

disabilities, migrant workers, and women workers. These protective measures should be explicitly outlined in the work agreement.

Furthermore, the contractor must prioritize occupational health and safety measures for the laborers. The ULB will actively monitor the contractor's compliance with legal and welfare requirements. The ULB will also organize training sessions for the workers and establish a forum at the ULB level to address any grievances raised by the workers.

It is a prerequisite for the contractor to possess a valid Labor License, and all laborers working on the site must be registered with the appropriate authorities. This comprehensive approach ensures the well-being and fair treatment of workers throughout the remediation project.

## 8. CODE OF CONDUCT

A code of conduct needs to be incorporated with the contract under the project. The contractor should conduct continuous awareness generation and training activities to ensure that the workers abide by the code of conduct. While preparing the code of conduct, following aspects should be ensured.

- Compliance with applicable laws, rules, and regulations of the jurisdiction
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment (PPE), preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment)
- The use of illegal substances
- Non-Discrimination (for example based on family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction)
- Interactions with community members (for example to convey an attitude of respect and non-discrimination)
- Sexual harassment (for example to prohibit use of language or behavior, towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate)
- Violence or exploitation (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favors or other forms of humiliating, degrading or exploitative behavior)
- Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behavior with children, limiting interactions with children, and ensuring their safety in project areas)

- Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by their employer and not open areas)
- Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favors, are not provided to any person with whom there is a financial, family, or personal connection)
- Respecting reasonable work instructions (including regarding environmental and social norms)
- Protection and proper use of property (for example, to prohibit theft, carelessness, or waste)
- Duty to report violations of this Code
- No retaliation against workers who report violations of the Code, if that report is made in good faith.

## 9. SYSTEMATIZING THE CODE OF CONDUCT

Awareness raising: The Contractor is required to conduct ongoing awareness-raising and training activities to ensure that workers consistently adhere to the Code of Conduct. Additionally, the Contractor must take measures to ensure that local communities are well-informed about the Code of Conduct, enabling them to report any concerns or instances of non-compliance. This proactive approach aims to foster a shared understanding of ethical standards and accountability within both the workforce and the surrounding communities.

## 10. TRANSPARENCY IN CONTRACT SPECIFIC TERMS AND CONDITIONS

All contracts must contain

- Wages: Specific wages and payment modality, timeline
- Working Hours: hours of work, maximum number of hours that can be worked on the project, overtime, compensation
- Leaves: rest per week, annual leave, maternity leave, sick leave
- Benefits: medical treatments in case of accidents or otherwise
- Notice of termination of employment and details of severance payments in a timely manner
- Collective agreements that apply to the project, other specific terms, and conditions
- Details of the grievance redressal mechanism.

## LABOUR MANAGEMENT PLAN MATRIX

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To complete the registration by the Principal Employer, the ULB, as per the provisions of the Contract Labour (Regulation & Abolition) Act 1970 (CL Act), Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979 (ISML Act) and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 (BOCW Act) and procure certificate to that effect. | 3 Registration Certificates to be procured by the ULB under CL Act, ISML Act and BOCW Act respectively.<br><br>3 registrations of ULB secretaries | Before Awarding works | Registration Certificate issued by District Labour Officer under CL Act, ISML Act and BOCW Act | ULB |

| | | | | |
|---|---|---|---|---|
| To Procure license under CL Act, ISML Act and registration under BOCW Act by the contractor | The contractor must take the licenses.<br><br>2 Licenses and One registration under CL Act, ISML Act and BOCW Act respectively. | Before commencing the work at site | License and registration certificate issued by the competent Authority. | Contractor |
| To procure Workmen Compensation insurance policy proportionate to the number of labour force deployed. (By the Contractor) | One insurance policy. | Before commencing work at site | Copy of insurance policy | Contractor |
| To display a copy of the certificate of registration at the conspicuous place at the premises where the building and other construction work is being carried on. | One notice board | As soon as the work is started. | Photographs of the notice board where the license is displayed. | Contractor |

| | | | | |
|---|---|---|---|---|
| To establish a labour information signboard at camp site by including following details like, date of payment of wages, working hours, holidays, wages rates for different categories of labours and name and contact details of local labour inspector and his/ her office and emergency contact numbers. | One notice board | Do | do | |
| To conduct pre- employment medical examination (as per the provisions of BOCW Act)- to ensure medical fitness of the employee. | All workers must be examined | No of workers employed by the contractor | Pre-Medical Examination certificate issues as per Rule 223(C) of BOCW Act (Form No. IX) by the Registered Medical Practitioner. | Contractor |
| To conduct Periodical Medical Check-ups (once in every six months) | All workers must be examined. | No of workers employed by the contractor | Medical Examination certificate issued by a registered medical practitioner. | Contractor |

| | | | | |
|---|---|---|---|---|
| To provide safe drinking water- the contractor must provide safe drinking water at worksite as well as camp site* (Guideline is provided along with this document) | As per requirement | During the entire contact period | Photographs of supply of potable water, Bill of water purchase. | Contractor |
| To arrange first Aid facility at work site as well as camp site (Specifications and items to be maintained in the box is mentioned in this document) | As per requirement | During the entire contract period | First Aid Register, Bill of purchase, photographs of First Aid kit | Contractor |
| To arrange separate First Aid room at work site | Allot one specified room( according to the nature of work) | To be made available during the construction period | Photographs of the facility | Contractor |
| To provide first Aid training to selected labourers or staff members through an authorized agency. | One training with authorized agency | Within one month of commencement of the work | Training records & Photographs | Contractor |

| | | | | |
|---|---|---|---|---|
| To establish linkage with local hospitals/ health care institutions for emergency medical assistance | Tie up with at least one hospital | Within one month of the commencement of the work | Letters issued by the hospital or correspondence and agreement with the hospital. | Contractor |
| To establish rest room at work site or camp site | ( according to the nature of work) | Before the commencement of the work | Photographs of the rest room | Contractor |
| To establish Canteen facility for labours if the contractor engages more than 250 labours | ( according to the nature of work) | Before the commencement of the work | Photographs of the facility, canteen register etc | Contractor |
| To maintain essential registers and records like Form A (Registration of employees), Attendance Register, Wages Register, and other registers like incidents registers including Accident register, Harassment complaints, recovery register, Maternity leave, Termination etc | | As and when the work starts | Copy of registers. | Contractor |

| | | | | |
|---|---|---|---|---|
| Constitute GRC for labours (maximum members to be six. Number of members from employer and employee to be equal. Female members should be minimum 50%. ) | Project grievance mechanism can be used | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | ULB |
| Constitution of ICC (minimum members to be four. The presiding member should be a senior female employee) | Constitution of ICC | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | ULB |
| To publish the abstract of labour laws within the premises of the labour camp.<br>1. The Payment of Wages Act<br>2. The Employee compensation Act<br>3. The Building and Other Construction Workers (RECS) Act<br>4. The Contract Labour (A&R) Act | Abstract of Six acts | As and when the camp is established | Photos of the notices published. | Contractor |

| | | | | |
|---|---|---|---|---|
| 5. The Child and Adolescent Labour (P&R) Act<br>6. The Maternity Benefit Act | | | | |
| To establish code of conduct and provide induction trainings | | As and when new employees are joined | Training reports and other documents | Contractor |
| Conduct HIV/AIDS awareness programs | As per requirement | Once in six months | Reports, photographs etc | Contractor |
| All the Drivers should possess effective and valid Driving License | Drivers should be selected after verification of DL | As and when drivers are appointed | Photocopy of license ids to be collected | PIU |
| All the vehicles involved in the project shall be insured to cover the third-party risk | Vehicle must be allowed to be plied in the project only after procurement of third-party insurance to the vehicle | As and when vehicles are plied in the project | Photocopy of insurance is to be collected | PIU |

**Budget for LMP**

| S.No | Item | Cost |
|---|---|---|
| 1 | Labour compliance as per LMP | [redacted] |

PREVENTIVE GBV ACTION PLAN

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| Formation of internal complaints committee | ULB level ICC will be constituted | Before implementation | ULB | Minutes and Reports | TSC |
| Map GBV issues | Ensure justice, safety and protection, reasonable wages, care and support, adequate Work space, Avoid Gender discrimination Physical,Sexual .<br><br>Psychological and socio<br><br>Economic violence. stress, emotion, conflict, abuse, threatens | During implementation | Contractor/ULB | Issue tracking system in place<br><br>Feedback report(monthly) | TSC |

| | | | | | |
|---|---|---|---|---|---|
| Map GBV service providers and quality assessment of services | • NGOs<br>• Police Station KELSA<br>• Women protection officer<br>• List of Non Government and private agencies providing GBV support<br>• Map local informal grassroot level organizations<br>• Review the quality of services in terms of prevention, protection, rescue, rehabilitation, restoration, reintegration, research, and documentation | Before implementation | TSC | • Directory of service providers<br>• List of key partners<br>• Mapping of roles and responsibilities<br>• Monthly report on quality Assessment | TSC |

| | | | | | |
|---|---|---|---|---|---|
| Facilitate GBV awareness and sensitization programs | • Organize sensitization activities<br>• Display sign boards around the project site | During implementation | Contractor/ICC | • Detailed activity plan<br>• Progress reports<br>• Completion report | TSC |
| Create a GBV response and support mechanism | SOP for the actions be followed in terms of any incidents related to GBV will be formed along with ICC. The SOP will detailed the identification of support mechanism and terms of conditions for comply with existing rules and regulations and operational strategy. | During implementation | ULB/ICC | • SOP for prevention, protection, and rehabilitation | TSC |

| | | | | | |
|---|---|---|---|---|---|
| Reporting, monitoring and review | • Create GBV data fields<br>• Quarterly reports<br>• Conduct review | During implementation | Contractor/ TSC | • Progress reports (Monthly, quarterly)<br>• CB report<br>• Monthly complaint status and action taken report<br>• Establishment of Feedback system | TSC |

**Budget for Preventive GBV action Plan**

| S.No | Item | Cost |
|---|---|---|
| 1 | Activities as per GBV plan | [redacted] |

## CITIZEN ENGAGEMENT PLAN

### 1. Stakeholder identification

As part of social safeguard initiatives for the Bioremediation of dumpsite at Kasargod, the social experts of TSC, DPMC and DPMU conducted brainstorming exercises with locals and functionaries of Kasargod Municipality. A detailed list of primary and secondary stakeholders is prepared on the basis of these exercises.

#### 1.1 Waste Generators

The dumpsite is located in Kelugudde specifically in Ward 4 . It covers an area of 1.16 acres.

| Sl.No | Waste Generators | Nos |
|---|---|---|
| 1 | General Households | 100 |
| 2 | Shops | 3 |
| 3 | Institutions | 7 |

Table 5: Waste Generators

#### 1.2 Service Providers

The identified service providers of the dumpsite are as follows:

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| Service Providers | | |
| 1 | ULB Council | Providing ground support to the remediation process |
| 2 | Govt institutions like District administration and line departments, PCB,KSEB,KWA, | To deliver necessary approvals and provide necessary services. |

| | | |
|---|---|---|
| | Fire&Safety, Police and Geology Dept. | |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | Contractor | Execution of the Remediation process |
| 5 | Service providers/HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| 6 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |

## 2. Need of the plan

Citizen engagement as part of the proposed bioremediation of the Kelugude dumpsite in Kasargod municipality aims to facilitate two-way communication between the project and its stakeholders in order to make better informed decisions. Such an engagement will certainly pave the way for better implementation of the project, and it will ensure public participation in trouble shooting at all the stages of the implementation of the project.

## 3. Objective of the plan

The citizen engagement plan for the proposed dump site remediation is prepared with following objectives;

- To create a conducive environment for the smooth implementation of the proposed bioremediation of the dumpsite by promoting constructive dialogues between the project and its stakeholders.
- To ensure stakeholder participation in the planning, implementation, and monitoring of the sub-project.
- To suggest appropriate activities with a monitoring plan and an expected budget for engaging the stakeholders with the motive of enhancing their ownership in the project through increased participation.

## 4. Stakeholder concern

### 4.1 Waste Generators

- Concerns on foul smell, dust, noise and leachate during the remediation process.
- Concerns on community health impacts during the remediation process.

- Concerns related to the further usage of the dumpsite for waste dumping purposes.

**4.2 Service Providers**

Major concerns of the service providers which has to be addressed by the citizen's engagement plan can be summarized as follows.

- Lack of proper awareness on the remediation activities.

**5. Activities proposed**

**5.1 Community/citizen Awareness**

- Sensitization of host community
- Periodic FGD to assess the community concerns on remediation activities.
- Sensitization programs to nearby institutions
- Formation of GRM committee
- IEC display board on remediation process and merits.

**5.2 Awareness to Service providers**

- Sensitization on the bio-remediation activity for the elected representatives and officials prior to the commencement of the bioremediation process.
- Meeting with Contractor to understand their plan of operations/No labors involvement/timeline etc.
- Sensitization meetings to the district administration, line departments, PCB, KSEB, KWA, Fire & Safety, Police and Geology Dept.

**6. Citizen Engagement Plan**

| S. No | Engagement Challenge | Impacts on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| 1 | Lack of Awareness on Project activities | Non co-operation of Community/stakeholders | Awareness campaigns /IEC material/ sensitization programs to the stakeholders | Contractor |

| | | | | |
|---|---|---|---|---|
| 2 | Delay in decision making and timely support from the ULB | To establish transparency and building confidence in the project commitments to ULB elected members and officials | Sensitization on the bio-remediation activity for the elected representatives and officials prior to the commencement. | Contractor |
| 3 | Lack of proper GRM system | Delay in the execution of remediation work | Constitution of GRM Committee to take-up social issues raised at site level | Contractor |
| 4 | Lack of conducive environment for bioremediation activity | Delay in the execution of remediation work | Sensitisation meetings to various departments | Contractor |

**7.Monitoring Plan**

| S. No | Activity | Means of Communications | Monitoring Indicator | Monitoring Responsibility |
|---|---|---|---|---|
| 1 | Sensitization on the bio-remediation activities for the Municipal Council and officials | Presentation and group discussion | No of councilors and officials attended | TSC |

| | | | | |
|---|---|---|---|---|
| 2 | Sensitization meeting to host community | Presentation and group discussion | No of persons attended. | TSC |
| 3 | Formation of GRM committee | Meeting and presentation | Office order/ proceedings | TSC |
| 4 | One to one meeting district administration, line departments, PCB, KSEB, KWA, Fire & Safety and Police | Presentation | No of one to one meeting conducted / no of officials attended | TSC |
| 6 | IEC display board | IEC boards | No of IEC developed and displayed | TSC |

**8.Budget**

| S. No | Activity | Specification | Quantity / events | Cost |
|---|---|---|---|---|
| 1 | Sensitization on the bio-remediation activities for the Municipal Council and officials prior to the commencement of the work | Half day Programme for Councilors and municipal officials | 1 | [redacted] |
| 2 | Sensitization meeting s and FGD with host community | Half day Programme by incorporating all host community members | 3 | [redacted] |
| 3 | Formation of GRM committee at local level to take up any issue | Committee formation | 1 | [redacted] |

| | | | | |
|---|---|---|---|---|
| | raised at site level and help to resolve an emergency. | | | |
| 4 | Meeting with Contractor to get an understanding of their plan of operations/No labors involvement/timeline etc. | One to one interaction | As required | [redacted] |
| 5 | Issue based one to one meeting district administration, line departments, PCB, KSEB, KWA, Fire & Safety, Police and Geology | One to one | As required | [redacted] |
| 6 | IEC display board for information dissemination | IEC display in the site | 1 | [redacted] |
| **Total** | | | | [redacted] |

| RISK | MITIGATION MEASURES | IMPLEMENTATION RESPONSIBILITY | MONITORING INDICATORS | MONITORING RESPONSIBILITY |
|---|---|---|---|---|
| Social and Community wellbeing | 1.Joint Meeting with community by ULB officials and Elected members | Contractor /PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Economic and Livelihood Issues | 1.Skilled /Unskilled jobs for the Community members in the sub-project | Contractor /PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Accommodation /labour camp | 1.Ensure basic amenities are provided to the labourers (Toiltes,Water ,Kitchen facilities etc)<br>2. Daily briefing to the labourers | Contractor | • Risk identification report<br>• Proposed action/mitigation plan<br>• List of facilities in labour camp<br>• Details of labours | TSC/DPMU |

| | | | | |
|---|---|---|---|---|
| Communicable Diseases | 1.Access to Medical Check-up<br><br>2.Awaresness to the laboures | Contractor | • SOP for prevention of communicable disease and health wellbeing on worksite and labour camp<br>• Report on medical check-up | TSC/DPMU |
| Crimes | 1. Intimation to the Local police about the camp | Contractor | Work site complaint register<br><br>Number of cases reported, and action taken | TSC/DPMU |
| Child Labour | 1.Ensure Adhar card of all labourers at the site | Contractor & TSC | • Number of child labour issues reported<br>• Data of labours | ULB/DPMU |
| Gender-based violence, including sexual harassment child abuse and exploitation | 1.Gender sensitization briefing to the labourers | Contractor /TSC | • Number of cases reported<br>• Action taken report<br>• Number of cases resolved<br>• Time taken for resolving complaints | ULB/DPMU |
| Laour licences | | Contractor /PIU | Number of labours having licence | DPMU |

Summary of SMP budget

| S.No | SMP Activity | Cost |
|---|---|---|
| 1 | Labour Management Plan | [redacted] |
| 2 | Labour Influx Management Plan | [redacted] |
| 3 | Preventive GBV action plan | [redacted] |
| 4 | Citizen Engagement Plan | [redacted] |
| Total | | [redacted] |

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

## Kayamkulam Dumpsite

**SUBMITTED BY**

**KERALA SOLID WASTE MANAGEMENT PROJECT (KSWMP)**

# Part A

# Environmental Impact Assessment

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# SUMMARY

**INTRODUCTION:** Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio mining of multiple Legacy Waste Dumpsites in various districts. The selected dumpsite is Murukkumood which is located in Ward no 22 Kayamkulam municipality, Alappuzha District.

**RATIONALE FOR THE PROPOSED SUB-PROJECT:** Kayamkulam ULB proposes bio mining and bioremediation of the Murukkumood legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

**PROPOSED SUB-PROJECT DETAILS:** Kayamkulam dumpsite is located at a distance of 2.5 km from the centre of Kayamkulam town in western side and encompasses a total area of 1 acres of land. The geographical coordinates of the dumpsite are 9.173379° N & 76.521623° E. The volume of legacy waste to be remediated in the dumpsite is 10261.02 Cu.m. The legacy waste is presented about 1.2 m below and 3.3 m above the ground level respectively. Hence bioremediation of the dumpsite is essential to mitigate the environmental impacts.

**APPLICABLE NATIONAL, STATE LEGISLATIONS AND TECHNICAL GUIDELINES:** To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed.

**THE WORLD BANK SAFEGUARDS POLICIES, AND KSWMP ESMF**: The World Bank policies and directives on environmental and social safeguards have been adhered to the proposed dump site remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are ensured.

**SUB-PROJECT SCREENING AND ITS CATEGORIZATION:** As per indicative categorization for dumpsite bio mining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (1 acres) and waste spread (0.70 acres) and environmentally sensitive features around this subproject is individually considered as E2 and EIA is prepared accordingly.

**ENVIRONMENTAL BASELINE:** Physio graphically, Kayamkulam in and around topographical features falls under relatively flat and low lying areas which includes the paddy land. The favourable time for remediation is between October-2023 to March-2024 non-monsoon period. As per Wind rose, the predominant wind directions are blowing from West direction to East throughout the year. As per the geotechnical investigation, the subgrade soil was encountered at 1.2m below the waste depth of the dumpsite and the predominant soil is silty sand. The dumpsite is surrounded by predominantly of Dry cultivation land use and the same will act as odour attenuation during remediation. The cultural heritage zone near dumpsites is Krishnapuram Palace at a distance of 3.0 Km in SW direction. Hence, no significant physical impact to the heritages sites is envisaged during remediation. As per the district disaster management plan-2015 the site is not in the flood prone area.

**DESCRIPTION OF ENVIRONMENTAL PARAMETERS:** The analysed air pollution data indicates that the levels are within acceptable limits of NAAQs for all the parameters. The ambient Noise levels Leq are above the National Ambient Noise standards for Residential Area both day and night time. The noise levels are influenced by the population within the vicinity, within the dumpsite there is an MCF and RRF facility. the groundwater sample taken from the downstream side (Sample 2) is contaminated, while the other two samples are not contaminated and the dumpsite has not caused any major increase in the contamination of ground water. Similarly, the surface water sample shows Exceeding limits of BOD and COD limits, impacting water quality and aquatic ecosystems. High iron levels can lead to the formation of precipitates, affecting ecosystem health. Elevated color and turbidity can impact aquatic ecosystems by influencing sunlight penetration, affecting plant growth. Electrical conductivity levels suggest some dissolved ions but generally remain within acceptable ranges for agriculture and certain industrial processes. The leachate monitoring data indicates, TDS is about 5395 mg/l while the suspended solids is about 57mg/l respectively.

**ANALYSIS OF ALTERNATIVES:** After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

**ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS:** Environment: During operational phase (bio-remediation), the main potential nuisances caused by a dump site are fugitive dust, odour, foul gases, smoke from the site (in case of fire), and leachate generation. Birds, vermin, and rodents, littering, noises both from machineries operating at the site and waste collection vehicles. Social: No specific social risk is identified for initiating the remediation process except the occupational hazards to the workers engaged in the remediation process. It can be overcome by using adequate protective measures properly. In connection with the dumpsite three family is residing in an aerial distance of 15 m. Hence sensitivity of receptors will not affect much to the bio-remediation process of the dump site

and can be categorized as Medium Vulnerable receptor capacity to absorb proposed changes or/and moderate opportunities for mitigation.

**ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN:** The management plan proposed are for pre-remediation as well as during remediation stage. The mitigation measures are recommended for impacts from air, noise, water, leachate, health and safety, OH&S aspects. The proposed monitoring plan includes leachate, surface and ground water monitoring for a period of once in three months. The cost of [redacted] is required for implementation and supervision of EMP.

**EMERGENCY PREPAREDNESS PLAN:** The identified emergency situations which may arise from remediation activities are fire risk in summer, occupational health and safety related risks. The Kayamkulam police station at 2.7 km, Kayamkulam Govt. Taluk hospital at 3.3 km, Kayamkulam Fire station at 3.8 km are the nearest emergency services. Periodic Compliance monitoring system will be done by the contractor during remediation.

**PUBLIC CONSULTATION AND INFORMATION DISCLOSURE: A** Transect walk was carried out on 22.02.2023 covering the surrounding area of the dump site. Effective IEC drive to be initiated to engage with the community to build support as the activity will create positive impact. Warning sign boards and project information boards with full details of grievance redressal mechanism along with all related contact details will be installed at site during the process at the site. Site control measures should be enforced to prevent unauthorized personnel into the work site.

***Note: All the references to Social Impact Assessment and Social Management Plan may be referred to Part B- Social Impact Assessment which is a separate document attached along with this document.***

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# CHAPTER 1 INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-Financing Framework agreement and as agreed Project Co-Lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio-mining of multiple Legacy Waste Dumpsites in various districts. There are 19 dumpsites identified for remediation under the Kerala Solid Waste Management Project. Several others have been taken up for remediation directly by the ULBs. Currently, 7 dumpsites considered within the three districts, which are (Ernakulum, Alappuzha and Idukki) falling under Package B are selected by Kerala Solid Waste Management Project (KSWMP) for remediation under the project. One of the selected dumpsite is Murukkumood is located near Ward no 22 Kayamkulam municipality, Ernakulum District.

## 1.2 The Rationale for the Proposed Sub-Project:

Murukkumood dumpsite in Kayamkulam ULB at ward no.22 has a total waste quantity of 10261.02 cum, spreading over 0.70 acres. The site is located between Lat - 9.173379° N and Long - 76.521623° E and has an elevation of MSL +25 (m), with a gentle slope towards the South West part. During the monsoon season, due to the geography of the site, runoff from waste flows toward the southwest side of the site, reaching the nullah situated 25 m to the south of the dumpsite. ULB proposes bio-mining and bioremediation of the Murukkumood legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio-mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

The proposed remediation of Murukkumood dumpsite, Kayamkulam Municipality Alappuzha District. The presence of these dumps encourages further dumping at these sites,

even though they are filled beyond capacity to take any more waste. The need for remediation of these dumpsites is directed by **NGT Order in OA 519/2019 dated 17/7/2019** on Remediation, the observation being the following,

## 1.3 Proposed Sub-Project Details

Murukkumood dumpsite is located at a distance of 2.5 km from the centre of Kayamkulam town in western side and encompasses an area of approximately 1 acre of land and waste spread over an area of 0.70 acres. The dumps site is not very far from human settlement. The coordinates of the dumpsite are 9.173379° N & 76.521623° E. It is located in ward no. 22 of the municipality. Kayamkulam municipality holds the ownership of the dumpsite. The highway is about 1.50 km from the dumpsite and the railway station is at a distance of 1320 m. North-eastern side of the dumpsite is vacant land. A small nallah flows North-eastern side of the dump site within the distance of 25 m. The exact date for start of the dumpsite was not available with municipality; however approximately it had started around 85 years ago, the information has been gathered during field visit.

Currently, the quantity of waste dumped at this site is about 10261.02 cum as estimated by the topo survey done as part of the pre-feasibility study conducted by KSMWP. As of now 70 % of the area is covered with solid waste. Average height of the waste heap is 3.30 m above and below 1.2m from the existing ground level. Hence bioremediation of the dumpsite is essential to mitigate the environmental impacts. Dumpsite reclamation involves excavation, screening, and separation of material from dumpsites into various components such as soil, recyclable materials, and residues.

## 1.4 Objectives and Scope of the EIA & SIA:

As per indicative categorization for dumpsite bio-mining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (1 acre) and waste spread (0.70 acres) and absence of environmentally sensitive features around, this subproject is individually considered as E2, and EIA is prepared accordingly.

The EIA & SIA process involves the identification of the potential environmental issues in the project and trying to address them during design interventions. The EIA further carries out impact prediction and evaluation of residual environmental and social issues of a Project. It then goes on to outline the proposed mitigation measures for residual impacts and enhancement measures for positive impacts which the Project will implement.

## 1.5 Structure of the Report:

The Consolidated EIA & SIA report has been structured into the following Chapters:

- Introduction and Project Description.

- Policy, Legal and Administrative Framework presents a review of the existing Institutions and legislation relevant to the project at the National and the State levels;

- Environmental Assessment Methodology discusses sequence of tasks carried Out in preparing EIA;

- Existing Environmental Scenario presents a consolidated picture of the existing Environmental setting of the project;

- Assessment of Potential Impacts identifies and quantifies the potential impacts on each of the environmental components due to the proposed project development;

- Analysis of Alternatives discusses the criteria for analysis of alternatives of technology for remediation.

- Mitigation Measures presents an elaborate listing of the nature of impacts on each of the environmental components and the avoidance and mitigation measures suggested.

- Public Consultation details the stages and types of public consultations carried out during the project preparation stage and people's perceptions of the project benefits and the Potential impacts;

# CHAPTER 2 POLICY AND REGULATORY FRAMEWORK

## 2.1 Applicable National, State Legislations and Technical Guidelines

**National Environmental Rules and Regulations: -**

To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed. A summary of environmental legislation/regulations relevant to project is furnished in the following **Table-2.1**.

Table 2.1 Summary of Environmental Legislation/ Regulations

| Sl. No. | Act / Rules | Purpose | Applicable (Yes / No) | Reason for Applicability | Authority |
|---|---|---|---|---|---|
| 1 | Environment Protection Act, 1986 | To protect and improve the overall environment. This is an umbrella Act. | Yes | As all environmental notifications, rules and schedules are issued under this act. | MoEF &CC, CPCB, SPCB |
| 2 | Solid Waste Management Rules, 2016 | To manage collection, transportation, Segregation, Treatment, and disposal of solid wastes (other than Hazardous waste, Plastic Waste, Bio Medical waste) | Yes | Dumpsite remediation/site raising | MoEF &CC, CPCB, SPCB |
| 3 | Air (Prevention and Control of Pollution) Act, 1981 | To control air pollution by controlling emission of air pollutants as per the prescribed standards. | No | No, Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 21 of Air (Prevention and control of Pollution) Act 1981. | State Pollution Control Board, Kerala |
| 4 | Water Prevention and Control of Pollution) Act, 1974 | To control water pollution by controlling discharge of pollutants as per the prescribed standards. | No | No, Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 25 of this Act. | State Pollution Control Board, Kerala |
| 5 | The Noise Pollution (Regulation and Control) Rules, 2000 & amendments | The standards for noise for day and night have been promulgated by the MoEF&CC for various activities. | Yes | This act will be applicable for all construction equipment deployed at worksite and in operation. | State Pollution Control Board, Kerala |
| 6 | Public Liability and Insurance Act, 1991 | Protection from accidents. | Yes | This act will be applicable for providing immediate relief to the persons affected by accident occurring during work. | State Pollution Control Board, Kerala |

| | | | | | |
|---|---|---|---|---|---|
| 7 | Central Motor Vehicle Act 1988 | To check vehicular air and noise pollution. | Yes | This rule will be applicable to vehicles deployed for construction activities and construction Machinery. | Motor Vehicle Department |
| 8 | The Plastic Waste Management Rules, 2016 | For the storage and disposal of plastic wastes through authorized vendors. | Yes | This act will be applicable for the storage and disposal of all the plastic wastes. | State Pollution Control Board, Kerala |
| Other applicable Rules | | | | | |
| 9 | Construction & Demolition Waste Management Rules, 2016 | | | | |
| 10 | Batteries (Management and Handling) Rules, 2001 | | | | |
| 11 | E-Waste (Management) Rules, 2016 | | | | |
| 12 | Kerala Municipality Act, 1994 & Rules | | | | |
| 13 | Hazardous & Other Wastes (Management And Transboundary Movement) Rules, 2016 | | | | |
| 14 | Bio-medical Waste (Management & Handling) Rules, 1998 | | | | |

**Applicable Social and Other Legislation**

**Other Legislations applicable to Construction activities under the project**

- Workmen's Compensation Act 1923 (the Act provides for compensation in case of injury by accident arising out of and during the course of employment);
- Payment of Gratuity Act, 1972 (gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years);
- Employees PF and Miscellaneous Provision Act 1952 (the Act provides for monthly contributions by the employer plus workers);
- Maternity Benefit Act, 1951 (the Act provides for leave and some other benefits to women employees in case of confinement or miscarriage, etc.);
- The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 is introduced to prevent and provide redressal of complaints of sexual harassment.
- The Protection of Women from Domestic Violence Act, 2005 defines domestic violence, describes the powers and duties of protection officers, service providers and lists the procedures for obtaining reliefs.
- Contract Labor (Regulation and Abolition) Act, 1970 (the Act provides for certain welfare measures to be provided by the contractor to contract labour);
- Minimum Wages Act, 1948 (the employer is supposed to pay not less than the Minimum Wages fixed by the Government as per provisions of the Act);
- Payment of Wages Act, 1936 (it lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers);
- Equal Remuneration Act, 1979 (the Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees);

- Payment of Bonus Act, 1965 (the Act provides for payments of annual bonus subject to a minimum of 83.3% of wages and maximum of 20% of wages);
- Industrial Disputes Act, 1947 (the Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment);
- Industrial Employment (Standing Orders) Act; 1946 (the Act provides for laying down rules governing the conditions of employment);
- Trade Unions Act, 1926 (the Act lays down the procedure for registration of trade unions of workers and employers. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities);
- Child Labour (Prohibition and Regulation) Act, 1986 (the Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labour is prohibited in Building and Construction Industry);
- Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979 (the inter-state migrant workers, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home to the establishment and back, etc.);
- The Building and Other Construction Workers Act (BOCW), 1996 is a social welfare legislation that aims to benefit workers engaged in building and Other Constructions Works.

## 2.2 The World Bank Safeguards Policies, and KSWMP ESMF

The World Bank policies and directives on environmental and social safeguards have been adhered to the proposed dump site remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are summarized in the following table.

**Environmental Codes of Practices (ECoP):** The ECoPs provide guidelines for environmental management of biomining and bioremediation activities which are seen to be of limited extent of impacts/risk, temporary and reversible, and readily managed with good practices during the implementation. The following key points should be considered.

**Key Points of ECop to be considered:**

- The bio-mining activities and preparatory activities shall follow the "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" published by CPCB in February 2019.

- Bio-mining methods include Tractor Tiller, Trench method, Cone Method, windrow, Thin Layer Method, etc. More appropriate may be the Cone method for legacy waste and window for relatively fresh waste.

- Leachate channelization and treatment facility shall be set up before starting the bio-mining works. Works shall take place only during the non-monsoon period; and there shall be suitable precautions to prevent any rainwater disturbing the operations (like seasonal unexpected rains, storm water, runoffs from other sources).

- Ballistic separator and trommel may be used for screening. Screened fractions into which waste is segregated include RDF, inert, Compost, and C&D wastes.

**Applicable World Bank Operational policies**

OP 4.01 Environmental Assessment Help to ensure the environmental and social soundness and sustainability of investment projects. Support integration of environmental and social aspects of projects in the decision-making process

OP 4.04 Natural Habitats Promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions.

OP 4.09 Pest Management includes training to prevent risk to human beings or animals from Bio-culture, enzymes, insecticides and such formulations used for remediation.

OP 4.11 Physical Cultural Resources (PCR) includes resources of archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites), aesthetic, or other cultural significance. Assist in preserving PCR and in avoiding their destruction or damage. PCR

WB General EHS Guidelines Recommendations of these guidelines would be incorporated in the ESMP and Bidding document for this sub-project.

The Environmental Management Framework (EMF) has been prepared to assist in the screening, assessment, and management of environmental risks of all solid waste management projects at an early stage during the planning and integration, mitigation hierarchy during the subproject design, implementation, and operation. The framework helps provide specific guidance on the policies and procedures to be followed for environmental assessment along with the roles and responsibilities of the implementing agencies.

# CHAPTER 3 ENVIRONMENTAL AND SOCIAL BASELINE

## 3.1 Project Location of the site

Murukkumood dumpsite is located at a distance of 2.5 km from the center of Kayamkulam town in western side and encompasses a total area of approximately 1 acres of land. Out of this, 0.70 acres of land is covered with solid waste. The coordinates of the dumpsite are 9.173379° N and 76.521623° E. It is located in ward no. 22 of the municipality. Kayamkulam Punaloor road is at a distance of 340m from the dumpsite from north-western directions. In the surrounding area of the dumpsite around 25 Households are residing within 100m radius. The railway station is at a distance of 1320m. North-eastern side of the dumpsite is vacant land. A small nallah flows North-eastern side of the dump site within the distance of 25 m. Govt Homeo & Ayurvedic Hospital-558m, Kandalasseril Temple-162m, Holy Trinity school-518m away from the project location. The google map image showing the location of Murukkumood dumpsite is shown below in **Figure: 3.1.**



*Figure 3.1 Murukkumood Dumpsite Location Map*

## 3.2 Methodology for Environmental Baseline Studies

The baseline appraisal should consider all aspects of the environment that may be altered by the proposed project. These can be categorized as physical, biological or socioeconomic attributes. The baseline should be based upon the findings of the screening and scoping studies. Surface water and sediments, groundwater, air quality, noise, soils and land use Biodiversity Socio-economic (social), cultural heritage, traffic and transport Physical Biological Socio-economic. The scope of the baseline study, including attributes that will be appraised, and the geographical extent of the analysis, will typically have been agreed with the relevant decision makers as an outcome of the scoping phase. It is important to re-emphasize that the scope (and detail) of the baseline study should be commensurate with the size and scale of the project and hence the potential changes that the project may have upon the environment and society. The baseline study will typically be developed in three stages:

**Desktop study:** Office-based exercise during which readily available existing information (i.e. that can be used to describe the existing environment) is collected and reviewed to ensure its appropriateness for use within the EIA & SIA;

**Field study:** The stage within which additional data is captured in the field, with the intent of addressing any gaps that have been identified in the existing knowledge base; and

**Reporting stage**: Collation of the captured information into the baseline report.

The below table indicates the environmental attributes and location of monitoring.

*Table 3. 1 Environmental Attributes*

| Sl. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | The sample locations (2 Nos) were taken within the dumpsite in North and South – East side. | As per the windrose, Prominent wind is in West and WSW. However, during an on-site observation, soil particles held in hand were noted to be carried in the air, revealing that the actual wind flow at the site occurs from the north to the southeast direction. |
| 2 | Noise (1 Location) | Ambient Noise level [E(P)] for 24 hours | At the Entrance of the dumpsite. | Most vulnerable point in the site in regards of Noise |

| Sl. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| | | | | quality is due to entry and exit of the waste loading and unloading vehicle. Please note that the site is devoid of proximity to any sensitive receptors within a 200 m radial circle . |
| 3 | Surface water (1 Location) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, Ecoli and Total coliforms (IS 10500-2012). | A nearby nullah is taken for water quality monitoring which is at a distance of 179m from the dumpsite in the North East direction. | Surface water sample was collected from one locations ie near the periphery of the dumpsite during monsoon period (July 2023). The nullah is at a distance of 25m and it is not using for any drinking purpose. |
| 4 | Ground water<br><br>(3 Locations) | Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total coliform (IS 10500-2012). | GW1:Groundwater sampling location at a distance of 400m from the dumpsite in the North West direction.<br>GW2:Groundwater sampling location at a distance of 470m from the dumpsite in the South East direction<br>GW3:Groundwater sampling location at a distance of 60m from the dumpsite in the South East direction. | The results indicate that the groundwater sample taken from the downstream side (GW2) is contaminated, while the other two samples are not contaminated and the dumpsite has not caused any major increase in the contamination of ground water. |

| Sl. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 5 | Bore Hole (1 location) | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coeff of permeability, Strength compressibility (vertically-3 samples per borehole). | Centre of the dumpsite | Volume of legacy wastes were found to be higher in the center part of the dumpsite during investigation. So the bore hole test was performed in the center. |
| 6 | Waste & Environmental Analysis | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammonical nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | Northern side of the dumpsite. | The data indicates that the TDS is about 5395 mg/l while the suspended solids is about 57mg/l. The chlorides are high at 1429 mg/l. The heavy metals are found to be low, hence the soil is unlikely to be contaminated by heavy metals from the waste. |
| | | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | Within the dumpsite at 2 locations. | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. So the two locations were |

| Sl. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| | | | | considered for sampling. |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor | 1sampling location | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. |

## 3.3 Environmental Audit of the Existing Facilities

There are functional MCF and RRF for dry waste within the Murukkumood dumpsite.

There are MCF and RRF within the dumpsite, which are not supported under KSWMP under this subproject. However, an environmental audit of the facility is important as this may be used as an associated facility to which some recyclables may be channelized to and is situated at the same site and might be impacted during the bio-mining activities.

*Table 3. 2 Environmental Audit of Existing facilities*

| Sl. No. | Aspects | Remarks |
|---|---|---|
| 1 | Structural Characteristics | **1. MCF**<br>Area - approx. 56 (in Sq. m)<br>Buffer/setback around the MCF – 3 ft<br>Distance from waste pile of dumpsite- 2 m.<br>Proposed in Year 1 Track 1 proposal for maintenance.<br>Doors & windows: Not Available, dust emission and odor can impact the MCF facility.<br>**2. RCF**<br>Area - approx. 28 (in Sq. m)<br>Buffer/setback around the RRF – 3 ft<br>Distance from waste pile of dumpsite- 2 m.<br>Proposed in Year 1 Track 1 proposal for maintenance.<br>Doors & windows: Not Available, dust emission and odor can impact the MCF facility. |
| 2 | Functional Characteristics | Activities in the MCF, RRF: Functional<br>Materials and condition of stacking: NIL<br>Activities spilling out onto the dumpsite: Yes |

| | | |
|---|---|---|
| | | Access: Common access for MCF, RRF & Dumpsite. All are in the same premises.<br>Total No: of workers – 34 |
| 3 | Facilities | Parking area- NIL<br>Loading/unloading Area- NIL<br>Storage room & area: Yes<br>Worker snack/rest areas: Yes<br>Worker / other washrooms & sewerage: Yes<br>Water supply for Cleaning, Washroom: Yes<br>Greenbelt: NIL |

## 3.4 Physiography and Climate

### Physiography

The land in and around the dumpsite is relatively flat and low lying areas which includes the paddy land.

### Climate

Kayamkulam is a coastal town located in the Alappuzha district of the Indian state of Kerala. It experiences a tropical climate characterized by high humidity, warm temperatures, and significant rainfall. As per Climate-Data.org, the mean yearly temperature observed in Kayamkulam is recorded to be 26.4 °C. The month of August registers the most frigid temperatures throughout the year, with an average low temperature of 25.4 °C. The month of maximum warmth in a year is March, during this period the temperature reaches up to 28.0 °C. The highest amount of precipitation occurs during the month of June, with an average quantity reaching up to 435 mm. So, the favorable time for remediation is between October-2023 to March-2024 non-monsoon period. As per wind rose diagram, the most predominant wind directions are blowing from West and WSW direction. The wind rose diagram for Alappuzha is shown in **Figure: 3.2**.



*Figure 3.2 Wind rose diagram*

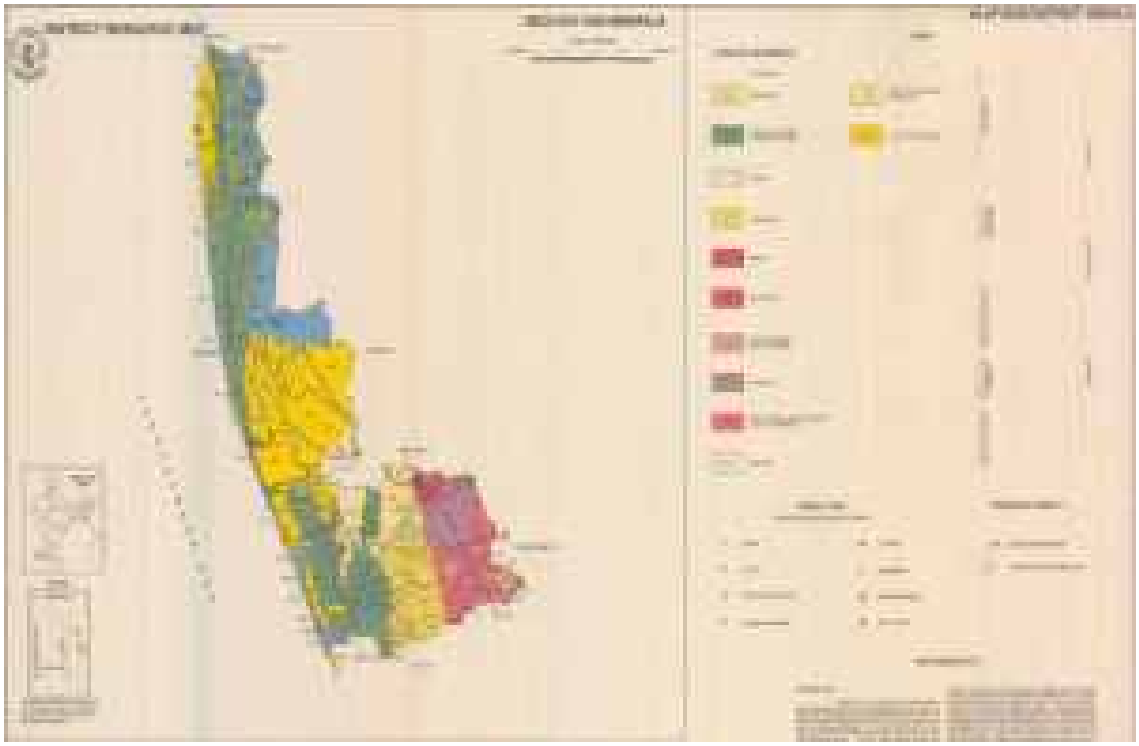
## 3.5 Hydrology, Hydrogeology, and Soil

### Hydrogeology

The project site is surrounded by the community. From monitoring wells dispersed across the state, the depth to water level is observed in the months of April, August, November, and January in 2021–2022. According to information published by the CGWB, the Government of India, the water level in Kayamkulam, fluctuates from 2-5 mbgl in the year 2021–2022. (Source: Annual Report 2021-2022, CGWB)

### Geology

The geology comprises the formations and structures existing in the area. Kayamkulam town is in the midland region. The topography of the project location is almost flat. Vegetable cultivation is being carried out adjacent to the location. This type of land is well suitable for food grain crops. The geology map of Alappuzha District is shown in **Figure: 3.3.**



*Source https //dmg.kerala.gov.in/wp-content/uploads/2020/01/dsr_ala.pdf*

*Figure 3.3 Geology Map of Alappuzha District*

### Soil

As per the geotechnical investigation, the soil was encountered at 1.20 m below the waste depth of the dumpsite and the predominant soil is silty sand. The detailed geotechnical investigation report is enclosure in the FR.

## 3.6 Land Use & Land Cover

The land use survey of 2010 revealed that the predominant land use of Kayamkulam Municipality is residential. 67.55% of the total area is under residential use. Existing land use analysis shows following breakups as shown in table. The details of analysis of the land use survey and the resultant findings of existing land use are given hereunder. The glaring aspect of existing land use of Kayamkulam municipality is blessed with potential resources such as agriculture land and water bodies.

The highest percent of land use falls under the category residential/agricultural mix, which include mainly dry agriculture lands where residential developments are co- existent. Cashew and rice is the principal crop followed by coconut, Banana, Pulses.

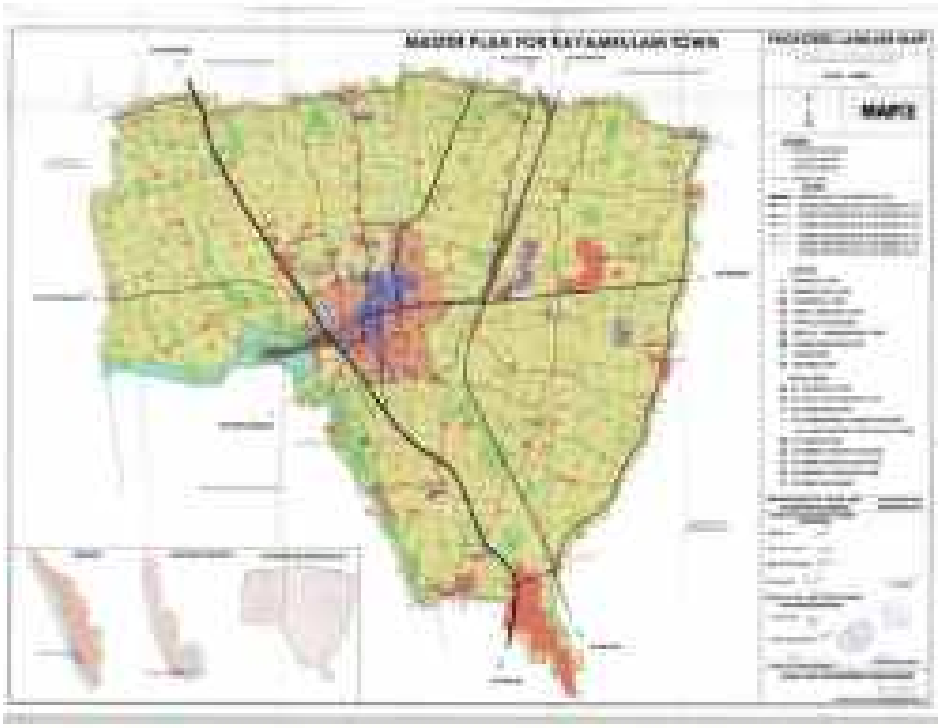


*Figure 3. 4 Landuse and Landcover Mao of Kayamkulam Municipality*

## 3.7 Cultural Heritage

The Krishnapuram Palace, built in the 18th century, now functions as a museum. Constructed in typical Kerala-style architecture, it has the largest mural painting in Kerala. The palace museum houses the Kayamkulam double-edged sword. Pathiramanal the picturesque island of vembanad lake is the first local biodiversity heritage in Alappuzha

## 3.8 Ecology and Biodiversity

The wild faunal species present are, mainly dogs, rodents and flies are seen near dumpsite. Also, crow, egrets, and other birds are seen feeding on the wastes. The flora species are shrubs, trees

The soil in the region is high with annual rainfall, this will result in good vegetative cover. During the visits to the site, there were no birds noticed in the dumpsite area. However, as the bio mining process will proceed, it is expected that the site will attract several types of birds that will come to the site to look for food**.** Due to the sandy nature of soil the coconut palm trees can see near to the site and the paddy crops.

## 3.9 Traffic Assessment

The proposed development will attract and generate the additional trips as an add-on to the existing traffic during its remediation period. In order to analyze the traffic conditions during the remediation and throughout the project lifespan, a traffic impact assessment is performed. The traffic impact assessment (TIA) is a technical analysis of traffic problems and issues relating to the specific development. The chief objective of the TIA is to identify whether a particular development project will have an impact on the safety and efficiency of adjacent roads.

The Dumpsite is at an aerial distance of 340m from the Kayamkulam - Punaloor PWD road. And there are two entrance in which the heavy vehicles can enter the premises. The approach roads to the dumpsite are municipality roads and the width of the roads are 5m. During the bio-mining process the following concepts to be incorporated.

1. It should be imperative that the ingress and egress points are staffed all the time to facilitate smooth traffic movement.

2. To provide adequate parking provision within the site premises during the construction phase for staff as well as visitors.

3. To schedule heavy vehicles to flow on the road during non-peak traffic hours to avoid congestions.

4. Traffic signage within the premises to be maintained, wherever required.

## 3.10 Natural Disasters

The area where the dumpsite is situated has a history of being prone to flooding, as observed in 2018 flood. The Murukkumood dumpsite is marked in the flood prone KML file which is shown in the **Figure 3.6** shown below. But as per the disaster management plan the site is not in the flood prone area.

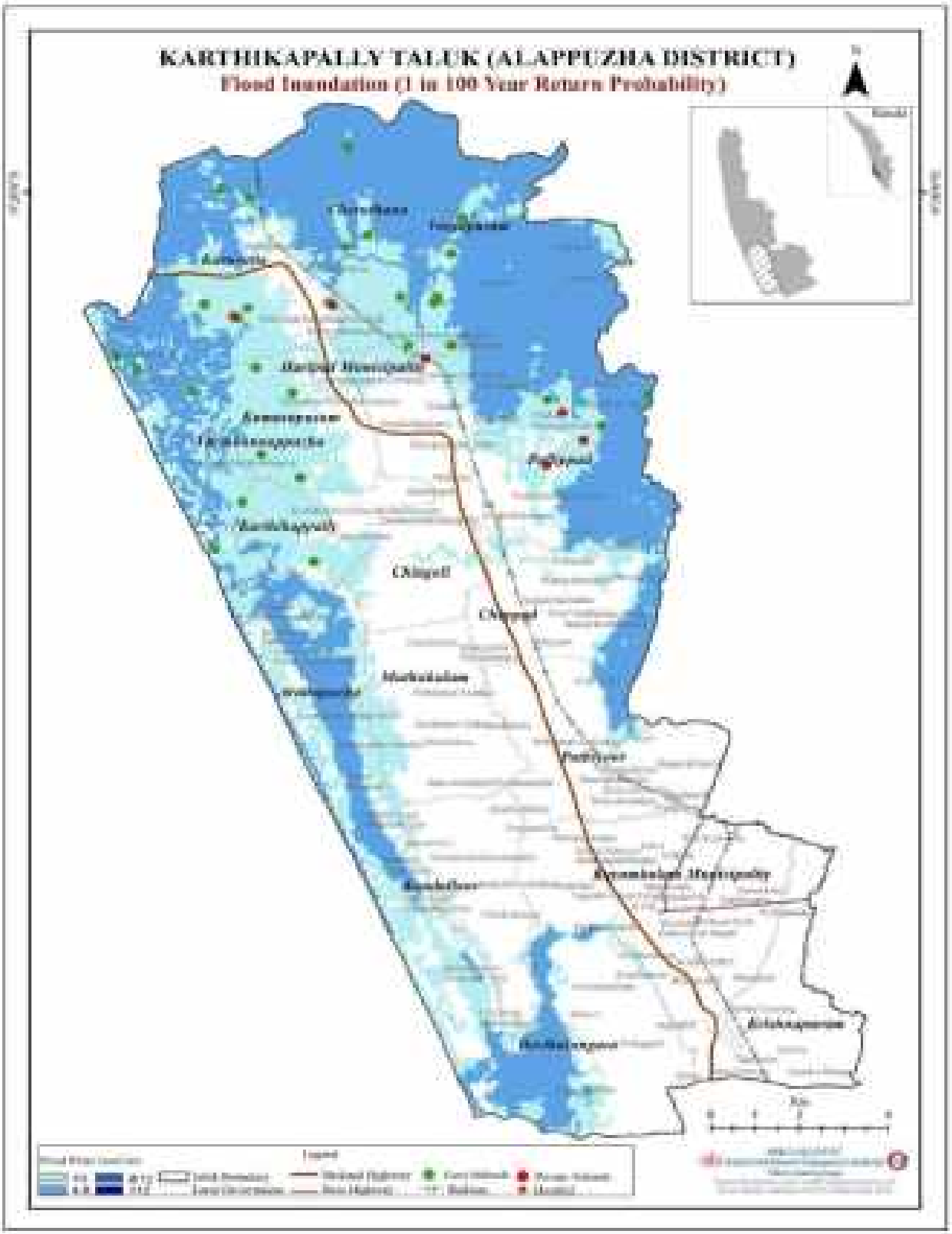



*Figure 3. 5 Fload Inundation Map of Karthikapally Taluk, Alappuzha District*



*Source-Flood KML file*

*Figure 3. 6 Flood Prone Map of the Murukkumood Dumpsite*

## 3.11 Description of Environmental Parameters

*Table- 3.3 Description of Environmental Baseline Parameters*

| Sl. No. | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| 1 | Water Supply<br>a) Surface water<br>b) Ground Water | A) Surface water: nullah is 25 m from the site in South direction and Surface water sample was collected and the test results showed – all parameters are well within limits except Turbidity, Iron, Colour, COD, TDS and Electrical Conductivity.<br>B) Ground Water collected from 3 different locations (1. Open well at a distance of 400m from the dumpsite in the North West direction, 2. Open well at a distance of 470m from the dumpsite in the South East direction and 3. Open well at a distance of 60m from the dumpsite in the South East direction.)<br>– all parameters are well within limits except for Turbidity, colour, Iron, BOD and Electrical Conductivity | Surface water: Exceeding limits of BOD and COD limits, impacting water quality and aquatic ecosystems. High iron levels can lead to the formation of precipitates, affecting ecosystem health. Elevated color and turbidity can impact aquatic ecosystems by influencing sunlight penetration, affecting plant growth. Electrical conductivity levels suggest some dissolved ions but generally remain within acceptable ranges for agriculture and certain industrial processes. |

| Sl. No. | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | | | Ground water: The results indicate that the groundwater sample taken from the downstream side (Sample 2) is contaminated, while the other two samples are not contaminated and the dumpsite has not caused any major increase in the contamination of ground water.<br><br>Site Drainage & leachate Impacts due to bio-mining activity (esp during any seasonal rain) is important as far as the nearby soil & water environment are concerned. |
| .2 | Leachate | The data indicates that the TDS is about 5395 mg/l while the suspended solids is about 57mg/l. The chlorides are high at 1429 mg/l. The heavy metals are found to be low, hence the soil is unlikely to be contaminated by heavy metals from the waste. | |
| .3 | Air Quality | Air samples were collected from 2 locations within the dumpsite and results found to be well within the permissible limits. | The concentration levels of the exploration are compared with the appropriate standards for the interpretation. The air pollution data indicates that the levels are within acceptable NAAQs. The air quality index is within the range of 51-100 which is moderate and is no significant contribution from the dumpsite. |
| .4 | Noise Level | Noise Level monitoring samples collected at entrance of the dumpsite. The ambient Noise levels Leq are above the National Ambient Noise standards for Residential Area both day and night time. The noise levels are influenced by the population within the vicinity, within the dumpsite there is an MCF and RRF facility. | Proper remedial measures for increased noise level shall be ensured by the contractor while bio mining activity. |

# CHAPTER 4 ANALYSIS OF ALTERNATIVES

## 4.1 Alternative 1: Zero or No Project Alternative (without Dumpsite Remediation)

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevent further contamination of the site.

If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows.

1. Foul Odor Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.

2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.

3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.

4. Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the surrounding environment, disrupting natural habitats and causing long-term ecological imbalances.

5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

## 4.2 Alternative 2: Mode of Execution / Management Alternative

Kayamkulam Municipality intends to complete the remediation project as earlier. However, considering the time required for mobilization, installation, sieving and handling recoverable etc., a time frame of about six months will be considered. The broad timeline chart for the execution of this project is given below **Table – 4.1.**

*Table 4.1 Timeline Chart for Execution*

| TIMELINE CHART FOR EXECUTION | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Task Name** | **M 1** | **M 2** | **M 3** | **M 4** | **M 5** | **M 6** |
| 1 | Planning & Mobilization | ■ | | | | | |
| 2 | Site Clearance & Development for accessibility within the site & fencing works | | ■ | | | | |
| 3 | Foundation & Civil Works (Cover Shed installation) for machineries | | | ■ | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4 | Site Development for Windrows & Leachate Collection | | | | | | |
| 5 | Electrical Works | | | | | | |
| 6 | Hiring & Installation of Machineries | | | | | | |
| 7 | Excavation of Legacy Waste | | | | | | |
| 8 | Windrow Formation & Spraying of Bio culture | | | | | | |
| 9 | Sieving Operations | | | | | | |
| 10 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | | | | | |
| 9 | Project Closure Activities:<br>• Leveling of Reclaimed Land using Bio-soil<br>• Handover the available infrastructure at site to the ULB<br>• Closure Report Submission to ULB. | | | | | | |
| 10 | Buffer Period (Rainy Season) | | | | | | |

### 4.3 Alternative 3: Technology Alternatives

The selection of the appropriate method or technique for remediation is determined by considering several parameters. These include the significant aspects and suitability of remediation types such as

1. Capping without land recovery.
2. Bio-mining – reclamation/recovery of 100% land
3. Capping with partial land recovery.

Additionally, factors like available resources such as manpower, machinery, finances, and physical site conditions, including the quantity and characteristics of legacy waste, Environmental baseline, social concerns, regulatory compliance (KSPCB/NGT), the need for complete land recovery, and opportunities for utilization of processed aggregates/by-products are taken into account.

After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

# CHAPTER 5 ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

Bio mining and bioremediation of existing legacy dumpsites brings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more man-days at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, bio-mining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration) are important in this case. In addition to the below mentioned,

(i) Drainage and leachate flow into regional waterbodies (& esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies,
(ii) Pollution on land/soil, dust and odour nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks,
(iii) Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and
(iv) Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at this stage, while some would be known only based on the project details that would be known from the work plan of the contactor once on board.

## 5.1 Impact Assessment Methodology

Impacts are assessed based on Magnitude, Duration, and Significance of the impacts and sensitivity of the receptors present within the 500 m aerial distance of Murukkumood dumpsite.

### 5.1.1 Magnitude and Duration of Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Bio-mining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;
- The spatial extent of the potential impact;
- Reversibility of the Impact;

- Legal standards and established criteria.
- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table Aspects for Determining the Magnitude of Impacts. Magnitude is assessed as medium, considering shorter duration of the activity. However, magnitude of cumulative impacts of various dumpsite remediation might be High.

Table 5.1: Aspects for Determining the Magnitude of Impacts

| Aspects | Large | Medium | Small | Negligible |
|---|---|---|---|---|
| **Duration of the potential impact** | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or Less than the lifespan of the program | Temporary with no detectable potential impact |
| **Spatial extent of the potential impact** | Regional – much beyond project boundaries | Beyond immediate Program components, site boundaries or local area | Within program boundary (but cumulative impact of various dumpsite biomining activities will be on larger extent) | A specific location within program component or site boundaries with no detectable potential impact |
| **Reversibility of potential impacts** | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months | Baseline remains constant |
| **Legal standards and established professional criteria** | Against national/approved standards and or international guidelines/obligations | Complies with limits given in national standards but not confirming to international lender guidelines in one or more parameters | Meets minimum national standard limits or international guidelines | Not applicable |
| **Likelihood of potential impacts occurring** | Commonly occurs under typical operating or construction conditions (Certain) | Usually seen occurring under most situations (Likely) | Occurs under abnormal, exceptional or emergency conditions | Unlikely to occur |

| | | | | |
|---|---|---|---|---|
| | | | (Occasional) | |

NOTE: Anticipated Project Duration - 5 to 6 months

### 5.1.2 Sensitivity of Receptor

The sensitivity of a receptor shall be determined based on a review of the population (including proximity/ numbers/ vulnerability) and the presence of features on the site or the surrounding area.

In the surrounding area of dumpsite around 25 Households are residing within 100m radius (with 3 houses within 15m). A Govt. Homeo & Ayurvedic Hospital at a distance of 558m, Kandalasseril Temple at a distance of 162m, Holy Trinity school at a distance of 518m. But there are no many habitats and project affected people and families. Hence sensitivity of receptors will not affect much to the bio-remediation process of the dump site and can be categorized as Medium Vulnerable receptor capacity to absorb proposed changes or/and moderate opportunities for mitigation.

### 5.1.3 Significance of the impact

The significance of the project impact is tabulated below: -

| Project Details | Sensitivity | Vulnerability of Resource | Importance of Resource |
|---|---|---|---|
| No project Impacts | Medium | Medium | Medium |
| Project with Bio Remediation (Biomining) | Medium | Low | Low |

Overall, Bio mining will have a medium impact, with more of a positive Impact on the Environment and Human health in longer term.

**Source-Pathway-Receptor Analysis**

A) **Source**: The source of contamination is the legacy waste remaining and being deposited at the Murukkumummod closed dumpsite, more specifically the landfill gas and leachate generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. In this case the waste is +20 years old, as dumping had started in year 1995 (Non-functional). The total waste volume is 10261.02 cu. m with the dumpsite spread over 0.70 acres and the legacy waste is presented about 3.30 m above and 1.20 m below from the existing ground level. In addition to the landfill gas and leachate, windblown dust and litter are also considered as sources of contamination.

B) **Pathways**: The following pathways for migration of contaminants have been identified: Wind- The main pathway for litter and dust dispersion is the wind. As long as the waste

is kept uncovered, the dust and litter will continue to be blown off the dumpsite to the surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. Rainwater runoff through the dumpsite acts as a pathway for transport of leachate to the soil and groundwater. The rainwater flowing off the dumpsite along the slope towards South west direction acts as a pathway for the uncovered waste to flow along the boundary of the dumpsite, which is enclosed with boundary wall. Since, the dumpsite is enclosed by boundary, runoff to the nearby river is not possible unless there is any leakage or due to heavy rainfall.

The leachate flows with groundwater and acts as the pathway. Surface water contaminants like run-off from the dumpsite, leachate and windblown dust and litter that reach nearby surface water bodies like canals and rivers are further transported by surface waters and in this case the surface water acts as the pathway.

C) **Receptors:** Receptors are air, surface water (drain passing through residential areas) and ground water. For drinking purpose, they mainly use municipal water supply (30 nearby Households within 200 m and 3 households at 15m distance), soil, flora, fauna and humans. In the case of remediated dumpsite, the most prominent group of receptors are the nearby residences. As the dump is not contaminated by hazardous wastes, remediation would improve the pollution scenario provided the bio-earth used is pollution free and of good quality. However, other impacts are expected on the final destinations of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF/MRFs in the region. Depending on the locations of end use of fractions retrieved from bio-mining, the contractor shall assess the impacts on communities and workers on site & nearby; and near locations of end-use. Key impacts may result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after bio-mining activity, activities in bio-mined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post biomining activity.

## 5.2 Impacts on Air Environment

- Key impacts on air include:
- Emission of Methane and other Greenhouse gases; and its impacts on scavengers, workers on site/other facilities on site (MCF and RRF in this case), nearby communities of Ward 22.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odour, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.

## 5.3 Impacts on Water Environment

**Ground water**

- Borehole data indicates waste depth is of 1.2 m with silty sand strata after that. Hence it is expected that the ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. With the slope of the dumpsite, this tends to get accumulated at low-lying gradients and flows into drain up to the nullah that flows at a distance of 25 m from the dumpsite in the southern side. Oozing & pooling of leachate & it draining to nearby areas during rains would be an important aspect to be managed during bio-mining to prevent ground water contamination
- Leachate samples: BOD, COD, TDS exceeding limits may impact the ground water quality in nearby residences, wells, and long term soil pollution.
- Borehole data: Dump below water table may impact water resources and wells nearby.
- Ground beneath the dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. There are no parameters exceeding the permissible limits for heavy metals.

**Surface water**

- The dumpsite experienced flooding during 2018 floods and the site is not vulnerable to flooding as per KSDMA but the dumpsite location is within the flood prone area in the KML Map for Flood prone area. The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas. Nullah is at a distance of 25 m and coast is at a distance of 8.6 Km from the dumpsite.
- Gentle slope is in the South West Direction. The dumpsite is surrounded by residential households and dry vegetation. It is important to contain and treat leachate from the proposed bio-mining activities on site. Treated leachate may be recirculated or used for other purposes.

## 5.4 Impact due to Odour

Dumpsite of organic, or partly organic waste, always results in anaerobic degradation of the waste and consequently, the production of landfill gas, consisting mainly of methane, $H_2S$, Ammonia, and carbon dioxide. If not properly managed the gas can cause odor problems in the neighborhood and since landfill gas is a highly potent greenhouse gas it will also contribute to the increased level of greenhouse gases (GHG) in the atmosphere. Dumpsite gas may also increase the risk of fires or explosions at the landfill site and surroundings.

## 5.5 Impact on Noise

A potential nuisance is a noise from transport of vehicle and machinery operating during remediation phase of the Dumpsite and transports of waste to the Dumpsite. The topography is favorable to attenuate noise to the surroundings. The distance to nearby residential areas is at 15m with 3 households. Hence, the impact will be higher during remediation to the residents.

## 5.6 Impacts on Soil

- Historic land use assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it shall be excluded from the site as bio-mining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.

- Spillover of activities to nearby road and land would result in pollution of all types on these areas. Hence it is important to restrict all activities to the site for legacy waste bio-mining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.

- Ground beneath dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. In Murukkumood, all heavy- metals are falling within the limit as per Fertilizers Control Order 1985 and its amendments. Murukkumood does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste (including legacy asbestos), e-waste or biomedical waste is found while bio-mining, same shall be retrieved, transported, treated and disposed as per specific waste guideline of the Central Pollution Control Board, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste), Feb 2019) and World Bank EHS Guidelines. A plan shall be prepared to auditing of all wastes, management, eliminating pollution & OHS risks; and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.

## 5.7 Other impacts on Biodiversity - Fauna/Flora

- Since the project involves transport of wastes, it is important to consider the impact beyond the project boundaries. Within 50 Km from the site, there is a Konni Reserve Forest and Coastal region at 8.6 Km from the dumpsite.
- Fauna: impacted by direct consumption of the solid wastes, sharps, entanglement, or by consumption of plants and/or animals contaminated by wastes, or as a result of leachate effects on groundwater and surface water.
- Flora: Plants near open dumpsites can be impacted directly by the waste, dust or smoke from burning. Disturbance to vegetation due to machinery, trampling by foot, vehicle or animals, or contamination by waste or leachate, the migration of landfill gas, or as a result of burning or smoke.

- Disturbance to other fauna and flora on site: onsite activities including those related to MCF and RRF may also impact fauna/flora through high noise levels of pre-construction / construction activities.
- Biodiversity of existing site: Available biodiversity of existing site is mentioned in the Environmental Baseline session and there is no key species identified which are listed by IUCN.

## 5.8 Other Impacts on existing or proposed activities on site/s

- There may be approvals from various agencies for bio-mining activities and associated facilities; depending on utilities and uses on site & associated activities. These permits shall be obtained prior to initiating activities on site.
- Impacts of bio-mining on existing facilities on site such as the MCF and RRF, etc. (disturbance to activities & people due to dust, leachate, noise, odour; additional load of wastes to these facilities, vibration impacts & structural damage, etc).
- Post bio-mining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped, or if this is dumped elsewhere or not processed, it will lead to health and environmental issues. This alternate location, being associated facility need mitigation measures to avoid/minimize pollution, Health & Safety impacts on workers, communities. Also, forward linkages are considered as associated facilities/linked activities. Impacts of transportation of these fractions (traffic increase, odor, leachate, dust), impacts during rains & emergencies, handling, storage at the identified locations, reuse etc. shall be mitigated.

# CHAPTER 6 ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN

## 6.1 Proposed Environmental and Social Management Plan

*Table 6. 1 Proposed Environmental Management Plan*

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| *A* | **Planning and Pre-Construction Stage** | | | |
| *1* | | *Planning for biomining facility* | | |
| 1 | Bio-mining & Bioremediation Plan & Capacities | • Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / bio-mined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these bio-mined material in line with the agreements with such facility owners and National, State regulations and WB EHS<br>• Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate Management Plan.<br>• The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers.<br>• Contractor to get all required licenses & permits before start of any activity on site | Contractor | SPMU/DPMU/ ULB |
| 2 | Site Access Closure | • The total cessation of dumping in the site will be implemented before any works.<br>• All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public.<br>• The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance to indicate that the waste dump has been closed from the operation.<br>• To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br>• Grading shall be performed where necessary to provide a neat appearance | ULB or Contractor as per Bidding mechanism | SPMU/DPMU/ ULB |
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – *impact on air quality, odor, water contamination due to leachate,* | • Carry out site assessments as per Guidelines for Bio mining of Legacy Waste Dumpsites of CPCB<br>• Consider safe bio-mining & gas / leachate generation from existing capped portion of the site<br>• Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means<br>• Provision of appropriate PPE's to the team undertaking the site assessments | TSC, ULB, Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | *health and safety impacts of the people working in the site assessment* | ▪ Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>▪ Plan for machinery operated which will be operated by skilled operators at all times.<br>▪ Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures.<br>▪ Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | | |
| 4 | Absence / Delay in Permissions for Developing the biomining facility and associated works as per National regulations | ▪ Required permissions for undertaking biomining at the existing dumpsite and assessments conducted for undertaking biomining as per existing Laws, Regulations; including for associated infrastructure, DG Sets, Consent to Establish; and other licenses including those as per Labor Laws, before the start of works on site | Contractor, ULB | SPMU/DPMU/ ULB |
| 5 | Dust impacts due to Site works, screening & stacking of retrieved wastes<br>*(Air Pollution) and Visual Blight due to excavation* | ▪ Plan to Provide temporary high screen, buffers around the site before the start of work to curtail dust emissions<br>▪ Arrange a green belt as early as possible on the area of the site with no / less dump. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers)<br>▪ PPEs to be used by workers<br>▪ Awareness to communities & suggest to use PPEs | Contractor and or ULB depending on agreement on bidding mechanism/DPR | SPMU/DPMU/ ULB |
| 6 | Material sourcing, transport, and stacking of construction materials<br>*(Occupational Health and Safety issues and Air noise pollution)* | ▪ Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism<br>▪ Prior intimation to nearby Primary Health Centre on work activities need for medical support, emergency support needs, type of laborers on-site and labor camp if any<br>▪ Materials shall be sourced only from approved quarries<br>▪ Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions.<br>▪ The driver should be with required license and follow speed regulations<br>▪ Materials shall be transported preferably through well-surfaced roads. If road it kuchcha, water sprinkling shall be done to prevent dust emission before and after truck passes<br>▪ Material transport and unloading activities should not result in noise disturbance to locals and should be during daytime<br>▪ Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors.<br>▪ Provide vehicle wheel wash area on site<br>▪ Workers to be provided with Personnel Protection Equipment (PPE) including safety boots, jackets, ear muffs, gloves. | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | ▪ Proper rest area on site shall be provided with water, first aid, toilets | | |
| 7 | The layout of Labour camp *(Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)* | ▪ Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp<br>▪ Nearby health center shall be informed about the labor camp & appropriate medical checkup shall be arranged periodically<br>▪ Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters)<br>▪ It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with landowners wherever the labour is accommodated<br>▪ Camp must not be provided in an area prone to Hazards<br>▪ Camp should be adequately at higher plinth levels to prevent water intrusion<br>▪ Rooms shall be of appropriate sizes with adequate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG)<br>▪ Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female labourers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc.<br>▪ The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security<br>(Refer ECOP section 06 and section 11 of EMF for KSWMP) | Contractor | Site engineer of SPMU, Labour Commissioner, PCB |
| 8 | Nearness/disturbance to sensitive areas such as forests, wildlife habitations, etc. especially in case of providing support facilities<br>*(Impacts on Fauna / Flora)* | ▪ Ensure site selection for any support facilities or activities (such as vehicle storage etc. if no in biomining site) based on the screening checklist and the master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate, Reduce. Obtain requisite permissions from respective authorities such as Pollution Control Board, ULB etc.<br>▪ Identify appropriate government site to avoid land acquisition and resettlement impacts<br>▪ Covered and well-marked storage area with cut off drains & odour/fly/dust/ fire prevention shall be ensured for excavated wastes and washing, segregation of the same are to be arranged with due consideration to nearby residences, slope and other landuses | Contractor | SPMU/DPMU/ ULB |
| 9 | Contamination of groundwater due to leaching. Leachate parameters; BOD, COD, TDS, Ecoli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution | ▪ During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant<br>▪ Depending on the contractors plan for bio-mining of the site, adopt plans to manage leachate | Contractor | SPMU/DPMU/ ULB |
| 10 | Impacts on flora, fauna" consumption of wastes, leachate impacts, dust smoke burning, trampling/machinery | ▪ Movement routes of vehicles to be planned to avoid key fauna/flora on site<br>▪ Leachate collection & storage/treatment and recirculation shall be planned to avoid impacts on flora, fauna | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| I1 | Nuisance hazards to neighboring areas | • Ensure proper design and adequate compound wall, high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements<br>• In case of waste mound and site edges are sliding or unsafe, provide engineered retention walls. | Contractor | SPMU/DPMU/ ULB |
| I2 | Treatment & Disposal of wastes and rejects | • Contractor to Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & inert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventorised and quantified, including Biosenth, rejects, inerts. These shall be tested and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertiliser Control Order 1985 and their amendments. Asbestos Management Plan shall be prepared for management if Asbestos wastes retrieved if any<br>• Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period. | | |
| **B** | **Implementation or Biomining & Bioremediation stage and Construction of ancillary facilities such as access road improvements, compound walls, greenbelts, drainage etc.** | | | |
| | **Implementation of bio-mining of the dumpsite** | | | |
| 1 | Impact due to the vehicular movement<br>*(Air and noise environment & Vehicular - Vehicular & Vehicular - Pedestrian Conflicts)* | • Vehicles and machinery are to be maintained so that emission conforms to National Ambient air quality standards.<br>• All vehicles and machinery should obtain Pollution Under Control Certificates.<br>• HORN PROHIBITION signpost to be erected.<br>• Rumble strips/speed breaker to be provided on access roads.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emission standards prescribed.<br>• Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle<br>• Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements.<br>• Avoid heavy vehicle movement through access roads to the Marakkannoor dumpsite during peak hours 7 a.m to 10 a.m mention: school hrs / peak hrs; and during important period / festivals when people use the road to access temple<br>• Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents. | Contractor, ULB | SPMU/DPMU/ ULB |
| 2 | Impact due to the use of heavy vehicle and equipment<br>*(Air and Noise environment)* | • Moving equipment (in case of construction of ancillary facilities) should be well sealed and be equipped with a dust-removal device.<br>• Equipment Operators & labourers should wear dust masks, ear protection, and hard hats.<br>• Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load.<br>• Labor to be provided masks / PPEs. | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | ▪ Construction / Bio-mining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spreading into neighboring sensitive land uses<br>▪ Noise standards at operation machines are to be strictly monitored to prevent exceeding of GOI noise standards.<br>  ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines.<br>  ▪ Using modern, well-maintained and regularly serviced vehicles.<br>  ▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>  ▪ Provision of earmuffs and ear protection to workers and employees in high noise areas.<br>▪ Workers in the vicinity of strong noise to wear protectors and their working time should be limited as a safety measure.<br>▪ As Murukkumood dumpsite has sensitive receptors and settlement areas within 200m (3 houses within 15 m radius) of it, noisy works shall be stopped from 22:00 to 06:00.<br>▪ Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum.<br>▪ Avoid noisy activities/machines near South side of the site where settlement exist within 50m. Noise barrier shall be provided at all noise-sensitive locations / for noise generating equipment such as DG sets, mixers (for ancillary facilities) especially near South side of the dumpsite<br>▪ Adopt required measures as per CPCB guidelines, and site & work specific safety requirements | | |
| 3 | Impact during the construction activities<br>*(water environment)* | ▪ Labour camps if any (depending on Contractors work plan & arrangements) are to be located away from water bodies.<br>▪ Vehicle washing or maintenance near water bodies are to be avoided.<br>▪ Contaminated water from construction / biomining activities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated on site. | Contractor | SPMU/DPMU/ ULB |
| 4 | Leachate and Runoff from biomining activities<br>*(Soil contamination and groundwater contamination)* | ▪ Provide site cut off drain around the site to divert off storm water from entering the site, and to prevent contaminating downstream resources with run off from the dumpsite<br>▪ Depending on the contractors plan for biomining of the capped area on site, implement leachate management to cause no harm to communities & environment<br>▪ Ensure storm water drains will lead to drain outlets<br>▪ Provide leachate drains lined from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area<br>▪ Provide proper treatment of leachate and storm water that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by bio-mining activities like excavation and waste segregation and stabilization<br>▪ The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB. | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | ▪ The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata<br>▪ Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff and hence reduce infiltration<br>▪ Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism<br>▪ Plan the works on-site only during non-rainy seasons and to complete the works before rains<br>▪ Store leachate preferably in aboveground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide for emergency containment additionally | | |
| 5 | Soil decontamination from accumulated waste levels<br>*(Impact on leachate, odor)* | ▪ Decontaminate the soil / stabilized layers remaining after sieving out wastes using windrow and bioculture of appropriate quality in line with standards / regulations or appropriate means as per CPCB Guidelines<br>▪ Vegetative layer using contaminant absorptive root varieties like Vetiver may be tried on soil and along the edge of the green belt or floating wetlands may be deployed in water channels nearby to maximize absorption of leachate in the soil by root-zone phytoremediation<br>▪ Soil and water testing shall be done and changes in contamination shall be noted. | Contractor | SPMU/DPMU/ ULB |
| 6 | Excavation of waste from the waste mound<br>*(Health and safety impacts)* | ▪ The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound.<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided<br>▪ Machinery operated for excavation should be operated by skilled operators at all times.<br>▪ Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on wastes.<br>▪ Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound<br>▪ In case of the waste mound and site edges are sliding or unsafe; provide engineered retention walls or string boundaries.<br>▪ When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection & treatment mechanism. | Contractor | SPMU/DPMU/ ULB |
| 7 | Transportation of wastes or retrieved or other material in overloaded and open vehicles<br>*(Air, Odour nuisances; spills and littering impacts on Air, Water, Land)* | ▪ All vehicles shall carry only approved load of weight<br>▪ Regular cleaning of roads & drains and removal of spills if any.<br>▪ All waste transport vehicles shall be covered and movement shall be during non-peak hours.<br>▪ Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities.<br>▪ Adopt required measures as per CPCB guidelines, and site specific safety requirements. | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 8 | Occupational health and safety impacts of the workers during the biomining & construction of support facilities:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage of chemicals/other materials, biocultures or wastes etc; by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | ▪ Avoid direct & double handling of wastes through avoidance measures (suitable planning & equipment), engineering controls & use PPEs<br>▪ Work area & Labour camps shall be provided with First Aid and other related activities.<br>▪ Emergency Preparedness plans shall be prepared and implemented for all manpower working centers and its field extension centers.<br>▪ An Environment Health & Safety policy shall be prepared and implemented<br>▪ Adequate manpower shall be provided & manager & staff shall listen and act upon the manpower related grievances.<br>▪ Workers will be provided with PPE such as face mask, gloves, shoes, nose masks & goggles<br>▪ Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed without slip, trip, fall especially on waste, leachate or trenches<br>▪ Proper training will be provided regarding the maintenance of health<br>▪ Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks & water supply), food, and water in a hygienic environment (with proper hand wash). Provide clean eating areas where workers are not exposed to contaminated, hazardous or noxious substances.<br>▪ First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus<br>▪ Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health checkups. Arrange daily health checkup for workers working on waste heaps<br>▪ Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals.<br>▪ Measures such as deferred timings and stretch break to be adopted<br>▪ Secure all installations from unauthorized intrusion and accident risks;<br>▪ Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every day start of works / activities. Key hazards would be (but not limited to) are flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and leachate from existing capped area on site, electric shocks, works with heavy machines & equipment, slips of men & material (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc.<br>▪ EHS specialist with adequate experience & third party supervision are important for bio-mining activity<br>▪ Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites<br>▪ Provide visitor orientation if visitors to the site need to gain access to areas where hazardous conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible | Contractor, ULB | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | ▪ Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;<br>▪ Ensure moving equipment is outfitted with audible back -up alarms & flag men with whistles or speakers;<br>▪ Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit.<br>▪ Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenance to be marked well & safe kept before activity start near those In close proximity to this location, there is a transformer. Disallow worker exposure to noise level greater than 85 dBA for more than 8 hours a day without hearing protection<br>▪ All workers shall be registered as per prevalent labor laws (including a workforce of subcontractors) and provided insurance cover & others as per existing acts/laws<br>▪ Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractor's person/insurance agent<br>▪ While using heavy machinery like JCB, cranes, etc, inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle.<br>▪ While using heavy machinery like JCB, cranes, etc, inform communities to prevent children and others from going near operating / movement areas including roads.<br>▪ Flagmen shall be arranged if work is near schools, hospitals, major roads, and traffic control is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if possible<br>▪ A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs;<br>▪ No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor<br>▪ All works related to working at heights will be undertaken only during the daytime when sufficient sunlight is available;<br>▪ Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done;<br>▪ All excavation activities to be conducted in supervision of the site contractor;<br>▪ Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured.<br>▪ All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans prepared and implemented, as per Banks Incident Reporting Tool | | |
| 9 | Risk of fire due to conditions leading to spontaneous combustion | ▪ Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for Implementation of SWM Rules 2016 – regdg Fire Incidents at MSW Dumpsites (https://cpcb.nic.in/openpdffile.php?id=UHVibGljYXRpb25GaWxlLzQyNDRfMTY1NDE2Mzk3N19tZWRpYXBob3RvNzYxMi5wZGY= ), LSGD Kerala Government GO on Fire Safety of MRF, MCFs (for the | Contractor, ULB | SPMU/DPMU |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | *(Air environment, disturbance to communities and workers, health impacts, safety issues)* | MRF on site if used for storage of wastes)and other Regulations, guidelines applicable<br>▪ Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3; and National/State regulations & WB EHS<br>▪ Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes<br>▪ Avoid conditions that can lead to spontaneous combustion such as:<br>o Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard<br>o Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.<br>▪ Design the facility for access by firefighting equipment, including clear aisles among waste heaps or work areas and access to adequate water supply.<br>▪ Ensure workers are briefed of fire hazard & its management<br>▪ No unauthorized entry shall be permitted to the site; including of workers during holidays, nighttime, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating "trespassers not allowed"<br>▪ The following activities should be implemented to prevent fires from occurring at the facility<br>o adequate fire-fighting equipment should be made available on-site and stored in an accessible manner,<br>o all operating staff should be trained and able to manage fire outbreaks at any part of the facility.<br>o clear signage should be established to inform workers and the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area.<br>o Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows.<br>o all fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the bio mining, storage, and processing areas.<br>o all flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating storm water.<br>▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the bio mining activity in line with National State regulations, guidelines and international good practices<br>▪ Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.<br>▪ Contain all local smokes/small fires inside the dump asap. Fire brigade help shall be sought on all smokes/fires outside the dump<br>▪ Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured.<br>▪ Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers | | |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 10 | Construction of new facilities in retrieved land | ▪ The excavated site shall be protected from any dumping during or after the bio mining activity and shall be reserved for SWM activities in line with SWM Rules 2016<br>▪ Any new facility under KSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations | ULB | SPMU/DPMU |
| 11 | Pest / Vermin Control & Visual impacts (Odour, flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center<br>▪ Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups<br>▪ Bio-pesticides / biological control shall be followed. However, bio-pesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used<br>▪ Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate management | Contractor, ULB | DPMU, SPMU |
| 12 | Odour nuisance | ▪ Waste with a strong odor to be covered immediately they are emptied from vehicles.<br>▪ Control and manage leachate treatment to minimize odor.<br>▪ Provide buffers screens to curtail odor from reaching surrounding communities especially to North side of site.<br>▪ Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor. | Contractor, ULB | DPMU, SPMU |
| 13 | Storage, Collection, Transport, Treatment & Disposal of wastes and rejects | ▪ Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste<br>▪ Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters<br>▪ Waste handling shall be inline with existing regulations & guidelines & avoid health & safety impacts<br>▪ No material is allowed to remain on site after the contract period<br>▪ Adequate fire safety arrangements & awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported<br>▪ Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/inserts in designated or agreed area & are in line with schedule; using GPS.<br>▪ Given that the access road is used by the public, it is imperative to implement the required safety precautions and environmental protection measures when transporting the waste. | Contractor, ULB | DPMU, SPMU |
| 14 | Other activities | ▪ No activity other than bio mining shall take place on site & any activity shall cause no adverse impacts on the environment or people<br>▪ If existing MCF shall be used for storing bio mining wastes, its safety shall be ensured in terms of fire & structural safety before starting to use the facility. Further usage of the MCF after bio mining works shall be after proper cleaning / washing & disposal of all rejects/inserts & tools to ensure good housekeeping & no H&S impacts | | |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | • If existing MCF shall be used by the ULB for storing dry wastes from Town, during bio mining period, alternate access shall be arranged & workers shall be adequately protected against any health & safety impacts | | |
| 15 | Energy Efficiency & Water Use efficiency | • All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & bio mining / construction techniques<br>• Landscaping & green belts to use local / indigenous plants & trees<br>• Waste water and Leachate to be treated & recycled/reused | Contractor | ULB |
| C | **Future Site Usage (EMP shall be updated in line with EMF & used if future site usage is proposed under KSWMP). This section is not the responsibility of the Contractor for Bio mining, but of the future facility operator & ULB** | | | |
| 1 | Future use of the bio mined site: Green Park, MCF, MRF, RRF, Treatment plants, landfill cell or any other, preferably for SWM | • ULB to ensure that the site will not be used for future dumping.<br>• Activities at existing MCF to be upgraded to ensure that no waste (even dry wastes) gets dumped around<br>• ULB shall plan the future use of the site shall be in consultation with the communities<br>• Phase 1 Environmental Assessment to be carried out, EA for existing facilities & EIA for proposed development in line with EMF in case this is proposed to be developed under KSWMP<br>• All applicable clearances, permits shall be arranged in line with applicable regulations for the proposed new use of the site, and appropriate designs/plans to be prepared & implemented | Future Facility Developer/ Operator & ULB | ULB (SPMU in case it is under KSWMP) |
| 2 | Vehicle movement for new activities: MCF/MRF, RRFs, Treatment plants, landfill cell<br><br>*(Air, water environment, a nuisance to biodiversity, communities, Health impacts)* | • The movement route shall be scheduled for each vehicle<br>• Enforce speed limits applicable and make drivers aware of this<br>• Vehicles movement shall be tracked by Health Supervisors to ensure keeping up to schedule, preferably using GPS<br>• Any adulterated fuel shall be avoided. There shall be periodic emission tests for vehicles<br>• Provision of Personal Protective Equipment such as face mask, gloves, nose masks & goggles to all workers in C&T vehicles, Maintenance yards<br>• Proper lubrication shall be provided to minimize squeaking noise due to friction<br>• Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br>• The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public<br>• Traffic will be managed at the site by providing adequate space for parking of vehicles<br>• Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design<br>• No waste or material shall be disposed in any place other than the designated area, including water bodies, coasts/forests, or sensitive areas. | Future Facility operator | ULB |
| 3 | Exhaust emissions<br>*(Air impacts)* | • No idling of vehicles on site<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed | Future Facility operator | ULB |
| 4 | Plying of vehicles through kutcha / unsurfaced roads and idling | • Vehicle movement shall be well planned – through topped roads. In case of necessity to move through Kutcha roads, ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Future Facility operator | ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | *(Air pollution SPM, CO, CO2)* | | | |
| 5 | Impact on the ambient noise quality during the operations *(Noise, nuisance to sensitive receptors, health impacts)* | ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines;<br>▪ Using modern, well-maintained and regularly serviced vehicles;<br>▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>▪ Provision of earmuffs and ear protection to workers and employees in high noise areas | Future Facility operator | ULB |
| 6 | Occupational health and safety impacts of the workers:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | ▪ All OHS and CHS measures to be followed in line with applicable regulations, guidance<br>▪ Workers & communities shall be made aware of OHS, CHS risks and impacts & mitigation measures adopted<br>▪ Emergency management plan to be prepared & followed<br>▪ Workers shall be appropriately trained or OHS during construction & Operation of all future facilities | Future Facility operator | ULB |
| 7 | Pest / Vermin Control (Odour, flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted<br>▪ Biopesticides / biological control shall be followed.<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used | Future Facility operator | ULB |
| 8 | Fire Safety | ▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented in line with National State regulations, guidelines and international good practices | Future Facility Operator | ULB |
| 9 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees<br>▪ Waste water to be treated & recycled/reused | Future Facility Operator | ULB |

### 6.1.1 Disposal phase of By-products from Bio-mining process:

The bio-earth and coarse fraction soil recovered from dumpsite will be used for filling low lying areas. The RDF material recovered from dumpsite will be transported to nearby cement factory and recyclable material will be handed over to the authorized recycling agency. If the by-products are not removed from the site within a three-month period, penalties will be imposed on the contractor.

## 6.2 Disaster Management and Emergency Preparedness

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care, and other necessities of life. In the case of Dumpsite remediation, Disaster Management Plan is aimed to ensure the safety of life, protection of the Environment, protection of installation, restoration of the remediation process, and salvage operations in this order of priorities.

For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel training is to be provided through rehearsals/drills. The disaster management Plan consists of Onsite Emergency Plan and an offsite Site Emergency plan, which is outlined here for Emergency Preparedness. The list of emergency helpline services is mentioned in the Table below.

*Table 6. 2 List of Emergency Helpline Services*

| Sl. No. | Emergency Services | Distance from the dumpsite |
|---|---|---|
| 1 | Kayamkulam Police Station | 2.7 Km |
| 2 | Fire station Kayamkulam | 3.8 Km |
| 3 | Kayamkulam Government Taluk Hospital | 3.3 Km |

### 6.2.1 Approach to Disaster Management Plan (DMP)

The objective and approach of the Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effect the rescue and medical treatment of casualties;
- Safeguard other people;
- Minimize damage to property and the environment;
- Initially contain and ultimately bring the incident under control;
- Identify any dead;
- Provide for the needs of relatives;
- Provide authoritative information to the news media;
- Secure the safe rehabilitation of the affected area;

- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency.

In effect, it is to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy. Disaster Management Plan should include Emergency Preparedness Plan, Emergency Response Team, Emergency Communication, Emergency Responsibilities, Emergency Facilities, and Emergency Actions.

#### 6.2.1.1 Identified Emergency Situations

Major disasters which can affect the remediation process are as follows:

- Floods due to heavy rainfall
- Fire risk in summer
- Occupational and health risks during the remediation process
- Safety-related accidents during the remediation process

#### 6.2.1.2 Proposed Organizational Structure for Disaster Management Plan

**Response team:** Setup an Emergency Organization. Emergency Organization includes the senior executive (head of EO as a Site controller), Manager Safety (Incident controller), Shift in charge, and Emergency Coordinators.

- All Incident control would be reported to the Site Controller. Each Incident Controller organizes a team responsible for controlling the incident with the personnel under his control.
- **Shift In-charge** would be the reporting officer, who would bring the incident to the notice of the Incidence Controller and Site Controller.
- **Emergency Coordinators** would be appointed who would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential and support services. For this purpose, security in-charge, personnel department, essential services personnel would be engaged. All these personnel would be designated as key personnel.
- In each shift, the electrical supervisor, in charge, and other maintenance staff would be drafted for emergency operations. In the event of power or communication system failure, some of the staff members in the office/facility would be drafted and their services would be utilized as messengers for quick passing of communications. All these personnel would be declared as essential personnel.

## 6.3 Proposed Monitoring Plan

The proposed monitoring plan is presented in table below,

*Table 6. 3 Proposed Monitoring Plan And Frequency*

| Monitoring media/parameters | Items and parameters | Frequency | Location |
|---|---|---|---|
| **Ambient Air Quality** | PM10, PM2.5, NOx, CH4, CO, Ammonia | Quarterly (1 sample) | 2 point |
| **Noise** | Leq Day and Night | Monthly | 2 point |
| **Health safety Hazards** | Medical records, documentation of injuries and accidents, Health and safety assessments | As and when accident/injury occurs | Incident reports |
| **Leachate** | • pH<br>• Biological Oxygen Demand- BOD<br>• Chemical Oxygen Demand-COD<br>• Nitrogen (Ammonia, Nitrate, Nitrite)<br>• Oxidation-Reduction Potential- ORP<br>• Electrical Conductivity-EC<br>• Total Organic Carbon (TOC) Dioxins<br>• Heavy Metals (As per the schedule II of SWM rules 2016) | Quarterly | 2 point |
| **Groundwater quality** | Parameters will be defined and sampling, preservation, and analysis of water will be carried out following those stipulated in the subsections below and Standards Methods for Testing Water and wastewater, 21st edition, published by American Public Health Association (2005). | Quarterly | 8 points |
| **Surface water quality** | | Quarterly | 6 points. 2 upstream and 4 downstream |

## 6.4 Estimated Budget for Implementation and Supervision of EMP

The estimated capital cost of [redacted] is required for budget provision for implementation and supervision of EMP. The remediation will be only during shorter time duration and hence the recurring cost won't be incurred. The estimated budget for implementation & supervision of EMP is shown in the table below.

*Table 6. 4 Estimated Budget for EMP*

| Sl. No | Particulars | Capital cost(lakhs) |
|---|---|---|
| 1 | Dust Mitigation measures including site green mat enclosure, Water sprinkling and wheel washing | [redacted] |
| 2 | Mobile toilet, Pest Control, Disinfectant | [redacted] |
| 3 | Medical cum First aid facility | [redacted] |
| 4 | PPE workers & welfare , Firefighting equipment | [redacted] |
| 5 | Monitoring & Testing (Air, Noise, Water, Soil, Leachate) | [redacted] |
| | **Total** | [redacted] |

# CHAPTER 7 INSTITUTIONAL ARRANGEMENTS

## 7.1 Proposed Institutional Arrangement

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of ToR for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation. The Support Organisation will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments. Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level. The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances. The PIU will submit the compliance reports on clearances, permits, and environmental and social safeguards to D-ESDU.

## 7.2 Capacity Building

- Sensitize and orient different stakeholders of the project with adequate communication of benchmark standards on various project components. Ensure up gradation of awareness generation at different levels. Special focus: Health Hygiene and sanitation Sub Activity

- Training program for HKS (Health & Hygiene, source level waste segregation and source level treatment, Fire and Safety)
- Training program for ULB Councilors and Ward convener (Proposed SWM project plan of KSWMP)
- Training program for Political and trade union leaders (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for Residence Association leaders (Health, Hygiene different composting methods and source level waste segregation, littering of waste, Public Health, Fire and Safety)
- Training program for workers of Municipal Sanitary workers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for school / college students (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for ULB officials (Proposed SWM project plan of KSWMP, proposed policies, existing policies etc... to improve the existing pattern into zero waste concept of the municipality)
- Training program for School children, Parents and Teachers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Massive awareness campaign on 5R (Reuse, Recycle, Repurpose, Reduce and Refuse)

**Importance of Capacity Building**

Capacity building is defined as the "process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in the fast- changing world. It is the development of knowledge, skills and attitudes in individuals and groups of people relevant in the design, development and maintenance of institutional and operational infrastructures and processes that are locally meaningful. It is generally defined 'capacity building' as the creation of an enabling environment with appropriate policy and legal frameworks, institutional development, including community participation, human resources development and strengthening of managerial systems. It is a long-term, continuing process, in which all stakeholders participate. The main aim of capacity building under solid waste management is to build a basic understanding regarding the solid waste management project at each step of value chain (waste generation, segregation & storage at source, primary collection, secondary collection, transportation, processing and disposal) and importance of their work and develop a sense of belonging towards the work.

## 7.3 Grievance Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizen can lodge complaint either directly to ULBs, toll free number or through digital platforms (website/email – grmkswmp@gmail.com / Toll free number-18004250238). The complaint will automatically be recorded in login of ward level official of ULB and an escalation system is constituted according to the category of each complaint to close the complaint in time. The complainer can close the complaint through a feedback form according to their satisfaction.

# CHAPTER 8 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

## 8.1 Approach to Public Consultation

KSWMP has developed a detailed strategy and installed various inclusive mechanisms in the different stages of the remediation process considering the project affected persons, families, and commercial establishments.

As the initial step, a **Transect walk** was carried out on **22/2/2023** covering the surrounding area of the dump site. The aim of the transect walk was to assess the site and gather information about its location, potential social risks, existing infrastructure and the impact on surrounding communities. The group exercise that entails walking between two points to intentionally cross or transect a community. The group explores environmental and social resources, conditions and systems by observing, asking, listening, looking and producing a transect diagram. Information collected can be used to reveal land use practices, hazards and vulnerabilities to inform disaster mitigation and water management.

**Ward level Consultation Meetings** will be conducted during the planning stage in the chairmanship leadership of ward councilor by engaging the representatives from different resident's associations, commercial establishments and other institutions in the ward for explaining about the remediation process and thereby to gain public support and cooperation.

## 8.2 Information Disclosure

Warning sign boards and project information boards with full details of grievance redressal mechanism along with all related contact details will be installed at site during the remediation process at the site. Site control measures should be enforced to prevent unauthorized personnel from entering the work site. Work zones should be delineated around specific bore holes, excavations and other areas that may pose the risk of potential exposure to the hazards

# ANNEXURE I

## INITIAL ENVIRONMENTAL EXAMINATION

Checklist to be followed for Environmental Screening during the Initial Environmental Assessment Stage has been provided below:

**Subproject Details**

| | |
|---|---|
| **Name of Subproject:** | Murukkumood Solid Waste Dumpsite Reclamation by Biomining. |
| **Subproject Components:** | Biomining, Leachate Treatment, Site development, green belt etc. |
| **Subproject Location (City / Town/ Village with ward numbers):** | Murukkumood / Kayamkulam / Ward 22 |

**Stage 1: Exclusion List**

**Is the Project Excluded from Consideration due to the following:**

| Sl No | Non-permissible Activities |
|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i) any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides |

This dumpsite remediation project involves 1. (i) no construction in demarcated Forest areas or protected areas or their buffers, (ii) no construction of landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) no treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). 2. NO activities which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas, 3. No activities with (i) any impact on or due to Dams or embankments (ii) and project will not purchase, store and use Banned Pesticides.

Hence, not excluded
Proceeding to Stage 2 Screening

**Stage 2: Environmental Screening Checklist**

| Project Details | | |
|---|---|---|
| **Sl.No** | **Components** | **Details** |
| 1 | Project components | Murukkumood Solid Waste Dumpsite Reclamation by Biomining |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste management, centralized non-biodegradable waste management facilities, centralized biodegradable waste management facilities, sanitary landfills, biomining of dumpsites, including for Linked activities / associated facilities) | Proposed project includes Bio-Mining of Legacy Waste Quantity of 10261.02 $m^3$,The Objective of the project is to dispose the old dumped waste and the formation of a windrow of legacy waste, followed by waste stabilization through bio-remediation (i.e. exposing all waste to air and using composting bio-cultures), i.e. screening of the stabilised waste to recover all valuable resources (such as organic fines, bricks, stones, plastics, metals, clothes, rags, and so on), and finally its long-term disposal. |
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project; including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination)<br>Site Survey No (attach map) with ownership details, Geographical co-ordinates of the site location [including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | Location of Project site: (Lat. 9.17352049,<br><br>Long 76.52148736 in ward 22.<br><br>Current land use: For the last +20 years, Kayamkulam Municipality's solid waste has been deposited in the dumping yard at Murukkumood . Later One Material Collection Facility has been set up adjacent to Murukkumood Dumping Yard to collect and process the Non-bio degradable waste from the Kayamkulam Municipality. But around 1.50 tons per day of biodegradable wastes from daily street cleaning, shops, vegetable market etc. is collected by the sanitation workers of the municipality and delivered to Murukkumood dumping Yard. Based on the preliminary survey conducted, it is estimated that 10261.02 m3 of Solid Waste has been deposited so far. The dumpsite is covered with compound wall with gate.<br><br>Site Survey No:1956<br>Historic land use: MSW dumpsite since 1995, land owned by Municipality.<br><br>Linked / Associated facilities / off site components: MCF & RRF<br><br>Earthquake zone: III (IS 1893-2022) |

| | | |
|---|---|---|
| **4** | Land Area proposed to be used: Location wise (in sq km / sq m) | 2832.79 sq. m at existing MSW dumpyard. |
| **5** | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | During the segregation process-2 KL/Day<br>Source-KWA |
| **6** | Power Required and Source of Power | No DG set requirement for this sub-project. Electricity connection is available within the site.<br>Source of Power - Existing KSEB line near to the dumpsite. |

**Baseline Environmental Conditions**

| **Sl. No** | **Environmental Aspects** | **Yes** | **No** | **Details(include distance in Km, info on its importance)** |
|---|---|---|---|---|
| 1 | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers) | | | |
| (i) | Critically Vulnerable Coastal Areas (CVCAs), Eco-sensitive Areas (ESAs) | | ✓ | Azheekal Beach-7.70km |
| (ii) | Cultural Heritage site, Protected monuments - listed by ASI/State | | ✓ | Krishnapuram Palace-2.90km |
| (iii) | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensitive area, with any schedule 1 species? If Yes, which is the area? | | ✓ | Azheekal Mangrove forest-6.90km<br>Kayamkulam/Ayiramthengu- 7.30km |
| (iv) | Other Wetlands/ Mangrove/ Estuarine Region | | ✓ | Kayamkulam Kayal-6.80km |
| (v) | Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves | | ✓ | |
| (vi) | Other Sensitive Environmental Components listed in EMF | | ✓ | |
| (vii) | Drinking water source, upstream and downstream uses of rivers, etc | | ✓ | A Natural stream is at a distance of 25m from the dumpsite<br>Karippuzha Thodu -2250m |
| (viii) | Low-lying areas/areas of Tidal Influence (provide CRZ details) | | ✓ | |
| (ix) | Sensitive Receptors – a) Habitations / Households / | ✓ | | Distance to nearby Household: About 25 residential units under 100m radius. |

| Sl. No | Environmental Aspects | Yes | No | Details(include distance in Km, info on its importance) |
|---|---|---|---|---|
| | Hostels, other special areas, etc. b) School c) Religious Places d) Tourist Areas | | | Govt Homeo & Ayurvedic Hospital-558m<br>Kandalasseril Temple-162m<br>Holy Trinity school-518m |
| 2 | Is the site in Critical / Over Exploited Ground Water Block. Provide the level of the groundwater table | | ✓ | GWL 2-5m As per Ground water year book of kerala (2021-2022) Published on September 2022. |
| 3 | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other (specify) | | ✓ | As per Disaster management plan Alappuzha the proposed location is not in the flood plain . Even if the Kerala comes in category of Zone III ,The magnitude of earth quake is nill as per DMP, Alappuzha Published in 2015. |
| 4 | Describe the type of soil and vegetation on site | | | Coastal Alluvial soil. No vegetation on site. |
| 5 | Is the site present in the flood plains as recorded in the last 100 years? Provide the HFL level of the site/region | | ✓ | As per Disaster management plan Alappuzha the proposed location is not in the flood plain |
| 6 | Existing pollution/contamination or degradation on site | ✓ | | Water contamination and Air pollution to the nearby households. Existing open dumpsite |
| 7 | Any other remark on baseline condition | | | Within the dumpsite location there is one RRF , MCF and Thumboormozhi . |

**Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology, and Soils**

| Sl. No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 8 | Total extend of land to be covered/built | | | 0.80 acre |
| 9 | Total extend of land where the waste will be dumped openly / or expected to get contaminated by waste or leachate/material storage | | | 0.80 acre |
| 10 | Extend of Land to be remediated | | | 0.80 acre |
| 11 | Extend of land expected to be under green belt | | | 0.10 acre |
| 12 | Will the proposed project cause the following on Land / Soil: | | | |

| Sl. No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| (i) | Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains | | ✓ | |
| (ii) | Substantial removal of Top Soil (mention area in sqm) | ✓ | | Presence of solid waste beneath the ground level combined with soil is to be excavated for bio-mining process.<br><br>Area-2832.79 |
| (iii) | Any degradation of land / eco-systems expected due to the project? | | ✓ | Leachate can be reused and treated. |
| (iv) | Loss or impacts on Cultural/heritage areas/properties | | ✓ | |
| (v) | Does the project activity involve cutting and filling/ blasting etc? | | ✓ | It is biomining of existing solid waste only. |
| (vi) | Will the project cause physical changes in the project area (e.g., changes to the topography) due to excavation, earthwork, or any other activity? | ✓ | | Waste heap is about 3.3 m above and 1.2 m below from Ground Level which is to be excavated. |
| (vii) | Will the project involve any quarrying/ mining etc? | | ✓ | |
| (viii) | Will the project / any of its component contaminate or pollute the Land? | | ✓ | Positive impact to the environment. |
| (ix) | Will the project contribute to any long term significant adverse (negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | ✓ | Positive impact to the environment. |
| (x) | Will the Project or related activities cause negative impacts on the land in combination with other anticipated / existing projects in the region? | | ✓ | Positive impact to the environment. |

| Sl. No | Impacts on Air and Noise Environment | Yes | No | Details/Remarks |
|---|---|---|---|---|
| 13 | Will the project cause or increase air pollution due to dust and / or vehicle emissions? | ✓ | | The process of bioremediation may cause dust emission from process and vehicle movement which shall be managed using effective mitigative measures |
| 14 | Will the project cause or increase pollution due to GHG emissions? | ✓ | | Chances of GHG emissions due to un-stabilised waste. |
| 15 | Will the project cause or increase odor nuisance? | ✓ | | The process of bioremediation may cause odour emission as part of the which shall be managed using effective mitigation measures |
| 16 | Is there a potential for release of toxic gases or accident risks (eg: potential fire outbreaks) | ✓ | | Will depend on waste composition on the site & presence of any fuel, inflammable materials. |
| 17 | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | ✓ | | Anticipated increase in noise levels due to the vehicular movements and working of machineries like conveyors, trommels etc |

| Sl. No | Impacts on Water Environment | Yes | No | Details/Remarks |
|---|---|---|---|---|
| 18 | Will the activities proposed at the site(s) impact water quality (surface or ground) – leachate, runoff, wastes deposition, erosion? | | ✓ | The site is a legacy dumpsite and the project shall reduce the leachate, runoff, waste depositions etc. Process will generate leachate. During rains, this might contaminate storm water, and site must be protected from erosion. |
| 19 | Will the activities proposed at the site(s) impact water resource availability and use - leachate, runoff, wastes deposition, erosion? | ✓ | | The natural stream is at a distance of 25m and HH are at a distance of 15 m from the Dumpsite. Proper leachate treatment and waste disposal is necessary. |
| 20 | Chances of Pollution of Water bodies/groundwater wells, nearby or downstream | ✓ | | The natural stream is at a distance of 25m. HH are at a distance of 15 m from the Dumpsite. Proper leachate treatment and waste disposal is necessary. |
| 21 | Will the activities proposed at the site(s) hinder natural drainage | | ✓ | |

| Sl. No | Impacts on Water Environment | Yes | No | Details/Remarks |
|---|---|---|---|---|
| 22 | Will the activities proposed at the site(s) decrease permeability/rainwater percolation | | ✓ | Positive impact to the environment. |

| Sl. No | Impacts on Biodiversity and Host Communities | Yes | No | Details/Remarks |
|---|---|---|---|---|
| **23** | Will the project necessitates cutting of Trees / Loss of Vegetation | | ✓ | Not Required |
| **24** | Will the project necessitate substantial removal of Top Soil (mention area in sqm) | ✓ | | The legacy waste is combined with soil will be remediated<br><br>Area-2832.79 |
| **25** | Any degradation of land / eco-systems expected due to the project? | | ✓ | The proposed process of bio-mining ensures that there will be no degradation of the land |
| **26** | Will the project result in Health & Safety Risks in the neighbourhood including the release of toxic gases, leachate, accident risks | ✓ | | Residential area is within 15m. So depending on the waste composition at the site, these risks may be expected. |
| **28** | Potential Noise, Light Pollution/movements causing disturbance to nearby habitats/communities | ✓ | | Yes. Residential area within 15m. And highway at a distance of 340m. |
| **29** | Potential disruption to common property, accessibility, traffic disruptions, conflicts, or disruption to the local community within the subproject area? | ✓ | | Yes. Residential area |

This Screening sheet must be completed for each of the proposed sites by respective cities/towns and forwarded to the Environment Specialist in Respective DPMU / SPMU along with the following enclosures.

**Enclosures:** Provide maps with the geographical location of the project; and an appropriately-scaled map clearly showing the project area and project sites with land use, existing buildings, infrastructure, vegetation, adjacent land use, utility lines, access roads, and any planned construction, and any other information to describe the project, locations and possible impact as required.(Location )

**Project Categorisation and Need for Safeguards Instruments, Oversight**

| **Project Category** | **E2** |
|---|---|
| **Key Reasons (for categorisation)** | **No sensitive areas nearby, not a large dumpsite.** |
| **Safeguards Instruments Required** | a) ~~E1: Project-specific EIA (impact assessment considering the project details & location) by Independent Consultant (with signed/sealed Screening~~ Form, Consultations, EMP, Budget, Responsibilities)<br>b) E2: Project-specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>~~c) E3: signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities~~ |
| **Additional Responsibilities Expected** (such as i) Specialists to be hired for Physical/Cultural resources, Natural Habitats/others, etc for EIA preparation, and/or supervision), ii) Consultations, iii) any other aspect | |

| **Status** | **Agency / Official** | **Name, Signature with Date and Seal** |
|---|---|---|
| **Prepared by** | PIU or ULB (project in-charge) | |
| | Environmental Engineer | |
| **Checked, Categorised as ___ (E1, E2, E3) & ToR issued by:** | DESDU / SESDU | |
| | Environmental Expert | |




*Figure A.1 View of waste Heap*



*Figure A. 2 Location map of Murukkumood Dumpsite*

# ANNEXURE II FIRE RISK ASSESSMENT

## Objectives

The important elements of fire risk Management planning can be classified as:

- Identifying the disaster potential scenarios and advance planning to combat and minimize the damage.
- Vulnerable zone delineation.
- Assessment of loss probability and its severity.
- To deal with such emergencies expeditiously.
- •. Warning, protective actions like evacuation of personnel.
- To contain the disaster by isolating the area, firefighting etc.
- To make efforts to return to normal condition when the situation is controlled.

*Table 7.1 Causes of Fire and Risk*

| Ignition (heat) sources | Fuel Sources | Oxygen Sources |
|---|---|---|
| Lit cigarettes/ butts, matches, lighters<br>Improperly stored batteries<br>Bushfire<br>Self-heating piles<br>Hot loads/contaminated waste<br>Hot work operations<br>Arson<br>Lightning<br>Fires from neighbouring activities<br>Faulty electrical wires | Flammable liquids, gases and solids<br>Combustible goods and waste (e.g. CRWM*)<br>Contamination in CRWM storage<br>Dry and unmanaged vegetation | Oxidising chemicals such as oxy-acetylene sets, bleach, hydrogen peroxide, nitrates<br>Physical introduction of oxygen through unbaling or turning of loose piles |

## Fire Prevention & Management Plan

It is a strategy well evolved, organized and rehearsed to contain the adverse effects of a possible disaster. It aims to mobilize the internal resources and use these with minimal dependence on external agencies for the following purposes:

To control and contain incidents.

- To safeguard employees and people in the vicinity.
- To inform employees, the general public and the authorities about the hazards/risks assessed, safeguards provided, residual risk, if any, and the role to be played by them in the event of disaster.
- To effect rescue and treatment of casualties.
- To prevent recurrence of such a disaster.
- To establish machinery for review, rectification/modification of the emergency
- To ensure safety of workers before personnel re-enter and resume work.
- To work out a plan with all provisions to handle and to provide for emergency preparedness and the periodic rehearsal of the plan.

## Pre-Disaster Stage

The prevention of disaster is of vital importance and is the moral responsibility of each and every individual employed in the dumpsite site. It can be prevented by observance of precautionary and preventive measures. During pre-disaster stage following points will be followed to avert the occurrence of disaster:

The emergency operation procedures of the dumpsite site will be written down so that no confusion is caused in the event of an emergency taking place.

- To reduce the probabilities of accidental leakage of methane.
- Smoking will be prohibited in the areas where handling of dumpsite will be done. NO SMOKING boards will be prominently displayed in Local Language ie Malayalam and English languages.
- All electrical wiring, fittings, cables, equipment will be checked periodically. Temporary wiring will not be permitted to be installed inside the dumpsite area. No inflammable material including papers, Oils, wooden racks will be stored within 1 meter of any electrical fittings. No unauthorized person will be allowed to tamper with electrical fittings.
- Welding, Burning, cutting, Chipping, soldering work, etc will only be carried out by authorized persons.
- Necessary compliance with various Statutory Guidelines and other relevant instructions as issued from time to time will be done.
- The Safety Department will arrange to educate all concerned regarding operational hazards of non-compliance of the safety guidelines. They will also provide necessary

guidance and support in proper implementation of the program. They will also arrange mock exercises periodically.

- The Safety Department will display important telephone numbers and instructions, in Mizo & English languages. The Security Control Room located at the dumpsite site will be equipped with the following –
- Sufficient number of copies of On-Site Disaster/Emergency Management Plan.
- Master plan of the dumpsite site indicating vital locations and possible sources of disaster.
- Important Telephone numbers
- Emergency lights (portable) and Wireless sets if required and possible).
- First Aid boxes
- Stretchers, blankets and other essential items at the fire station under the charge of Fire Services Dep't

## Disaster Stage

The most probable disaster which may occur at the dumpsite site is because of accidental leakage and fire. To control leakage and fire the following measures/precautions will be taken at the dumpsite site:

The guidelines as given below for the protection of fire will be followed:

- The dumpsite's fire protection will consist of structural solutions, fire extinguishing systems and fire alarm systems. The fire extinguishing system will consist of the fire system with fire pumps, distribution pipelines, hydrants and fire hoses and the portable extinguishers.
- The fire alarm system will be a part of the primary systems and take care of the places which are unmanned or will not have any fixed fire extinguishing system.
- The major operation areas shall be equipped with fixed smoke detectors, CO2 extinguishers near the door in the control room.
- All the rooms in the office shall be equipped with fixed smoke detectors.
- The ventilation rooms shall be equipped with fixed smoke detectors. One CO2 extinguisher will be located near the door to the ventilation room.
- The fire alarm and detection system shall be designed, installed, maintained and tested according to relevant standards.

- The water for firefighting shall be stored in the fire water tank (water reservoir).
- CO2 fire extinguishers contain extinguishing carbon dioxide which either by it or under expected conditions of use gives off CO2 to prevent fire.
- Dry fire extinguishers contain an extinguishing medium which either by itself or under expected conditions of use will give fine powder to prevent fire to get oxygen.
- As soon as a fire takes place inside the premises of dumpsite, action to be taken by various persons/officials

## Post Disaster Stage

After the incident a report will be prepared regarding occurrence of event/losses incurred and recommendations thereof for restoration of normalcy

## Reporting of Accidents

Situation in totality will be studied thoroughly, investigated with respect to the cause of the incident, extent of loss of life and property and a detailed report prepared by the individual/team nominated by dumpsite site authorities for this purpose. Based on the investigation report, rescue team would finalize time bound programmes for implementation of corrective measures proposed and regularly monitor the progress thereafter. Rescue, medical and welfare operations would be continued by the concerned agencies.

## ANNEXURE III MAP SHOWING BASELINE MONITORING LOCATIONS OF MURUKKUMOOD DUMPSITE




**GOOGLE IMAGE DEPICTING THE AAQ, AMBIENT NOISE MONITORING LOCATIONS AT MURUKUMOOD DUMPSITE**




**GOOGLE IMAGE DEPICTING THE SURFACE WATER, GROUND WATER AND LEACHATE MONITORING LOCATIONS AT MURUKUMOOD DUMPSITE**

KSWMP

# FEASIBILITY REPORT

# DUMPSITE REMEDIATION

# KAYAMKULAM-MURIKUMOODU











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## Executive Summary

Kayamkulam is a Municipality located in the Onattukara region of Alappuzha district. The primary environmental issue currently faced by municipal authorities revolves around a longstanding existing legacy waste dumpsite. Despite discontinuing the dumping activities, this dumpsite remains as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Consequently, these sites pose significant environmental, social, and economic challenges for the communities and ecosystems surrounding them. The SWM Rules 2016 directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the project for the remediation of legacy waste dumpsites in all the ULBs of Kerala. As part of the project, in phase1 the existing dumpsite at Kayamkulam, Ward No. 22, Murikkumoodu was proposed for remediation.

The Kayamkulam Municipality has an area of 40.41 sq.km with 44 wards. The municipality, with the financial and technical support of KSWMP, has proposed to remediate the existing legacy waste dumpsite located in around 0.70 acres of land in ward 22, Murikkumoodu and to recover land for future developmental activities. The Murikkumoodu dumpsite was used for dumping municipal solid waste from the year 1980 The dumping of solid waste has been stopped since April 2023. Considering the impending threat of fire hazards and leachate issues, the Municipal Council has proposed the remediation of legacy dumpsite as a priority and to utilize the remediated land for setting up other solid waste management facilities.

The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes. To assess the quantity & composition of legacy waste & also evaluate the environmental baseline of the dumpsite, samples from representative locations were collected and analyzed for various parameters viz., physical and chemical analysis of Legacy waste, Soil, Air, Noise, leachate, Groundwater and Surface Water. As part of the study, detailed site investigations were carried out for; – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical and Environmental Analysis by M/s Poluchem laboratories.

From the results of the investigations, it was found that the waste was seen up to a depth of 1.2 m below Ground Level and with an average height of 3.3m above GL. The total estimated quantity of legacy waste is around 10261.02 Cum. (Above 9129 Cum + Below 1132 Cum)

As per the SWM Rules 2016, selection of an applicable method/type or technique for dumpsite remediation needs to be arrived from the Feasibility study carried out, and based on the results, remediation can be done by a) Capping without land recovery, b) Bio-mining – reclamation/recovery of land & c) capping with partial land recovery. The selection of technology shall also depend on the available resources viz., manpower, machineries, money, and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for optimum land recovery and forward linkages/utilization of processed

aggregates/byproducts. Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by-products as per the requirements of the utilization/forward linkage. Based on the detailed assessment of the selection parameters, stationary trommel screening machineries shall be optimum for processing the legacy waste within the stipulated timeline of 31st March 2024.

Environmental & Social safeguards: The project attracts E2 Environmental category based on the project activities and status of the environment baseline. The project attracts moderate social risks based on the social mapping, transect walk and consultation with the people living around the proposed project site to assess the problems associated with the legacy waste dumpsite and the impact during the execution of the project.

An area of 0.70 acres will be reclaimed and will be utilized for setting up other solid waste management facilities. Total cost of the project is [redacted].

## 1. Introduction

The issue of municipal solid waste management in Urban India has become one of the foremost concerns during the last couple of decades.

The primary environmental issue currently faced by the municipal authorities in Kerala revolves around a longstanding existing legacy waste dumpsite. It has a long history of more than three decades of continuous dumping of both bio- and non- biodegradable wastes. Though the waste dumping activity has been stopped, the dumpsite remains as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Improper management of such sites pose significant environmental, social, and economic challenges for the communities and ecosystems in the vicinity.

In view of the environmental and social issues connected with dumpsites, the SWM Rules 2016, directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the remediation projects of legacy waste dumpsites in all the ULBs. As part of the project, in phase -1, the existing dumpsite of Kayamkulam ULB was proposed for remediation.

For arriving at a methodology for remediating the legacy waste in the dumpsites, as per the Project Implementation Manual, a feasibility study outlining the technical, economic, and socio- environmental factors has been carried out. As a result of the feasibility study that involved detailed field investigations & assessment, and market sounding, the method proposed for remediation of legacy waste dumpsite is biomining, which will ensure long-term sustainability and environmentally sound treatment, which is found technically feasible, economically viable, and socially acceptable. The details of various steps involved in the feasibility study are described in the following sections.

Kayamkulam municipality is experiencing issues with the treatment and disposal of MSW. The existing waste dumpsite at Kayamkulam (Murikkumoodu) needs to be remediated scientifically and the land reclaimed for productive use. The report is being prepared for the purpose of execution of closure of the dumpsite by Kayamkulam ULB. The site is close to a stream that eventually joins the Periyar River.

## 2. Profile of the ULB

### 2.1 Location

Kayamkulam is a town and municipality in the Onattukara region of Alappuzha district in Kerala. It is the second biggest town in Alappuzha district. It is located on the western coast of India and was an ancient maritime trading center. Kayamkulam is part of the Karthikappally tehsil. Krishnapuram Palace is located nearby. It is located at a distance of about 110 kms south from the state capital Thiruvananthapuram. It is one of the important commercial and tourist centre in the district.

Kayamkulam Municipality is located at latitude 9.173379" N and longitude 76.521623" E and is located as shown in Figure 1.

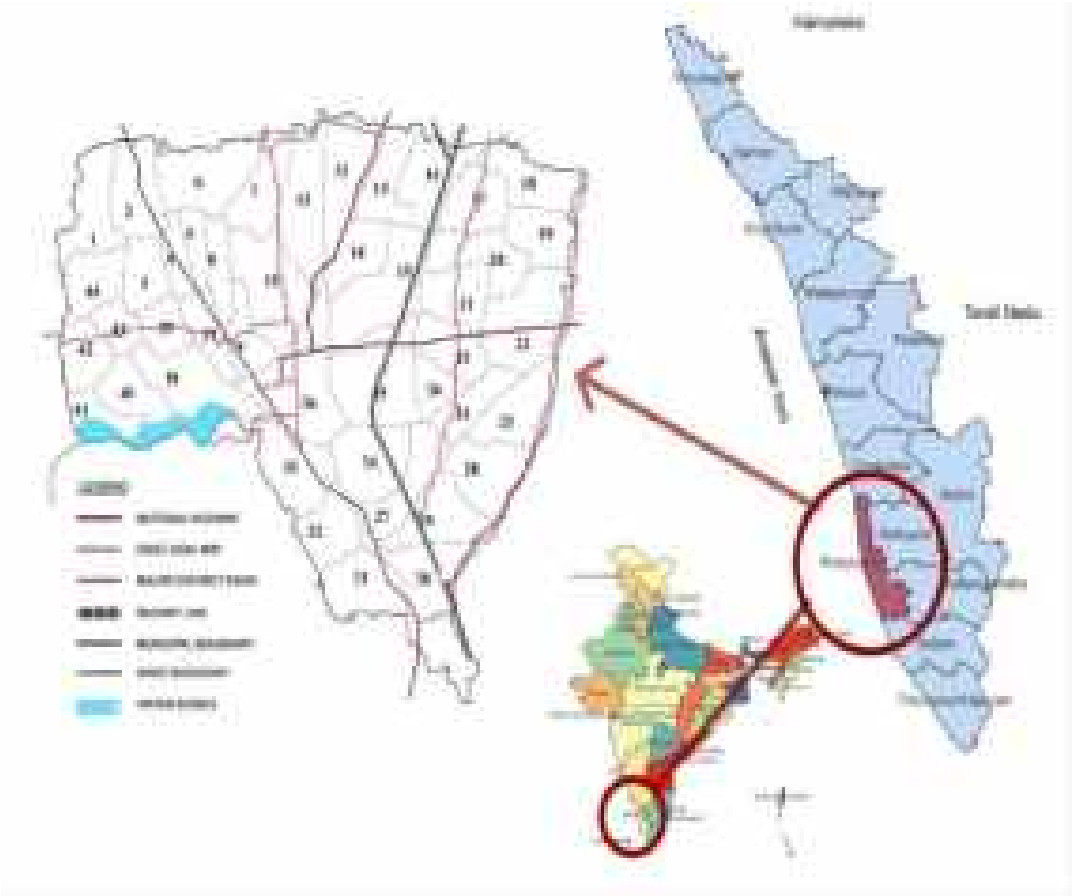


*Figure 1: Location of Kayamkulam Dumpsite*

Ward No. 22 is located at Central part of the municipality and comprise a population of 1809 and 488 households (Source: Census handbook of Alappuzha 2011), which comprises 5.47 % of the ULB population.

## 2.2 Demographic & Socio-Economic Status

The city had a population of 68,634 as per the census conducted in 2011. The projected population by the end of 2023 is around 69,598. Out of the total population of 69,598 of which 32,784 are males while 35,850 are females indicating a Sex Ratio of 1,094 against state average of 1,084. The overall literacy rate of Kayamkulam is 94.81 %. The ULBs portray a literacy rate higher than the state average of 94.00 %. In Kayamkulam city out of total population, 22,088 were engaged in work activities. 78.31 % of workers describe their work as Main Work (Employment or Earning more than 6 Months) while 21.69 % were involved in Marginal activity providing livelihood for less than 6 months. of 17,125 workers engaged in Main Work, 4,963 were Marginal Worker.

## 2.3 Connectivity

Kayamkulam city is well connected to neighboring local bodies and towns through National Highways, State Highways, and other Major and minor road networks. National Highway 66 passes through the municipality connecting Alappuzha, Kochi, Thiruvananthapuram, Thrissur, Kollam, Palakkad and Nagercoil. The Kayamkulam–Punalur road is a major road connecting it to major cities in east sengottai, Tenkasi, Tirunelveli via Pettah parts of the Tamil Nadu state. The nearest railway station and airport is Kayamkulam junction and Thiruvananthapuram respectively located at 1.5 km and 54.89 km from the town center.

## 2.4 Climatic Condition

The climatic conditions of Alappuzha are characterized by a tropical climate. Rainfall is significant most months of the year, and the short dry season has little effect. The mean yearly temperature observed in Alappuzha is recorded to be 26.6 °C | 79.8 °F. The annual precipitation in this location is approximately 2546 mm | 100.2 inch.

In terms of precipitation, the month with the lowest amount of rainfall is January, recording a mere 24 mm in its entirety. This denotes an exceptionally dry period within that particular time frame. Most of the precipitation here falls in June, averaging 435mm.

*Table 1: Meteorological data for Kayamkulam*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Avg. Temp °C** | 26.3 °C | 27.3 °C | 28 °C | 27.8 °C | 27.2 °C | 26 °C | 25.5 °C | 25.4 °C | 25.8 °C | 25.9 °C | 26 °C | 26 °C |
| **Min. Temp °C** | 22.7 °C | 23.4 °C | 24.7 °C | 25.3 °C | 25.3 °C | 24.5 °C | 24 °C | 23.9 °C | 24 °C | 23.9 °C | 23.7 °C | 23.1 °C |
| **Max. Temp °C** | 30.7 °C | 31.9 °C | 32.2 °C | 31.2 °C | 29.9 °C | 28.2 °C | 27.8 °C | 27.8 °C | 28.4 °C | 28.7 °C | 28.9 °C | 29.5 °C |
| **Rainfall (mm)** | 24 | 30 | 79 | 177 | 319 | 435 | 396 | 324 | 262 | 284 | 206 | 69 |
| **Humidity (%)** | 74% | 72% | 75% | 82% | 86% | 90% | 90% | 89% | 88% | 88% | 86% | 80% |
| **Avg. Sun hours** | 9.6 | 9.6 | 9.2 | 7.9 | 6.5 | 5.7 | 6.0 | 6.3 | 6.5 | 7.0 | 8.1 | 9.0 |

Source: *(https://en.climate-data.org/asia/india/kerala/alappuzha-23993/)*

Data: 1991 - 2021 Min. Temperature °C (°F), Max. Temperature °C (°F), Precipitation / Rainfall mm (in), Humidity, Rainy days. Data: 1999 - 2019: avg. Sun hours

## 2.5 Geography and Soil Type

Geographically, Kerala State is divided into three regions namely high land, midland and low land from east to west. Kayamkulam is located in Alappuzha district of Kerala. Alappuzha district has a diverse topography. It is a sandy strip of land intercepted by lagoons, rivers and canals. There are neither mountains nor hills in the district except some scattered hillocks lying between Bharanikkavu and Chengannur blocks in the eastern portion of the district. The topography of the project location is almost flat. The general nature of the soil is alluvium with admixture of sand, clay and silt.

## 2.6 Ground Water Level

From monitoring wells dispersed across the state, the depth to water level is observed in the months of April, August, November, and January. According to information published by the

CGWB, the Government of India, the water level in Kayamkulam fluctuates from 0.05 to 0.44 MBGL.

## 2.7 Land use

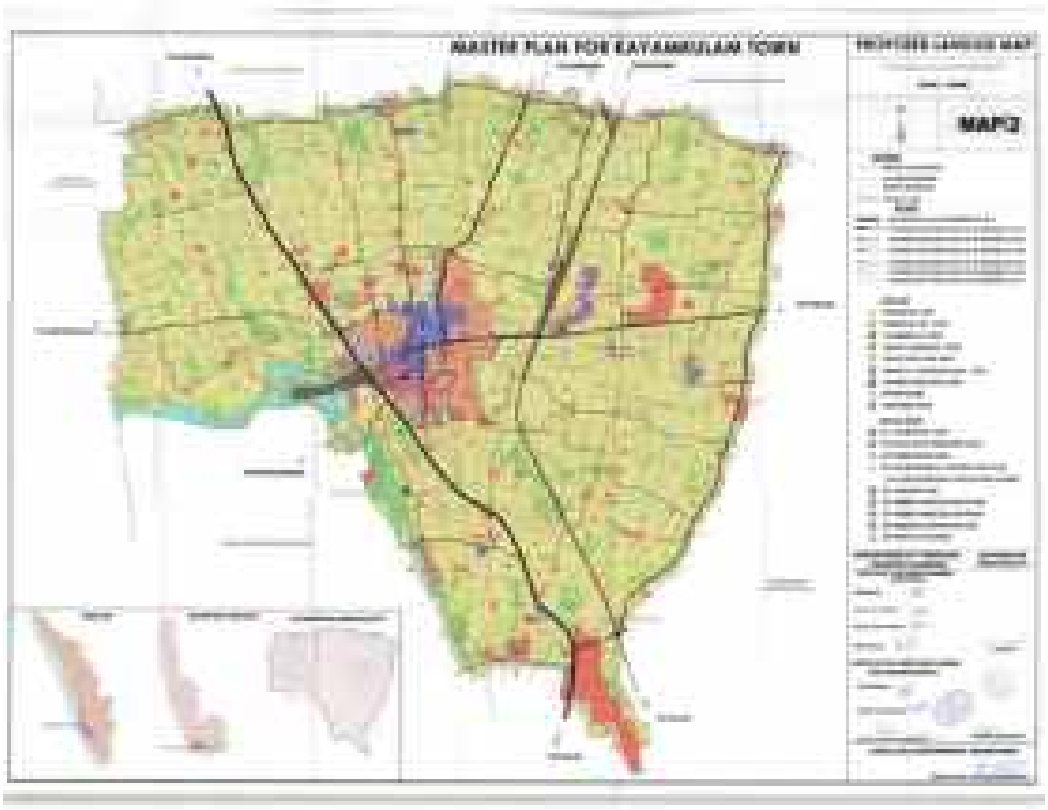



*Figure 2: Existing Landuse Map of Kayamkulam Municipality*

From the above map, it can be concluded that the predominant land use of Kayamkulam Municipality is residential. 67.55% of the total area is under residential use. Existing land use analysis shows following breakups as shown in table. The details of analysis of the land use survey and the resultant findings of existing land use are given hereunder. The glaring aspect of existing land use of Kayamkulam municipality is blessed with potential resources such as agriculture land and water bodies.

The highest percent of land use falls under the category residential/agricultural mix, which include mainly dry agriculture lands where residential developments are co- existent. Rubber is the principal crop followed by paddy, coconut and tapioca.

*Table 2: Landuse Pattern of Kayamkulam Municipality*

| Sl. No. | Land Use | Area in Ha | % of Total Area |
|---|---|---|---|
| 1 | Residential | 1471.9 | 67.55 |
| 2 | Commercial | 49.66 | 2.28 |
| 3 | Industrial | 14.87 | 0.68 |
| 4 | Agriculture | 128.46 | 5.90 |
| 5 | Recreational, open space | 0 | 0 |
| 6 | Transportation | 22.92 | 1.05 |
| 7 | Slums | 1.07 | 0.05 |
| 8 | Forest | 0 | 0 |
| 9 | Revenue Surplus land | 129.42 | 5.94 |
| 10 | Water bodies | 55.03 | 2.53 |
| 11 | Other Vacant land | 26.45 | 1.21 |
| 12 | Other (specify) Marshy land | 153.9 | 7.06 |
| 13 | ULB Roads | 18.57 | 1.96 |

*Source: CSP, Kerala, 2009*

## 3. Detailed description of the dumpsite

### 3.1 Physical feature of the site

Kayamkulam dumpsite is located approximately 2.9 km from the centre of Murikkumoodu town in western side and encompasses an area of approximately 1 acre of land. The dumpsite is not very far from human settlement. The coordinates of the dumpsite are 9.173379° N & 76.521623° E. It is located in Ward No. 22 of the municipality. Kayamkulam municipality holds the ownership of the dumpsite. A small nallah flows North-eastern side of the dump site within the distance of 69.2 m.

The exact date for start of the dumpsite was not available with municipality; however approximately it had started in the year of 1980 from the information gathered during field visits. Presently, the quantity of waste dumped at this site is about 10261.2 Cum (Above GL 9129 cum + Below GL 1132.02 Cum) as per the topographical survey conducted by ULB. As

of now 68 % of the area is covered with solid waste. The dumping has been irregular with no proper liner system which would have otherwise prevented the leachate from percolating into the groundwater system. There are high chances of water being contaminated in this area due to the irregular dumping. Average height of the waste heaps is 3.3 m above the existing ground level.



*Figure 3: Location and Aerial View of the Kayamkulam Dumpsite*



*Figure 4: Present Dump Site, Kayamkulam*

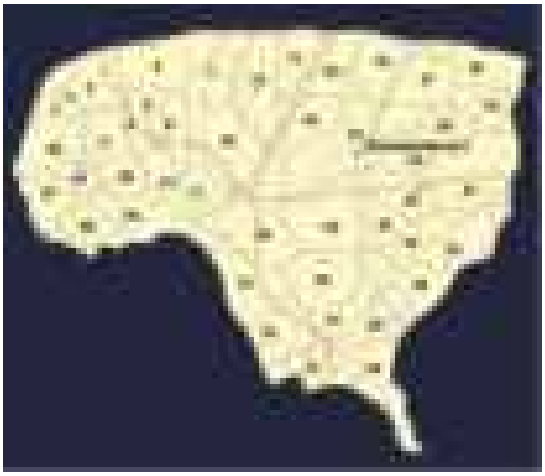


*Figure 5: Dumpsite Ward Location*

The salient feature of the existing dumpsite is presented below:

*Table 3: Salient Features of Kayamkulam Dumpsite*

| | |
|---|---|
| Name of Dumpsite | Kayamkulam- Murikkummodu dumpsite |
| Location of Dumpsite | Ward No. 22 of the municipality |
| Coordinates of Dumpsite | Latitude: 9.173379°N<br>Longitude: 76.521623°E |
| Distance from the central part of the town | 2.8 km |
| Area of dumpsite | 1 acre |
| Average height of dumpsite | Below 1.2m and Above 3.3 m |
| Ownership of dumpsite land | Municipality |
| Distance from nearby features- residential, school, offices, temples, institutions, industry etc.) | There are Residential and other structures within 100 meters from the site |
| Start date of dumpsite | 1980 |
| Utilities on site | 440 LV grid available at 100m from site. Water connection available at dumpsite, drinking water to be supplied by tanker |
| Site demarcated | Site is currently demarcated with a boundary wall. |

## 3.2 Surrounding Features of the Dumpsite

The dumpsite is located adjacent to a residential neighborhood. There is an adjacent drain to the dumpsite. Boundary wall is there for the dumpsite. There is one stream flowing at a distance is 69.2 m from the dumpsite.

## 3.3 Litigation status of the Site

There is no litigation record available with ULB.

## 4.0 Scope of Work

Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at Kayamkulam includes the following steps.

- Conducting detailed field investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical, and Environmental Baseline Analysis by M/s Poluchem Laboratories.
- Assessment & Analysis of detailed investigation report submitted by the Laboratories.
- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.
- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the By-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation optimum land recovery – Biomining, Capping partially Biomining & Capping), Methods/Technologies (Stationary & Mobile-compact), Implementation mode, Forward linkages (Utilization/Management of By-products) and Environmental & Social categorization as per the ESMF developed for projects envisaged under KSWMP.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Delineation of baseline assessment, impact & risk assessment, mitigations measures, Environmental Management & monitoring plan, budget for EMP, EMOP, institutional responsibilities for implementing monitoring and reporting
- Social Safeguards - Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.

- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport,
- Environmental and social monitoring costs, Revenue from the project, Funding for project
- Project Implementation plan –contractual models and timelines.

### 4.1 Objectives:

- Maximum reclamation of the area and by eliminating the chances of dump fires, leachate generation, and foul odor.
- To reduce greenhouse gas emissions, soil pollution, and groundwater contamination.
- To increase nearby real estate/social value and benefit the citizens.

## 5 Detailed Investigation Strategy

### 5.1 Investigation Strategy

To understand the nature and composition of the legacy waste and the existing baseline environmental conditions, samples from waste, surface and groundwater, leachate, soil, air, and noise were collected as per the requirements given in the Project Implementation Manual, considering the state and national guidelines. Samples were collected as mentioned below;

- Bore hole upto a depth of 10 m and collection of 3 (nos) samples from the soil at interval of 1.5 m.
- Waste analysis viz., leachate sample from 1 (no) locations and physical analysis from 2 (nos) locations, and chemical analysis from 1 (no) location.
- Environmental baseline analysis surface water 1 (nos) location and ground water samples from 3 (nos) locations (Well Water Samples -1 up gradient, 2 down gradient) and Air sampling from 2 (nos) locations and noise sampling from 1 (nos) location

### 5.2 Investigation Plan

The detailed investigations carried out for the legacy waste dumpsite is given in the table below:

*Table 4: Investigation Plan*

| S.no | Parameters | Sampling Nos |
|---|---|---|
| 1 | **Geotechnical Investigation** | |
| A | Bore Holes up to 10m depth(1No. /2 Hectare) (as per CPHEEO) | 1 |
| B | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, Strength compressibility (vertically-3 samples per borehole). | 1 |
| 2 | **Waste & Environmental Analysis** | |
| A | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammoniacal nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | 1 |
| B | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | 2 |
| C | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium(N-P-K), Total carbon, C/N ratio, calorific value, Biochemical and Biodegradable factor. | 1 |
| D | Ground water (well water samples-1 up gradient, 2 down gradient)- (shallow and deep wells) Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, E Coli and Total coliform (IS 10500-2012). | 3 |
| E | Surface water (pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, E Coli and Total coliforms (IS 10500-2012). | 1 |
| F | Ambient Air Quality (Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | 2 |

| S.no | Parameters | Sampling Nos |
|---|---|---|
| G | Ambient Noise level [E(P)] for 24 hours. | 1 |

## 5.3 Sampling Methodology

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat/Long) were considered. The following table shows the strategic location details of samples selected for the detailed investigation.

*Table 5: Detailed Investigation Plan Executed for Waste Dumpsite at Kayamkulam*

| Sl. No. | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | Within the Dumpsite<br>Dumpsite boundary | The AAQ locations were chosen based on the Windrose data. Two Ambient Air quality monitoring stations were installed within 100 metre distance from the dumpsite in upwind and downwind direction |
| 2 | Noise (1 Location) | Ambient Noise level [E(P)] for 24 hours | Entrance of the dumpsite | Most vulnerable point in the site in regards of Noise quality is due to entry and exit of the waste loading and unloading vehicles. |
| 3 | Surface water (1 Location) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, | Adjacent thodu in 200 m aerial distance | Adjacent thodu sampling was considered. No alternative surface water sources were |

| | | | | |
|---|---|---|---|---|
| | | NO3, SO4, Total Alkalinity, Total hardness, Ecoli and Total coliforms (IS 10500-2012). | | identified during sampling. |
| 4 | Ground water (3 Locations) | Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, CI, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, E-coli and Total coliform (IS 10500-2012). | Well water of nearby nearest house in 200 aerial distance | Nearest ground water source in downstream direction |
| 5 | Bore Hole (1 location) | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coeff of permeability, Strength compressibility (vertically-3 samples per borehole). | Centre of the dumpsite | Volume of legacy wastes were found to be higher in the centre part of the dumpsite during investigation. So, the bore hole test was performed in the centre. |
| 6 | Waste Analysis | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammoniacal nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | Within the dumpsite | The legacy waste was found to be older and no access to all points. Hence sampling location were chosen also based on the accessibility. |
| | | Physical Analysis of waste (As per CPHEEO Manual) | | |

| | | | | |
|---|---|---|---|---|
| | | including Density, Bulk Density, Moisture content, size of waste constituents. | | |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Poatassium(N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor | | |

For the borehole investigation, the samples were collected by rotary drilling a 150mm bore hole using a fast rig attached to a drag bit. The soil drillings are removed by a circulating bentonite slurry which also aids in keeping the side walls stable. An SPT sampler was driven in to collect the representative samples, which is carefully packed in double walled polythene bags, sealed, and sent to laboratory for testing. Standard penetration tests were conducted on soil at every 1.5m depth and the number of blows to achieve 300mm penetration were noted. Fractions recovered from the mining of legacy waste should be tested, especially for the presence of toxic metals and organic contaminants.

The total quantity of waste present in the waste dump is calculated based on the topographic study executed by ULB (towards calculating quantum of waste above ground level) and the results of borehole investigation (towards calculating the quantum of waste below ground level).

## 5.4 Analysis and Interpretation of Exploratory Data

The baseline condition of the waste dumpsite at Kayamkulam has been assessed through the geotechnical investigation and Waste & Environmental baseline assessment executed through M/s Matter Material Testing & Research Laboratory (P) Ltd and M/s Polluchem Laboratories (P) Ltd respectively. The results of Topographical survey conducted in the year 2022 also considered for the analysis. The signed reports of all analysis are enclosed as Annexures.

### 5.4.1 Topographical Survey Interpretation

A topographical survey was conducted for KSWMP by M/s Technosol Consultants, Kollam at the site for assessment of accumulated waste quantity and other features at the site in the month of November - December 2022. The objective of a topographical survey is to assess the waste profile, volume and the extent of garbage spread over the area of disposal site. This survey gives an indicative estimation for Quantity of Legacy waste. From the geotechnical survey it is evident that the site is not uniformly distributed with waste. In Figure 4, the topographical survey output is furnished.



*Figure 6: Contour drawing of the site (Source- Toposurvey by Technosol, Kollam)*

- Above GL the height of waste heap 3.3 m & Below GL its 1.2 m
- Estimated waste volume: 9129 cum Above GL, & 1132.02 cum Below GL
- Map shows Approx. 70 cents of land used for waste dumping

The topographical survey input has been converted to ArcGIS in order to represent the nature of Kayamkulam (Murikkumoodu) disposal site through a three-dimensional elevation-based representation. Considering the facts that the site is very old with no record of exact date of start of its operations, no regular records of incoming waste quantities since the date of operation, significant waste loss due to rag picking activity, open burning & its decomposition with time, it is not possible to cross verify the waste volume estimate. The cross section of the dumpsite and the contour map is appended as Annexure 1

### 5.4.2 Physical Analysis of Legacy Waste

Physical analysis of the legacy waste disposed at the Kayamkulam dumpsite was conducted by a NABL approved lab M/s Poluchem. The result of the physical analysis conducted in the presence of DPMU, PIU and TSC is provided in the following table.

*Table 6: Grain Size analysis of waste at Kayamkulam dumpsite*

| Sl No | Sieve Size | Quantity retained (Kg) | % fraction |
|---|---|---|---|
| 1 | +80m | 2.319 | 18.49% |
| 2 | 37.5mm | 2.058 | 16.41% |
| 3 | 10mm | 2.953 | 23.54% |
| 4 | 4mm | 3.092 | 24.65% |
| 5 | Pan | 2.121 | 16.91% |
| | Total | 12.543 | 100% |

About 16.90% of the material consists of organic/silt material. This material can be used for recovering compost and can be enriched with nutrients. The RDF / SCF material makes up about 26.51 % of the total and consists of plastics and rags/clothes. The other 49.51 % of the waste will be landfilled.

### 5.4.3 Chemical Analysis of Legacy Waste

The result of the chemical analysis of the samples collected from the Kayamkulam dumpsite is provided below in the following table.

*Table 7: Results of Chemical Analysis*

| CHEMICAL PARAMETERS |
|---|

| Sl. No. | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 7.72 |
| 02 | Biodegradable Factor | USEPA | % | 2.3 |
| 03 | Total carbon | USEPA 9060A | % | 3.8 |
| 04 | Phosphorus(P) | USEPA | % | 0.018 |
| 05 | Nitrogen(N) | USEPA | % | 0.21 |
| 07 | Potassium(K) | USEPA | % | 0.017 |
| 08 | C/N Ratio | USEPA | .. | 18:1 |
| 09 | Calorific Value | ASTM D 5865 | Kcal/kg | 2867 |

*Table 8: Analysis of Toxic metals in waste*

| TOXICITY ANALYSIS- HEAVY METALS | | | | | |
|---|---|---|---|---|---|
| **Sl. No.** | **Parameters tested** | **Test Method** | **Unit** | **Result** | **Permissible Values** |
| 01 | Iron (Fe) | USEPA 3050 | % | 1.8 | |
| 02 | Arsenic (As) | USEPA 3050 | mg/kg | <0.1 | 41 USEPA, 12 Canada |
| 03 | Selenium (Se) | USEPA 3050 | mg/kg | <0.1 | 2 Canada |
| 04 | Nickel (Ni) | USEPA 3050 | mg/kg | <0.1 | 50 |
| 05 | Zinc (Zn) | USEPA 3050 | mg/kg | 24.5 | 1000 |
| 06 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 | 5 |
| 07 | Copper (Cu) | USEPA 3050 | mg/kg | 3.86 | 300 |
| 08 | Chromium (Cr) | USEPA 3050 | mg/kg | 6.5 | 50 |
| 09 | Lead (Pb) | USEPA 3050 | mg/kg | 16.1 | 100 |
| 10 | Mercury (Hg) | USEPA 3050 | mg/kg | <0.1 | 0.15 |
| 11 | Manganese (Mn) | USEPA 3050 | mg/kg | 97.4 | |

The average Nitrogen, Phosphorus and Potassium (NPK) content in the legacy waste samples picked from the site is 0.21, 0.018, 0.017, respectively by weight. This is far lower than 0.8, 0.4 and 0.8 as specified by the Fertilizer Control Order (FCO) 1985 for city compost and hence cannot be used as compost. The carbon: nitrogen ratio is 18.1 which is much lesser than the

specified standard. This could be due to the materials being exposed to sun and air over the years or that the carbon content may have leached into the ground through leachate during the rainy season. Another possible contributor to the reduced carbon levels could be multiple fire incidents at the site. Although the material has very less carbon content, the NPK value can be enriched by adding additives like poultry litter. The enriched material can be given to farmers or used for horticulture purposes. The material cannot be sold as organic compost in the present form due to very low carbon content.

The toxicity analysis of heavy metals present in waste is given in Table 8. None of the metals are exceeding the permissible standards. In addition to the chemical analysis to understand the NPK value, carbon content and ash content, a sample was chosen to check the calorific value of the RDF / SCF material. Calorific value analysis is useful to decide if the material can be used for generating heat or energy. The result of calorific value analysis is provided in the following table.

*Table 9: Calorific value of RDF / SCF material from Dumpsite*

| Sl. No. | Parameter | Unit | RDF / SCF Material |
|---|---|---|---|
| 1 | Calorific Value | Kcal/Kg | 2867 |

### 5.4.4 Key Findings from Physical and Chemical Analysis of Legacy Waste

The chemical and physical tests indicate that there is no scope to recover compost as the material. The nutrient value is extremely low. The carbon content is also low with the biodegradable factor being only 2.30. The material cannot be sold as compost in the present form since the carbon content in the material does not meet the FCO standards.

The average total calorific value of the material is 2867 kcal/kg. This material can be used for generating energy after drying and processing to reduce the moisture content and removing the inerts. This process would also increase the calorific value of the material to meet the calorific value requirement of RDF / SCF material to be used in kilns for generating heat. The full chemical report is appended as Annexure 2.

### 5.4.5 Geotechnical Investigation Interpretation

Geotechnical investigation was carried out to assess the quality of the dumped garbage at the site. The subgrade soil was encountered at 1.2 m, the drilling continued until 10.5 m that is 9.3

m below the waste depth. The soil did not exhibit any plasticity index. The clay fraction is between 2 to 5%. The permeability value is between 1.24 E-04 to 1.45 E-04 cm/sec. The full geotechnical report is appended as Annexure 3.

The base soil is non-plastic soil and the clay and silt fractions accounted for less than 40%, which implies the soil is not suitable for sub-base material. The safe bearing capacity of the soil is 150kPA, implying that the maximum height of fill may be only a maximum of 12m. During excavation, the side slopes should be maintained at 1 (V) and 3 (H). The Cation Exchange Capacity (CEC) of the soil is 11.91 meq/100gm which can adsorb heavy metals in case it is present in the soil.

## 5.5 Leachate Management System

There is no leachate collection/management system in the dumpsite. To address the concern of contamination of the groundwater and soil due to uncontrolled dumping, leachate samples are picked for analysis. The data is presented in Annexure 4. The data indicates that the TDS is about 5395 mg/l while the suspended solids is about 57 mg/l. The chlorides are high at 1429 mg/l, while the COD, BOD are 380 mg/l and 98.6 mg/l respectively.

*Table 10: Leachate characteristics at Kayamkulam dumpsite*

| **GPS Reading: N-09 º10 ’24.114” E -76º31’18.084”** | | | |
|---|---|---|---|
| **Parameters tested** | **Test method** | **Results** | **Limit As per SWM Rule 2016/Land disposal** |
| pH | IS 3025 (P) 11 –1983RA2017 | 7.81 | 5.5 to 9.0 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 5395 mg/l | 2100 |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 57 mg/l | 200 |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 1429 mg/l | 600 |
| COD | IS 3025 (P) 58 -2006RA2017 | 380 mg/l | - |
| BOD (3 days at $27^O$ C) | IS 3025 (P) 44 – 1993RA 2014 | 98.6 mg/l | 100 |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 254 mg/l | - |

| | | | |
|---|---|---|---|
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 196 mg/l | - |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 1.3 mg/l | - |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.36 mg/l | - |
| Cyanide as $CN^-$ | IS 3025 (P) 27-1986RA2014 | BDL (MDL- 0.01 mg/l) | 0.2 |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL (MDL- 0.01 mg/l) | - |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL (MDL- 0.001 mg/l) | - |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | 0.87 mg/l | - |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 2.4 mg/l | - |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL (MDL- 0.001 mg/l) | - |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 5.4 mg/l | - |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL (MDL- 0.01 mg/l) | 0.2 |

The heavy metals are found to be low, hence the soil is unlikely to be contaminated by heavy metals from Legacy waste.



*Figure 7: Leachate Collection*

## 5.5 Environmental Conditions of the Dumpsite

The specific environmental issues associated with the Kayamkulam disposal site are being discussed in the following sections.

### 5.5.1 Groundwater Contamination

The permeability of the soil is high ($1.45 \times 10^{-4}$ cm/s) implying that the leachate has a possibility of percolating through the base of the dumpsite and contaminating the groundwater. There is a natural stream adjacent to the north-east part of the dumping ground. The surface flow as well as the leachate from the site also has a possibility to contaminate the same. The ground water sampling tests within the site's vicinity have indicated high levels of TDS, Hardness, Chlorides, COD and BOD.

### 5.5.2 Soil Contamination

As it is an unlined dumpsite, there is a probability of finding traces of contaminant from waste and leachate in the underlying soil. Since it is an uncontrolled disposal site, the mixed waste contains different types of pollutants which may eventually have an impact on the soil. Results of soil analysis of the samples taken from the borehole in the Murikkummodu dumpsite is as shown below:

*Table 11: Chemical analysis of soil extracted from borehole at Kayamkulam dumpsite*

| Sl. No | Parameter | Result | US (NY State-Codes, rules and regulations) Industrial Use |
|---|---|---|---|
| 1 | Cadmium (Cd) mg/Kg | < 5.0 | 60 |
| 2 | Chromium (Cr) mg/Kg | 134.5 | 800 (Hexavalent) 6800 (Trivalent) |
| 3 | Copper (Cu) mg/Kg | 18.9 | 10000 |
| 4 | Nickel (Ni) mg/Kg | 11.0 | 10000 |
| 5 | Lead (Pb) mg/Kg | 24.9 | 3900 |
| 6 | Zinc (Zn) mg/Kg | 282.9 | 10000 |
| 7 | Mercury (Hg) mg/Kg | < 1.0 | 5.7 |
| 8 | Arsenic (As) mg/Kg | 4.0 | 16 |

While comparing results of the report with the US Industrial Use benchmark, it is observed that the values are significantly within the benchmark values. Bioremediation may be carried out to reduce traces of heavy metals in soil and for site clearance. The location may be used for industrial landuse for setting up the SWM facilities like Material Collection and Resource Recovery Facility. However, the solution may be considered after proper soil and groundwater investigation post dump-clearing stage.

### 5.5.3 Ambient Air Quality

Solid Waste Management has a wide variety of impacts on the environment including those associated with climate change. All the three major greenhouse gas (GHG) that are making the largest contribution to global warming viz., carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$) are generated during the waste management process. There is no open burning within this site. The site does not receive any fresh organic waste and therefore the odors are not perceptible.

## 5.6 Analysis and interpretation of exploratory data (Environmental Baseline)

The concentration levels of the exploration are compared with the appropriate standards for the interpretation. The air pollution data indicates that the levels are within acceptable NAAQs. The noise levels are influenced by the highway passing nearby and are also within the acceptable levels. The dumpsite is not having any operation that causes noise. The results are tabulated below and there is no significant contribution from the dumpsite.

The ground water quality results indicate that the dumpsite has not caused any major increase in pollution levels and the quality parameters are within the IS 10500:2012. The results are tabulated below.

*Table 12: Results of ground water sample within 10m from Kayamkulam dumpsite*

| **GW1 Gps Reading: N- 09 º10’33.434” E -76º31’08.457”<br>GW2 Gps Reading: N- 09 º10’14.796” E -76º31’30.571”<br>GW 3 Gps Reading: N- 09 º10’21.558” E -76º31’16.262”** | | | | | |
|---|---|---|---|---|---|
| **Parameters tested** | **Test method** | **GW1** | **GW2** | **GW3** | **Acceptable Limit as per IS 10500 - 2012** |

| | | | | | |
|---|---|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.02 | 6.09 | 6.94 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 8 Hazen Unit | 30 Hazen Unit | 6 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 3.4 NTU | 33.7 NTU | 1.4 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 320 µS/cm | 510 µS/cm | 210 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 198 mg/l | 312 mg/l | 136.5 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 4 mg/l | 28 mg/l | 6 mg/l | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 56.56 mg/l | 137.36 mg/l | 58.58 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 12.95 mg/l | 112 mg/l | 68 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 57.17 mg/l | 53.08 mg/l | 17.35 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 40.81 mg/l | 79.47 mg/l | 1.88 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.19 mg/l | 1.3 mg/l | 0.24 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL (MDL-1 mg/l) | 3.4 mg/l | BDL (MDL-1 mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL (MDL-0.1 mg/l) | BDL (MDL-0.1 mg/l) | BDL (MDL-0.1 mg/l) | 1.0 mg/l |

*Table 13: Micro-biological Analysis of Groundwater*

| **PARAMETERS TESTED** | **UNIT** | **TEST METHOD** | **RESULTS** | | | **LIMIT AS PER IS 10500:2012** |
|---|---|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 130 | 170 | 170 | Shall not be detectable in any 100 ml sample |

| | | | | | | |
|---|---|---|---|---|---|---|
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Nil | Nil | Nil | Shall not be detectable in any 100 ml sample |



*Figure 8: Groundwater Samples Collection*

Similarly, the surface water sample shows that it is not largely influenced by the dumpsite as the quality is within the limits of IS 2296, except for BOD which shows a marginal 6.3 mg/l and COD of 12 mg/l. The results are reproduced below.

*Table 14: Results of surface water sample within 10m from Kayamkulam Dumpsite*

| Parameters tested | Test method | Results N- 09º10'24.29" E- 76°31'24.07" | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A* | Class C* |
| pH | IS 3025 (P) 11 – 1983RA2017 | 6.35 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 250 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 46.8 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 290 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 174 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 58 mg/l | --- | -- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 101 mg/l | 200 mg/l | -- |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 64 mg/l | -- | -- |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 34.71 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 25.98 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 – 1989RA2014 | 2.8 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 5.51 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 1.37 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 - 2008RA2014 | BDL (MDL-0.1 mg/l) | 1.5 mg/l | 1.5 mg/l |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL (MDL-0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL (MDL-0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL (MDL-0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL (MDL-0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL (MDL-0.01mg/l) | 0.5 mg/l | --- |

| | | | | |
|---|---|---|---|---|
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL (MDL-0.001mg/l) | 0.001 mg/l | --- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL (MDL-0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D (3 days at 27$^{O}$ C) | IS 3025 (P) 44 - 1993RA2014 | 6.3 mg/l | 2 mg/l | 3 mg/l |
| COD | IS 3025 (P) 58 - 2006RA2017 | 12 mg/l | --- | -- |
| TOC | APHA5310 | BDL (MDL-0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 4.5 mg/l | --- | -- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL (MDL-0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL (MDL-0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

*Table 15: Microbiological Analysis of Surface water*

| **PARAMETERS TESTED** | **UNIT** | **TEST METHOD** | **RESULTS** | **Limit as per IS 2296** | |
|---|---|---|---|---|---|
| | | | | **Class A*** | **Class C**** |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 300 | 50 | 5000 |
| E- coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | --- | --- |

*Class A-Drinking water source without conventional treatment but after disinfection
*Class C- Drinking water source after conventional treatment and disinfection



*Figure 9: Surface Water Sample Collection*

## 5.7 Risk assessment based on applicable source-pathway-receptor-combinations for human health

The gaseous emissions from the dumpsite are not significant and do not pose a problem of air pollution. Similarly, the soil pollution seems to indicate minimal risk as far as soil pollution is concerned. The water analysis also does not indicate any significant pollution either in surface water or groundwater.

Surface Water: Dumpsites can release pollutants into nearby surface water bodies through leachate, which is generated when rainwater or other liquids come into contact with the waste. Leachate can contain various contaminants such as heavy metals, organic compounds, and pathogens. Proper containment and management of leachate are essential to prevent water pollution.

The analysis of surface water reveals that all the parameters are within the acceptable limit, except it is slightly acidic and the dissolved oxygen content is less than prescribed limit, so also the BoD is greater than the allowable limit, indicating that the water contains organic load.

**Risk Assessment- surface water**

| Risk Assessment | |
|---|---|
| Source | Legacy waste Dumpsite |
| Pollutant | Leachate from Dumpsite -BOD Higher than the acceptable limits |
| Pathway | Water/Run off |
| Receptor | Human, Animals,Aquatic life and flora fauna |
| Risk | High BOD Indicates the water is highly polluted and its is harmful to ecosystem as fish and other aquatic life may suffocate in oxygen-depleted waters.Also it will contain more Pathogen and make the water unfit for human and animal |

Groundwater: Pollutants from dumpsites can infiltrate into the underlying groundwater, particularly if the dumpsite is not adequately lined or if waste disposal practices have caused contamination of the soil. Once pollutants enter the groundwater, they can spread over a wide area, affecting drinking water sources. Remediation techniques often focus on preventing or minimizing further groundwater contamination.

The analysis of ground water samples taken at one location reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The pH of the sample analysis is 6.35, which is in a slightly acidic range which can make the water not fit for any industrial purpose as it is more corrosive.

**Risk Assessment - Groundwater**

| Risk Assessment | |
|---|---|
| Source | Legacy waste Dumpsite |
| Pollutant | Leachate from Dumpsite - pH is acidic in nature |
| Pathway | Water,soil |
| Receptor | Human, Animals,Aquatic life and flora fauna |
| Risk | Possible risk to human health<br>Diarrhea<br>Nausea and Vomiting<br>Abdominal Pain<br>Weakness<br>Possible risk to flora<br>It can decrease the availability of plant nutrients, such as phosphorus and molybdenum, and increase the availability of some elements to toxic levels, particularly aluminum and manganese. |

Air: Dumpsites may emit pollutants into the air through processes such as open burning of waste or the release of gas from decomposing organic materials. Airborne pollutants can include particulate matter, volatile organic compounds (VOCs), dioxins, and other hazardous substances. These pollutants can have adverse effects on air quality and human health. Measures to control and mitigate air pollution during dumpsite remediation include covering waste, implementing proper waste management practices viz., dust containment screens, etc. to be ensured.

**Risk Assessment - Air**

| Risk Assessment | |
|---|---|
| Source | Legacy waste Dumpsite |
| Pollutant | Particulate matter, VOCs, Dioxins |
| Pathway | Air |
| Receptor | Human, Animals,Aquatic life and flora fauna |
| Risk | No Anticipated risk |

Soil: Dumpsites can contaminate the surrounding soil with a wide range of pollutants. Hazardous chemicals, heavy metals, and organic compounds can leach from the waste and accumulate in the soil, potentially posing risks to plants, animals, and humans.

**Risk Assessment - Soil**

| Risk Assessment | |
|---|---|
| Source | Legacy waste Dumpsite |
| Pollutant | Heavy metals |
| Pathway | soil |
| Receptor | Human, Animals,Aquatic life and flora fauna |
| Risk | Possible risk to human health soil that contains substances such as heavy metals which may be toxic to humans can pass those substances on to humans through crop uptake leading to unsafe foods.<br>Possible risks to animals- when farm animals consume the plant grown from contaminated soil it affected the health of animal<br>Possible risk to flora- soil pollution may after plant metabolism and reduce crop yield, also the trees and plants that absorb the soil contaminants enter into the food chain |

Bioaccumulation in Biota: Pollutants from dumpsites can enter the food chain and bioaccumulate in plants and animals. As pollutants move up the food chain, their concentrations can increase, leading to potential health risks for humans and wildlife. Remediation efforts include restoring the land and minimizing the exposure of organisms to contaminated environments

**Risk Assessment - Bioaccumulation in Biota**

| Risk Assessment | |
|---|---|
| source | Legacy waste Dumpsite |
| Pollutant | Leachate and heavy metals |
| Pathway | Air,water and soil |
| Receptor | Human, Animals, flora and fauna |
| Risk | Possible risks to human health, animal flora and fauna<br>Accumulation of contaminants in flora and fauna indirectly through food chain affects human health |

## 6 Evaluation of Remediation Techniques

Reclamation of existing unmanaged municipal waste dumpsites is becoming a key requirement for ULB's in India as unscientific and unplanned methods of waste disposal in non-engineered landfills have led to lot of environmental issues including soil and ground water contamination, uncontrolled landfill gas emissions into the atmosphere and exposure to disease vectors and scavengers. The Hon'ble NGT seized with these problems across the country has ordered that the respective authorities to remedy this at the earliest.

The dumpsites have emerged as pollution hubs, especially those situated in human settlements, as cities have grown over the decades. It has, therefore, become a necessity for the city authorities to remediate the existing dumpsites in an environmentally sound and economically viable manner.

Remediation of waste dumpsite is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

- Environment Enhancement - reduction in greenhouse gas emissions, soil pollution, groundwater contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.

- Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in nearby real state value and rental values.
- Land - Dumpsite land becomes available for utilizing the same for the establishment of other Waste Management Facilities.
- Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled, or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels

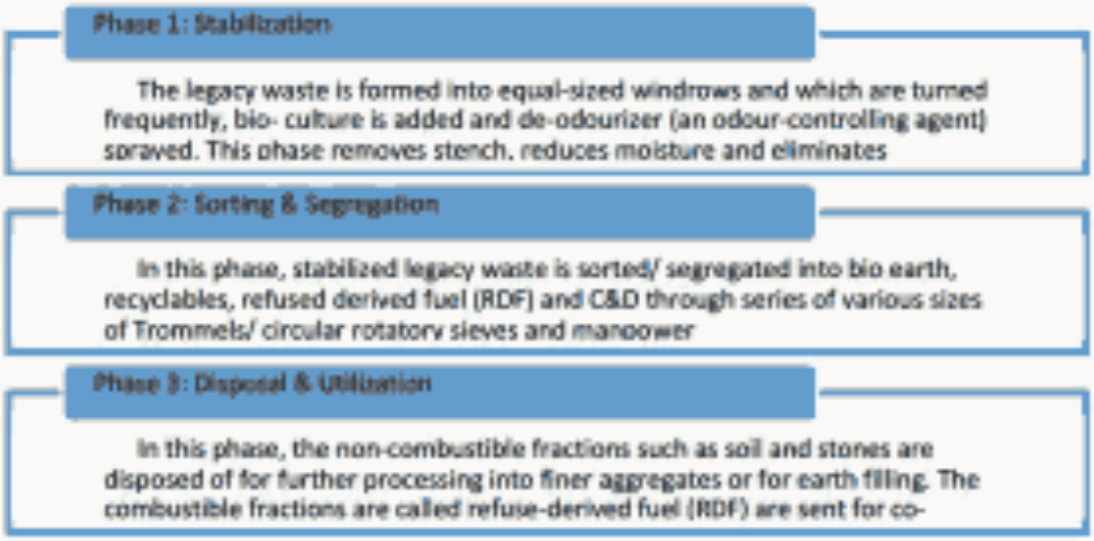
For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- A total station survey for assessment of volumetric quantity of legacy waste above the ground level.
- Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- History of the site, Physical features of site, as –is/current situation and compositional analysis of waste.
- Baseline study of heavy metals; subsurface soils and water; rainfall; soil type; surface hydrology; topography; wind direction etc. Shall be studied prior to bioremediation
- Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area.

Alternative analysis for the various dumpsite remediation options are detailed in following section.

## 6.1 Bio-Mining – Reclamation/Recovery of Land

Bio- mining is the scientific technique to extract materials of economic interest from legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) and followed by sustainable management through recycling, co-processing, road construction etc.




| | |
|---|---|
| Salient Features | • Land recovery, increase in value of land and available for public use/habitation with immediate effect.<br>• Ensures long-term sustainability and environmentally sound treatment of legacy waste and present lucrative revenue-generating opportunities.<br>• Bio products/aggregates generated from the process can be used as alternative construction material, fuel and recyclables.<br>• Compliance to SWM Rules and NGT orders.<br>• Improvement in aesthetics and quality of life & health. |
| Applicability | • The ownership is well defined.<br>• Working space is available in the dumpsite.<br>• Linkage for utilization by-products is available |

### 6.2 Capping Without Land Recovery

Capping is a scientific process of profiling legacy waste and covering with barrier layers consisting of soil, high density polyethylene (HDPE) liner, gas collection system surface drainage system, and a vegetative cover to minimize the percolation of rainwater into the legacy waste.

| | |
|---|---|
| Salient Features | • The capped area becomes a green space and can be developed into parks/recreational areas. |

| | |
|---|---|
| | • Capped area will be equipped with environmental monitoring systems for post-closure maintenance to monitor pollution levels in groundwater and surface-water sources and air (especially methane emissions) at least 15 years<br>• Capped area needs to be inspected periodically for settlement due to physical, chemical and biological transformation, leachate generation, erosion and naturally occurring invasion by deep- rooted vegetation.<br>• Recurring expenditure will be incurred for regular maintenance. On July 17, 2019, the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested bio-mining as environmentally safe and the most preferable approaches to dumpsite remediation.<br>• SWM rules do not permit habitation over it for at least 15 years because of the danger posed by toxic gases release by the waste. |
| Applicability | • Simple & robust, least expensive method among various available technologies |

### 6.3 Capping with Partial Land Recovery

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bioremediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can be linked to relevant buyers and the inert material will be capped over lower footprints, with well-designed slopes to prevent further degradation of the environment.

The reclaimed land may be covered with loamy soil that has plants with high transpiration rates. The plants do not permit the ingress of water into the soil thereby reducing the possibility of leachate generation. The plants and soil microbes also behave as oxidation layer. The soil is compacted and maintained with gentle slopes with 1V to 3 H. Contour drains may be provided to divert the water away from the soil thereby preventing ponding of water. The reclaimed land may be covered with solar panels to generate renewable energy during the period of observation following the post closure.

| | |
|---|---|
| Salient Features | ● The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.<br>● Ensures short -term sustainability and environmentally sound treatment of legacy waste.<br>● Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area |
| Applicability | ● Legacy waste dumpsite area partial of steep terrain, inaccessible ravines and narrow valleys.<br>● Lack of linkage for disposal of inert<br>● Recovery land for public use is not a priority |

## 6.4 Selection of Remediation Option

Selection of the applicable method/type or technique is based on the factors like., salient aspects & applicability of remediation types viz., Capping without land recovery, Bio-mining – reclamation/recovery of land & capping with partial land recovery and also available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for land recovery and forward linkages/utilization of processed aggregates/by-products.

Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. Moreover, as per Solid Waste Management Rules, 2016 and several National Green Tribunal (NGT) directives have mandated that urban local bodies opt for bio-mining over capping

However, after the bioremediation municipality wants to use the land for setting up of Material Collection Facility and Resource Recovery Facility. Hence backfilling of the site with boulders and inert are planned.

For the execution of dumpsite bio-mining two strategies can be adopted;

- *Insitu biomining*: Here the biomining is carried out within the premises of the dumpsite after clearing the waste and reaching the original ground level or in a land adjoining the dumpsite. The advantage is that only the finished products are moved out of the premises, inerts may be used for gradation and filling up low lying areas within the site, or in a

newly developed sanitary landfill. This is quite economical when legacy waste quantities are significant. The possibility of gaseous emissions, noise and odor and formation of leachate exist as the processing takes place at the site. The location would remain affected for the time till all waste are processed.

- *Ex Situ biomining:* In small dumpsites, or where the area is a constraint, the entire waste is excavated and taken away to an alternate location for processing. The work in the dumpsite can be completed quickly and the disturbance due to the excavation can be minimized. The cost of transportation of the whole waste adds to the cost of bio mining. But since the process plant can serve multiple locations, economies of scale may be achieved and may also compensate for the added transport cost.

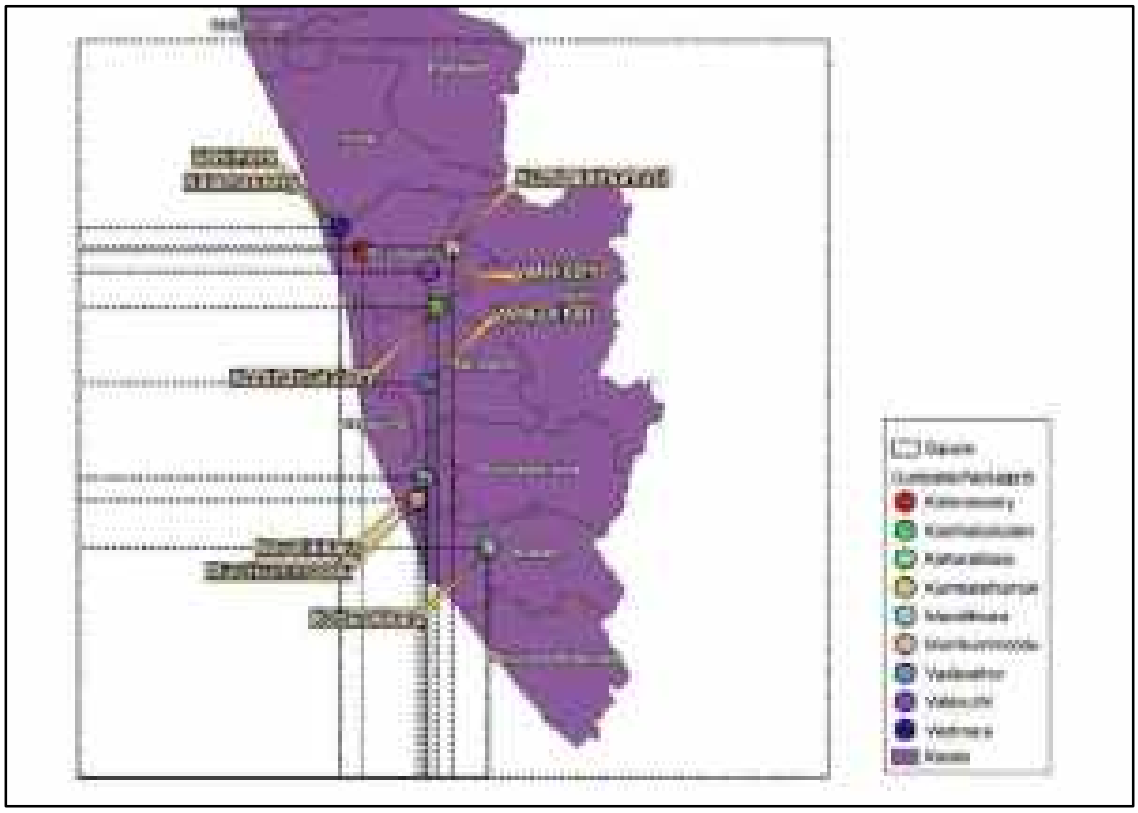


*Figure 10: Location of Other Dumpsites nearby*

# 7 Technical Description of the Selected Option

## 7.1 Methodology

The legacy waste dumpsite reclamation through bio-mining with recovery of land involves

Phase 1: stabilization

Phase 2: sorting & segregation

Phase 3: disposal & utilization

Phase 4: Back filling of boulders and inerts

## 7.2 Selection of Machineries

The type of machinery, capacity and type of screens to stabilize the legacy waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) will depend on the physical site conditions including quantity & characteristics of legacy waste and utilization of the aggregates/by-products/recovered material.

The type of machinery available for the bio mining are as follows:

- Stationary screening machinery and
- Mobile/compact machinery

### 7.2.1 Stationary Screening Machinery

A Stationary trommel is a specialized piece of equipment used in legacy waste bioremediation processes to separate and classify solid waste materials. It is designed to efficiently screen and sort different components of the waste based on size and other characteristics. Technical description of a Stationary Trommel used in legacy waste bioremediation are as follows:

- Structure: The Stationary trommel consists of a frame made of steel or other durable materials. It is designed to withstand the harsh conditions of waste treatment facilities. The frame supports a cylindrical drum that is inclined at an angle for optimal material flow.
- Drum: The drum is the main component of the Stationary Trommel and is typically made of perforated metal or mesh. It is cylindrical in shape and rotates on its axis using a motorized drive system. The drum's 3- 5 mtr diameter and 10 mtr length can vary depending on the specific requirements of the waste treatment process.
- Motor and Drive System: The Stationary Trommel is equipped with a motor and drive system that powers the rotation of the drum. The motor is typically electrically powered and is connected to the drum through a gearbox or direct drive mechanism. The rotational speed of the drum can be adjusted to optimize the screening process
- Inlet and Outlet: The Stationary Trommel has an inlet where the legacy waste is fed into the drum for processing. The waste material enters the drum at one end, typically assisted by a conveyor or loader. The screened waste material is discharged from the opposite end of the drum through an outlet.
- Screening Mechanism: As the drum rotates, the legacy waste inside it is subjected to a combination of tumbling and rolling actions. The perforated drum allows smaller-sized particles and materials to pass through, while larger items such as bulky waste, debris, and contaminants are retained inside the drum. The drum's perforation size can be customized to achieve the desired separation efficiency.

- Waste Sorting: The Stationary Trommel facilitates the separation of different components within the legacy waste. It effectively segregates organic waste, inert materials, recyclables, and other categories based on their size and physical properties. This sorting process prepares the waste for further treatment or disposal.

### 7.2.2 Mobile/Compact Screening Machinery

The Mobile Trommel is a technical apparatus utilized in legacy waste bioremediation processes. Its primary function is to separate and sort various types of waste materials, such as solid waste and organic matter, for effective bioremediation

***Structure***: The trommel consists of a cylindrical drum, typically made of heavy-duty metal, which is inclined at a slight angle. The drum is supported by a framework and set in motion by a motor or engine, causing it to rotate slowly. The rotation of the drum allows the waste materials to be fed into the trommel at one end, while simultaneously moving the materials along its length. Large screening area (9.5 sq m). Helps in good quality segregation & high productivity

***Screening Mechanism***: The Mobile Trommel incorporates various mechanical features to facilitate waste separation. As the waste enters the drum, it encounters a series of screens or perforations arranged along the length of the drum. These screens have different mesh sizes, which allow for the separation of different-sized particles. The smaller particles, such as sand or fine soil, pass through the screens and fall through openings at the bottom of the trommel, while larger materials, such as plastics or larger debris, are retained and carried along by the rotation of the drum.

***Separation System***: Additionally, the Mobile Trommel may be equipped with paddles or lifters mounted inside the drum. These paddles help to agitate and tumble the waste materials, assisting in the separation process by ensuring proper contact between the waste and the screens. They also help to break up clumps or aggregates, aiding in the release of trapped organic matter. Four different screen inclination angles for operations between 20°-35° are available for selection provides flexibility.

***Treatment Process***: In the context of legacy waste bioremediation, the Mobile Trommel plays a crucial role in preparing the waste for subsequent treatment steps. By separating the waste into different fractions based on particle size, it allows for targeted bioremediation processes. For example, the fine fraction may be subjected to aerobic or anaerobic composting, while the larger fraction can undergo mechanical or physical treatments.

***Transport***: Quick and easy folding of conveyor helps in quick setup time.

***Discharge height***: Wider conveyor and higher discharge heights help in making bigger stockpile and eliminates the frequent loader usages

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by- products as per the requirements of the utilization/forward linkage.

Based on the detailed assessment of the selection parameters listed above, the site conditions, legacy waste characteristics, statutory requirements etc, stationary trammel machine shall be the optimum screening machinery

## 7.3 System Requirements

The following are the infrastructural facilities required for setting up of machineries and equipment in biomining of a dumpsite: These are required irrespective of the option of in-situ or ex-situ processing.

- Fencing and secure entrance gate
- Security and reception office
- Weighing bridge
- Records room
- Laboratory
- Medical room
- Workers' area
- Parking for vehicles (heavy earth equipment, trucks, etc.) with tire washing facility.
- Administrative building
- Fire control unit (detailed methodology for fire management plan)
- Toilet–bath complex, with personnel protection equipment (PPE) storage room)
- Overhead water tank
- Leachate collection and treatment unit
- Environmental monitoring unit
- Segregation and processing area
- Temporary storage area for rejects, domestic hazardous waste and sanitary waste
- Material storage area
- Waste drying and windrow area.
- DG set

The total area required is about 900 sqm in an in situ biomining plant. The process shed needs to be covered building. Temporary construction power at 440V needs to be obtained from KSEB. This can be easily availed as there is an existing electrical infrastructure passing through the site. A 440V, 125KVA needs to be established for the project. Water storage tanks needs to be provided for the duration of the project. The water may be supplied by tankers. Labour

will reside in Kayamkulam and commute daily to the site, hence no labour sheds are envisaged during this project. The requirements are only indicative, and the contractor is required to propose own design and capacity to complete the works in the stipulated time and standards.

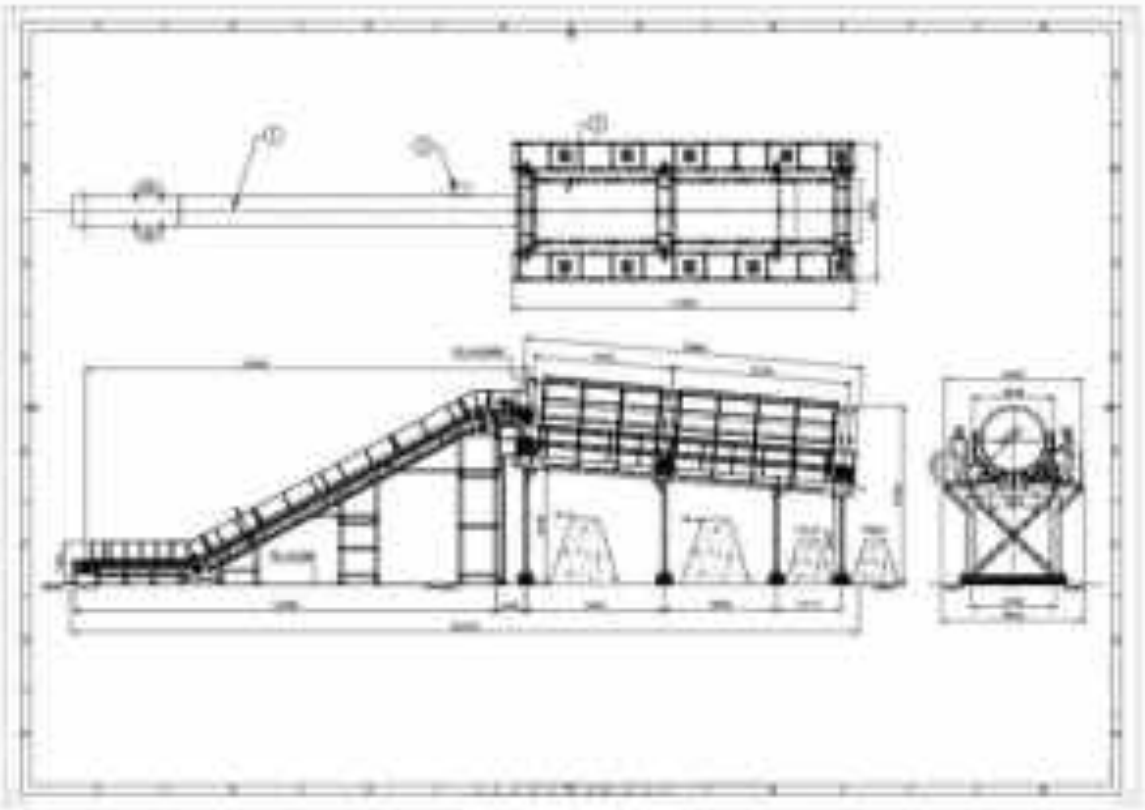


*Figure 11: Schematic of the Segregation System*

## 8 Scope of Disposal for RDF, Bio Soils, C & D Waste, and Others

### 8.1 Utilization of By Products

The details of the utilization of aggregates/by-products screened out by processing of the stabilized legacy waste are provided in the table below

*Table 16: By Product Composition*

| By products | Percentage Composition | Quantity (Cum) | Utilization/Linkage/Usage |
|---|---|---|---|
| RDF | 18.49 | 1897.26 | RDF will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel. |

| | | | |
|---|---|---|---|
| Recyclables | 23.54 | 2415.44 | |
| Inert | 16.40 | 1682.80 | Can be utilized for filling at the site itself |
| Compost Soil Enricher | 41.56 | 4264.47 | Can be used as a soil enricher and given to farmers. The same cannot be sold as fertilizer unless it is enriched with carbon content to meet the standards suggested by FCO for city compost |
| Total | 100 | 10,261 | |

The **Table 9.1** details the expected recovered items in line with the investigation results present. However, during the execution stage, the bidder is required to analyse each recovered fraction at least every 15 days and report submitted to the concerned authority. It is to be noted that the RFB document should cover necessary clause in this regard.

RDF / SCF consists largely of combustible components which are shredded into a uniform size, in order to produce a homogenous material which can be used as substitute for fossil fuels in e.g. cement plants, lime plants, coal fired power plants or as reduction agent in steel furnaces. The calorific value of the RDF should be higher than 1500kcal/kg for use in cement plants.

The nearest cement Industry that can accept the RDF from Kayamkulam is located near Trichy, Tamil Nadu at a distance varying between approx 360 kms from the Dumpsite site. The other sites are at Karnataka between 740km to 1074km, while cements plants at Andhra are at 740km to 900kms.

*Table 17: Distance to potential RDF / SCF users*

| Name of the cement plant | Location | State | Distance from Kochi (KM) |
|---|---|---|---|
| Dalmia Bharath | Ariyalur | Tamilnadu | 458 |
| Dalmia Bharath | Dalmiapuram | Tamilnadu | 424 |
| ACC | Wadi | Karnataka | 1,075 |
| Chettinad | Karikazhi | Tamilnadu | 315 |
| Chettinad | Kallur | Tamilnadu | 386 |
| Dalmia Bharath | Belagavi | Karnataka | 956 |
| JK | Muddapur | Karnataka | 965 |
| Dalmia Bharath | Kadapa | Karnataka | 739 |
| Bharathi VICAT | Kalburgi | Karnataka | 1,074 |

| | | | |
|---|---|---|---|
| JSW | Kurnool | Andhra Pradesh | 901 |
| Bharathi VICAT | Kadapa | Andhra Pradesh | 739 |
| Ultratech | Tadipatri | Andhra Pradesh | 815 |
| Zuari | Yerraguntla | Andhra Pradesh | 877 |

## 9 Details of Estimated cost

The details of the estimated cost for bio-mining - recovery of land by remediating legacy waste dumpsite is provided in the table below:

*Table 18: Project cost estimates and revenues from sale of product*

| Sl. No | Activity | Rate/ m3 | Quantity (m3) | Amount (in INR) |
|---|---|---|---|---|
| 1 | **Bio-mining Operations** | | | |
| a | Processing the Waste | [redacted] | [redacted] | [redacted] |
| 2 | **Disposal Cost** | | | |
| a | Disposal of RDF | [redacted] | [redacted] | [redacted] |
| b | Disposal of Compost/ Soil enricher | [redacted] | [redacted] | [redacted] |
| d | Disposal of Inert | [redacted] | [redacted] | [redacted] |
| | **Total (1+2)** | | | [redacted] |
| | E& S Safeguards from ESIA | | | [redacted] |
| | Contractors Profit and Overheads at 15% | | | [redacted] |
| | Net Cost | | | [redacted] |
| | Average Cost Index for Kerala based on DSR 2018 is ~1.35 at present. Considering the same, the Grand Total is | | | [redacted] |
| | Cost per $m^3$ | | | [redacted] |

## 9.1 Revenue from the Project

The anticipated sources of revenue from the processing of the legacy waste dumpsite viz., by sale Bio earth & C&D waste, organic compost, RDF and recyclables. But due to the following reasons mentioned below no revenue from the project is considered

- RDF is utilized as fuel (co – processing) in the cement industries, presently most cement industries are only accepting the RDF at free cost and transportation cost also not borne by the cement industries.
- The uncertainty of quantity and quality of the recyclables from legacy dumpsite due to burnt or crushed or disintegrated, rusted and additional money is required for cleaning of the recyclables for saleable

## 9.2 Funding for Project

The estimated cost of INR [redacted] for the project Dumpsite Remediation. The sources and funding pattern is given below:

*Table 19: Sources of Funds*

| **Item wise funding pattern** | | | |
|---|---|---|---|
| Item | Bank Share (70%), ₹ | State Govt. (30%), ₹ | Total cost ₹ |
| Dumpsite remediation for the Kayamkulam | [redacted] | [redacted] | [redacted] |

# 10 Project Implementation Plan

Kayamkulam Municipality intends to complete this project as early as possible. However, considering the time required for mobilisation, installation, sieving and handling recoverable etc, a time frame of about 06 months is considered.

## 10.1 Timeline

The broad timeline for the execution of this project is given below.

*Table 20: Project Timeline*

| TIMELINE CHART FOR EXECUTION | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Task Name** | **M 1** | **M 2** | **M 3** | **M 4** | **M 5** | **M 6** |
| 1 | Planning & Mobilization | | | | | | |
| 2 | Foundation & Civil Works (Cover Shed installation) for machineries, Hiring & Installation of Machineries, Electrical Works | | | | | | |
| 3 | Excavation of Legacy Waste | | | | | | |
| 4 | Site Development for Windrows & Leachate Collection | | | | | | |
| 5 | Windrow Formation & Spraying of Bio culture | | | | | | |
| 6 | Sieving Operations | | | | | | |
| 7 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | | | | | |
| 8 | Project Closure Activities:<br>Levelling of Reclaimed Land using Bio-soil<br>Handover the available infrastructure at site to the ULB<br>Closure Report Submission to ULB, | | | | | | |

## 10.2 Contract Model

***Execution Method:***

Design, Own, Operate and disposal/Management of by-products/aggregates with -zero residues and maximum land recovery. The work shall be carried out in compliance with SWM Rules 2016 and CPCB Guidelines for the disposal of legacy waste 2019.

***Working Model***

- 100% work to outsourced to selected private contractor
- TSC will assess the quantity of waste and the ULB will hand over the land for setting up the plant to the Contractor.
- Cost of Electricity connection to be provided by ULB for the plant.
- Electricity charges for the usage of the plant to be paid by contractor
- ULB shall facilitate the disposal/Utilization of By-products and contractor is responsibility for disposal of RDF, recyclables and aggregates

## 11 Benefits of the Project

The project benefits of dumpsite remediation at Kayamkulam are ;

- Reclamation of Land: An area of 1.25 acres will be reclaimed which can be used for resetting SWM facilities of ULB
- Environmental Protection: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By cleaning up contaminated sites, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity
- Health Improvement: Remediation projects reduce these risks, leading to improved public health outcomes and a reduction in waterborne and airborne diseases.
- Enhanced Water Quality: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to safe drinking water.
- Aesthetic and Social Benefits: Remediation of legacy waste dumpsite can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents. Uncontrolled waste dumping will be stopped.
- Operational & Life cycle Aspects - Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through a bio-mining process.

## 12 Conclusion

- The activities of the bio-mining will be commenced from December 2023 to Mar 2024. An area of **1.25 acres** will be reclaimed and will be used for setting up other solid waste management facilities in future.
- Optimum of the land will be reclaimed and recovered through the biomining process, and this will by ensuring environmental safeguards.
- For the optimum screening of the **23332.83 m3** of legacy waste, mobile / compact screening machinery shall be used.
- Favourable site conditions for bio-mining:
    - Electrical power infrastructure viz., power lines & electrical transformer is available adjacent to the boundary of the dumpsite.
    - Piped water supply is available at the dumpsite.
- The project activity requires “Site Authorization, Consent to Establish and Consent to Operate” from KSPCB
- The implementation/execution of the project activities shall be conforming to SWM Rules 2016, NGT orders, KSPCB norms, World Bank guidelines and KSWMP ESMF and other regulatory rules & norms Environmental & Social safeguards:

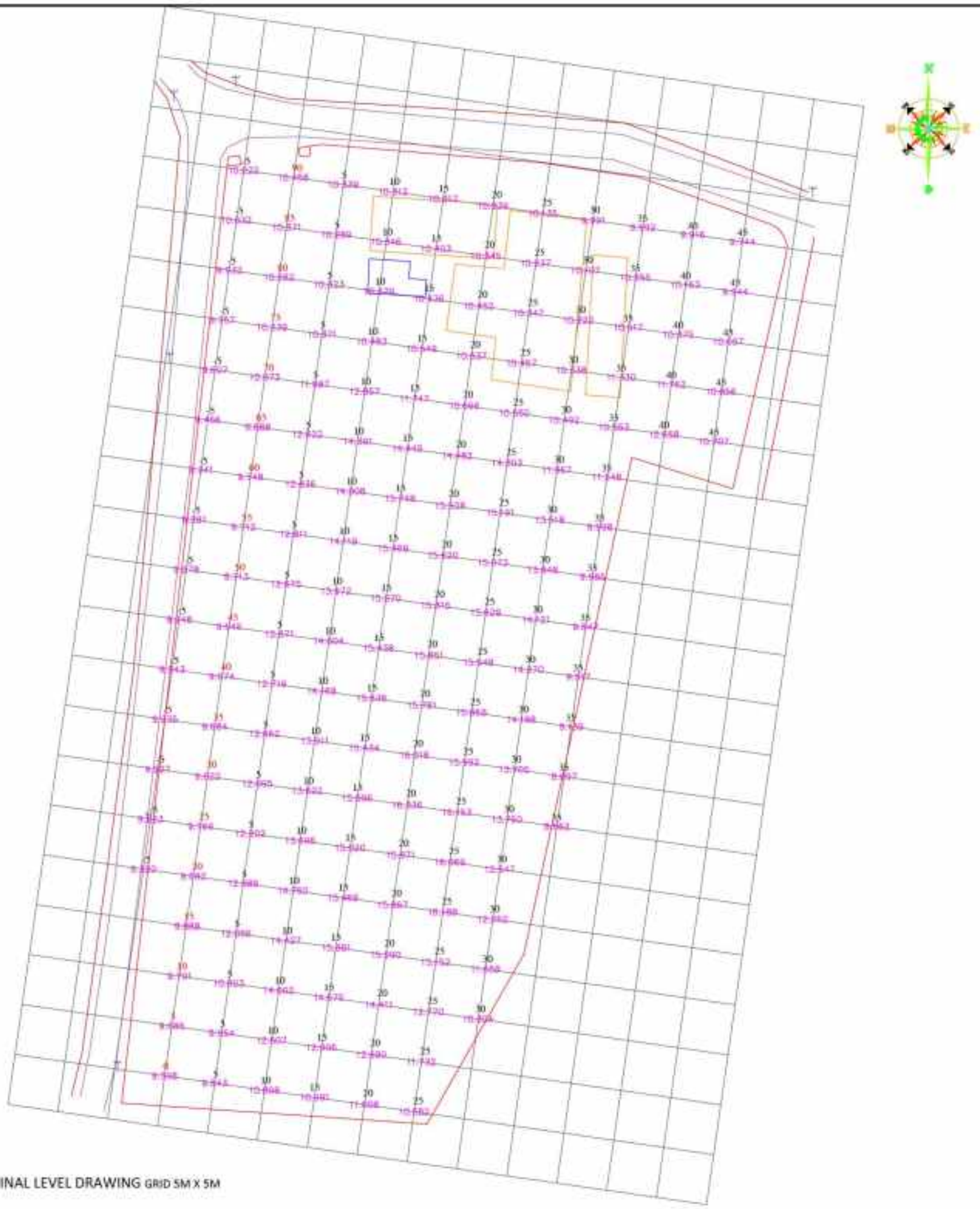
- The project attracts E2 Environmental category based on the project activities and status of the environment baseline.
- Site specific Environmental Assessment and Environmental Management Plan has been developed.
- The project attracts moderate risk social category based on the social mapping & transect walk to understand the settlements/habitations/establishments etc., and consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.

- Total cost of the project is Rs [redacted]

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**Annexures**

| | |
|---|---|
| Annexure 1 | Topographical Survey Report & Volumetric Analysis |
| Annexure 2 | Geotechnical Survey Report |
| Annexure 3 | Waste Characterization Report |
| Annexure 4 | Waste & Environmental baseline assessment reports |
| Annexure 5 | Site Plan |
| Annexure 6 | Operation Plan |
| Annexure 7 | ESIA Report |



FINAL LEVEL DRAWING GRID 5M X 5M

LEGEND:-

ELECTRIC POST

OTHER TREE

JACK TREE

REDUCED LEVEL

COCONUT TREE

MANGO TREE

TEAK TREE

MAHOGANY TREE

CONTOUR LINE

TOPOGRAPHIC SURVEY& CONTOUR

CLIENT:-

SITE AT:-

MURUKKUMOODU,KAYAMKULAM, ALAPPUZHA

Survey No :
Block No :
Ward No : 22
District : Alappuzha
Municipality : Kayamkulam
Taluk : Karthikappally

| No | Revision | By | Date |
|---|---|---|---|
| | | | |
| | | | |

Surveyed by : AMAL

Drawn by : AMAL

Checked by : MHG

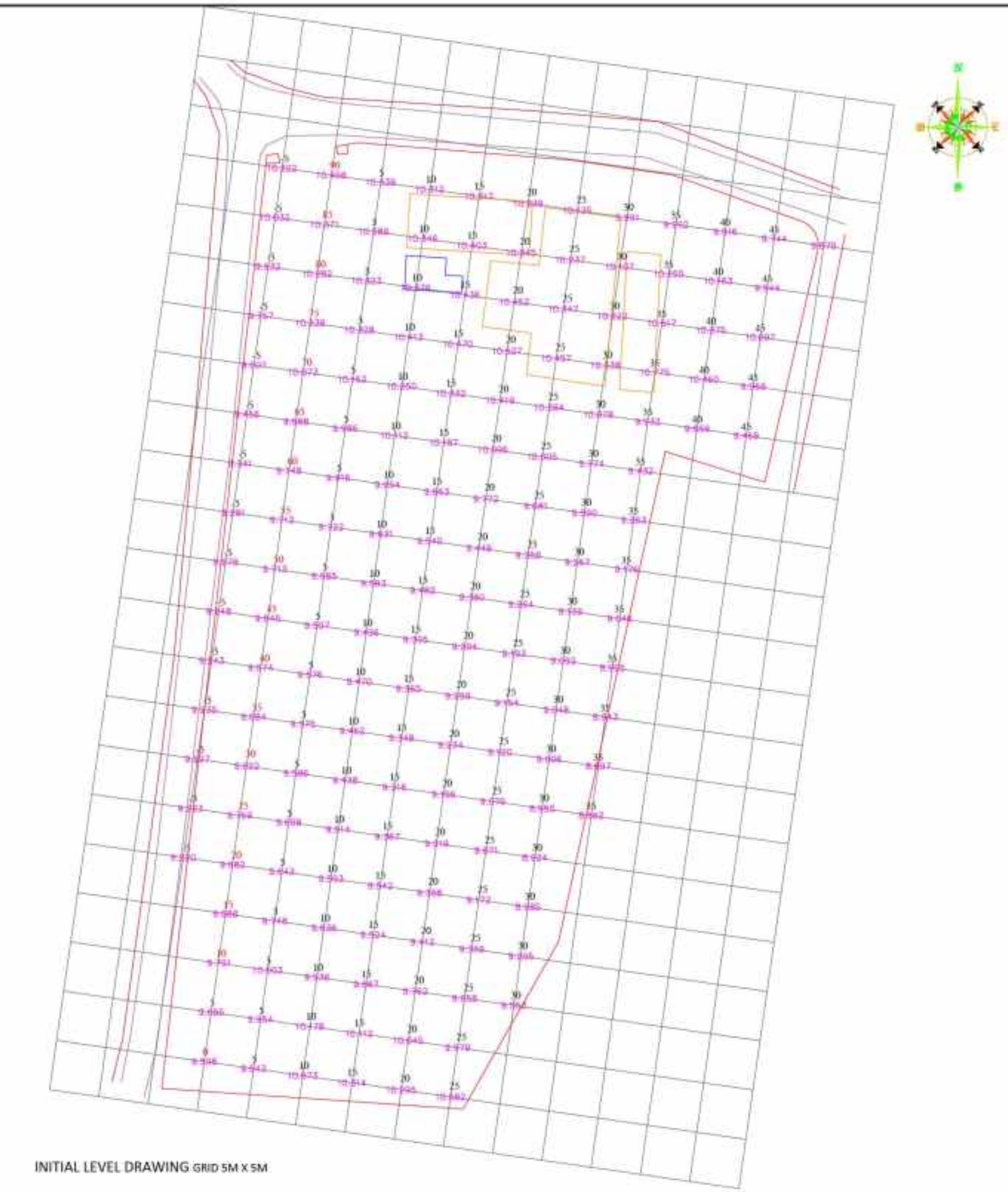
Date : 17 FEB 2023

Drawing No. 01

AREA: 1 Acre 2.76 Cents (4157m2)
Volume : 9630 m3
Dumping area : 2370 m3

SCALE: 1 CM = M

TECHNOSOL CONSULTANTS
KOLLAM - 691003. PHONE : +91 7012216429
+91 9946788844
technosolconsultants@gmail.com



INITIAL LEVEL DRAWING GRID 5M X 5M

LEGEND:-

ELECTRIC POST

OTHER TREE

JACK TREE

REDUCED LEVEL

COCONUT TREE

MANGO TREE

TEAK TREE

NON-GIVANT TREE

CONTOUR LINE

TOPOGRAPHIC SURVEY& CONTOUR

CLIENT:-

SITE AT:- MURUKKUMOODU,KAYAMKULAM, ALAPPUZHA

Survey No :
Block No :
Ward No : 22
District : Alappuzha
Municipality : Kayamkulam
Taluk : Karthikappally

| No | Revision | By | Date |
|---|---|---|---|
| | | | |
| | | | |

Surveyed by ABDO1

Drawn by ANSI

Checked by ANIL

Date : 17 FEB 2023

Drawing No. 01

AREA: 1 Acre 2.78 Cents (4357m2)
Volume : 9130 m3
Dumping area : 2970 m2

SCALE 1 CM = M

TECHNOSOL CONSULTANTS
KOLLAM - 691003, PHONE : +91 7012230428
+91 9744788644
technosolconsultants@gmail.com

# KAYAMKULAM DUMPSITE

## Volumetric Analysis Report

| Chainage (M) | Area of Cutting | Area of filling (M) | Average area of cutting ($M^2$) | Average area of filling ($M^2$) | Distance (M) | Volume of Cutting ($M^3$) | Volume of Filling ($M^3$) |
|---|---|---|---|---|---|---|---|
| 0.000 | **0** | 5.818 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5.000 | 0.000 | 43.173 | 0.000 | 24.495 | 5.000 | 0.000 | 122.475 |
| 10.000 | 0.000 | 85.053 | 0.000 | 64.113 | 5.000 | 0.000 | 320.563 |
| 15.000 | 0.000 | 129.268 | 0.000 | 107.160 | 5.000 | 0.000 | 535.800 |
| 20.000 | 0.000 | 143.493 | 0.000 | 136.380 | 5.000 | 0.000 | 681.900 |
| 25.000 | 0.000 | 139.003 | 0.000 | 141.248 | 5.000 | 0.000 | 706.238 |
| 23.000 | 0.000 | 157.475 | 0.000 | 148.239 | 5.000 | 0.000 | 741.194 |
| 23.000 | 0.000 | 159.885 | 0.000 | 158.680 | 5.000 | 0.000 | 793.400 |
| 40.000 | 0.000 | 162.930 | 0.000 | 161.408 | 5.000 | 0.000 | 807.038 |
| 45.000 | 0.000 | 161.380 | 0.000 | 162.155 | 5.000 | 0.000 | 810.775 |
| 50.000 | 0.000 | 156.748 | 0.000 | 159.064 | 5.000 | 0.000 | 795.319 |
| 55.000 | 0.000 | 151.888 | 0.000 | 154.318 | 5.000 | 0.000 | 771.588 |
| 60.000 | 0.000 | 151.888 | 0.000 | 151.888 | 5.000 | 0.000 | 759.438 |
| 65.000 | 0.000 | 114.295 | 0.000 | 133.091 | 5.000 | 0.000 | 665.456 |
| 70.000 | 0.000 | 54.068 | 0.000 | 84.181 | 5.000 | 0.000 | 420.906 |
| 75.000 | 0.000 | 12.515 | 0.000 | 33.291 | 5.000 | 0.000 | 166.456 |
| 80.000 | 0.000 | 0.000 | 0.000 | 6.258 | 5.000 | 0.000 | 31.288 |
| 85.000 | 0.000 | 0.000 | 0.000 | 0.000 | 5.000 | 0.000 | 0.000 |
| 90.000 | 0.000 | 0.000 | 0.000 | 0.000 | 5.000 | 0.000 | 0.000 |
| | | | | | | **0.000** | **9129.831** |

MatterLab
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Report Number: **ML/GT/2896/239/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE B OF KSWMP AT MARIKKUMOODU, KAYAMKULAM, ALAPPUZHA DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | IPE Global Ltd. |
| Address | : | 2nd Floor, 16/3878-3879, Kavanatt Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact Person | : | Mr. Ranbir Dey |
| Project No | : | GT-233 |
| Project Name | : | Geotechnical examination of dumpsite under package B of KSWMP at Marikkumoodu, Kayamkulam. |
| Owner | : | KSWMP |
| Project Location | : | Marikkumoodu, Kayamkulam, Alappuzha District |
| Tel / Fax No | : | - |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 18-08-2023 | 1st Submission | Dr. Gautham Adapa | |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Dr. Jimmy Thomas | Geotechnical Expert, Consultant, MatterLab | |
| Approved by: | Freddy Suman | General Manager, MatterLab | |

## TABLE OF CONTENTS

1 INTRODUCTION ..... 3

2 SCOPE OF WORK ..... 3

3 OBSERVATIONS FROM SITE VISIT ..... 3

4 GEOTECHNICAL INVESTIGATIONS ..... 4

5 LABORATORY ANALYSIS ..... 6

6 SUMMARY ..... 7

## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results

# 1 INTRODUCTION

Matter Material Testing and Research Laboratory Pvt. Ltd has been set-up as a result of increased demand locally from various industries for a multidisciplinary testing, materials consultancy & investigation facility in alignment with global standards and technology advancements. MatterLab is an independent professional and technical services provider to all who are concerned with quality and performance of materials & products.

IPE Global Ltd. which provides technical support consultancy services to the Urban local bodies in different municipalities for the Kerala State Waste Management Project (KSWMP) has entrusted the geotechnical investigative works as part of their DPR study for the remediation of dumpsite in Marikkumoodu, Kayamkulam to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was bored using a rotary drill. The initial site visit was done on 29th May 2023. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 13th June 2023 and was completed on 14th June 2023. Standard Penetration test (SPT) was conducted within the borehole as required. Representative and undisturbed soil samples were collected to conduct relevant laboratory tests to acquire the necessary parameters. This report presents results of the geotechnical investigation of the ground encountered after drilling through the waste at the dumpsite.

# 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil samples and performing necessary laboratory tests on the collected samples to obtain the desired parameters of the ground profile.
- Preparation of report with laboratory test results.

# 3 OBSERVATIONS FROM SITE VISIT

Matterlab has deputed a team from our geotechnical department along with Mr. Ravi Kumar of IPE Global during the fourth week of May 2023, in order to collect the information regarding the site prior to mobilizing the equipment for drilling.

The location of the dumpsite is situated where there was human habitation in the surrounding area of the dumpsite.




**Figure 1 : Location of the borehole drilled at the dumpsite.**

## 4 GEOTECHNICAL INVESTIGATIONS

### 4.1 Rotary drilling

Rotary drilling technique was adopted for advancing and clearing out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste in the landfill.

### 4.2 Drilling equipment

Mechanical drilling machine was used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The borehole of 150mm diameter was formed using a drag bit (Soil Cutter) in soil. The drag bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by

drilling mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

### 4.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as representative samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log - commencement and completion date, location of borehole, elevation of top and bottom of boring, ground water table, boundaries of

each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelog is attached as **Appendix-I.**

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant Standard Codes. A summary of laboratory tests carried out is shown below in **Table 1** and the complete results of laboratory testing are presented in **Appendix II**.

**Table 1: Details of various laboratory tests and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 1 | Soil | Grain-Size Analysis | IS: 2720(Part-4)-1985 |
| 2 | | Atterberg's Limit | IS: 2720(Part-5)-1976 |
| 3 | | MDD/OMC(Light Compaction) | IS:2720(Part-7)-1980 |
| 4 | | Direct Shear | IS:2720(part-130-1986 |
| 5 | | Permeability | IS :2720 (Part-17)-1986 |
| 6 | | Bulk Density & Dry Density | BS:1377-(Part-2)-1990 |
| 7 | | Consolidation | IS: 2720(Part-15)-1986 |
| 8 | | Moisture Content | IS 2720(Part 2)-1973 |



(a)



(b)



(c)



(d)

**Figure 2 :** Laboratory tests performed at MatterLab.

## 6 SUMMARY

The geotechnical investigation of the original ground below the waste at the dumpsite at Marikkumoodu, Kayamkulam, Alappuzha district was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a single borehole was drilled through the waste into the ground using a rotary drilling method. The waste of height of 4 m is cleared at the borehole location to provide a platform to the machinery before drilling. The maximum depth of investigation was 10.5m (1.2 m in waste and 9.3 m in the ground). SPT and collection of undisturbed soil samples were carried out at regular intervals within the ground. Various laboratory tests were carried out on the SPT and undisturbed soil samples.

Based on the investigations carried out, it is observed that the original ground below the dumped waste comprises of sandy layer of 7.0 m thickness underlain by a clay layer until depth of termination. As per the information provided by the client, the waste in the dumpsite needs to be excavated, segregated using a few machinery and the inert material left after the bio-mining needs to be dumped within the site. As informed by the client, during the process of bio-mining the waste would be excavated from one feasible location of the site and transferred to another location of the site. During these operations, any temporary storage waste in the form of heaps should be carried out ensuring the stability of the sloping face of the waste. It is suggested that for slopes with a height ≤ 1.5 m the angle of face should not be steeper than 45°. For slopes of a height greater than 1.5 m the slope should be limited to 30°

to horizontal or flatter. It is not advisable to use slope heights > 5 m without a proper stability analysis. If the inert material is being disposed at the site with no further plans of transporting it or transferring it, it is recommended to compact the material into layers using an 8-10 T roller with compacted lift thickness not exceeding 300 mm.

**The Safe Bearing Capacity (SBC)** is calculated as per IS 6403:1981 (Reaffirmed 2021). For any temporary structures planned at the site, the **recommended allowable bearing pressure** for isolated footings at a minimum depth of 1.0 m below **original ground level** is **300 kPa.** For any slope stability calculations involving the natural ground, the parameters presented in the summary sheet of laboratory results can be used.

The above recommendations are made based on the subsoil profile and laboratory test results obtained on the samples collected from the site. If there is any variation in soil profile during execution, fresh recommendation may be obtained from M/s Matter Material Testing & Research Laboratory (P) Ltd. or from a qualified and experienced geotechnical engineer.

# APPENDIX-I

# BORELOGS

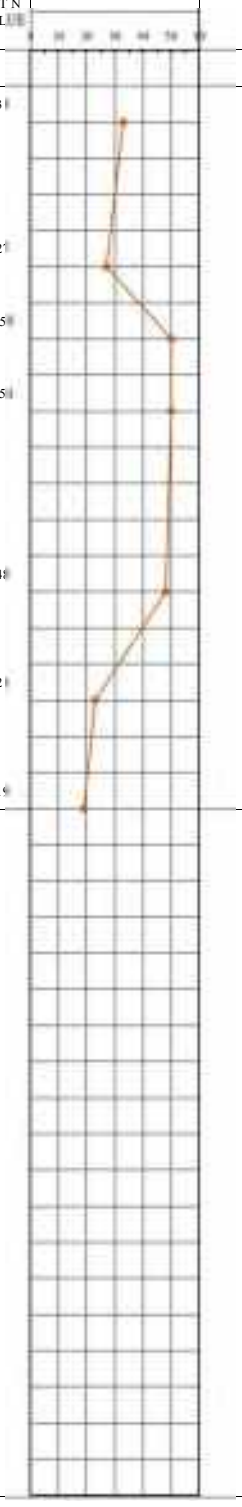
Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT** | **: Geotechnical investigation at Dumpsite in Kayamkulam** | **SHEET NO.** | **: 1 of 1** | **START DATE** | **: 13/06/2023** |
| **CLIENT** | **: IPE GLOBAL** | **BORE DIAMETER (mm)** | **: 150** | **END DATE** | **: 14/06/2023** |
| **Proposed Structure** | **: Dumpsite Remediation** | **BORING TYPE** | **: Rotary** | **REDUCED LEVEL (m)** | **:** |
| **LOCATION** | **: Murikkumudu,Kayamkulam** | **TERMINATION DEPTH (m)** | **: 10.5** | **EASTING (m)** | **: 76.521623** |
| **BOREHOLE NO.** | **: BH-01** | **WATER LEVEL** | **:** | **NORTHING (m)** | **: 9.173379** |

| DEPTH m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM N1 | N2 | N3 | SPT N VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.2 | | Filled Soil and Plastic Waste deposit | 1.2 | | | | | | | |
| 1.5 | | Grey Silty Sand | 0.3 | 1.2 | SPT-01 | 24 | 18 | 15 | 33 | |
| | | | | 1.5 | UDS-01 | | | | | |
| 3.0 | | Yellow Medium Sand | 1.5 | 2.0 | UDS-02 | | | | | |
| | | | | 3.0 | SPT-02 | 7 | 12 | 15 | 27 | |
| 4.0 | | Silty Sand with Gravels | 1.0 | 3.5 | UDS-03 | | | | | |
| | | | | 4.0 | SPT-03 | 50 | > | > | >50 | Balance-30cm |
| | | | | 4.5 | UDS-04 | | | | | |
| | | | | 5.0 | SPT-04 | 50 | > | > | >50 | Balance-30cm |
| 7.5 | | Coarse Sand with Shell dust | 3.5 | 6.0 | UDS-05 | | | | | |
| | | | | 7.50 | SPT-05 | 18 | 29 | 19 | 48 | |
| 9.0 | | Medium Sand with Gravels | 1.5 | | | | | | | |
| | | | | 9.0 | SPT-06 | 6 | 10 | 13 | 23 | No Sample |
| 10.5 | | Clay with Sand | 1.5 | | | | | | | |
| | | | | 10.5 | SPT-07 | 6 | 7 | 12 | 19 | |
| | | **Bore hole terminated at the depth of 10.5m below top of waste (9.3m below original ground)** | | | | | | | | |

DEPTH V/S N VALUE



Abbreviations
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
CR- Core Recovery, RQD- Rock Quality Designation

Sd/-
Site Supervisor

# APPENDIX-II

# LABORATORY TEST RESULTS

# SUMMARY OF LABORATORY TEST RESULTS

**Report Number : ML23/R-02188 Report Date:04/07/2023**

**Project : Geotechnical Investigation at Dumpsite in Kayamkulam**

**Borehole ID : BH-01**

| N value | MatterLab ref | Depth (m) | Type of sample (SPT/UDS/RC) | Soil description | IS Classification | Atterberg Limit | | | Grain size distribution | | | | | | | Maximum dry density, gm/cc | Optimum moisture content, % | Bulk Density, gm/cc | Dry density, gm/cc | Moisture content, % | Cohesion (c), kPa | Internal friction angle, ° | Permeability, cm/s | Consolidation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit,% | Plastic Limit,% | Plasticity Index | Coarse Gravel,% | Fine Gravel,% | Coarse Sand,% | Medium Sand,% | Fine Sand,% | Silt,% | Clay,% | | | | | | | | | Initial Void ratio | Preconsolidation pressure, kPa | Compression Index, $C_c$ | Recompression Index, $C_r$ |
| 33 | ML23/W-02188/S1 | 1 2 | SPT | | | 18 | Could not be determined | NP | | | | | | | | | | | | | | | | | | | |
| | ML23/W-02188/S2 | 1 5 | UDS | | | | | | | | | | | | | | | 1 79 | 1 69 | 6 0 | 0 | 38 | 1 24 E-04 | 0 529 | 168 | 0 19 | 0 01 |
| | ML23/W-02188/S3 | 2 0 | UDS | | | | | | | | | | | | | 1 83 | 12 | | | | | | | | | | |
| 27 | ML23/W-02188/S4 | 3 0 | SPT | Poorly graded sand | SP | | | | 5 | 8 | 7 | 49 | 26 | 5 | | | | | | | | | | | | | |
| | ML23/W-02188/S5 | 3 5 | UDS | | | | | | | | | | | | | | | 2 08 | 1 96 | 6 1 | 0 | 36 | 1 45 E-04 | 0 315 | 221 | 0 05 | 0 01 |
| | ML23/W-02188/S6 | 4 5 | UDS | | | | | | | | | | | | | 1 95 | 8 1 | | | | | | | | | | |
| >50 | ML23/W-02188/S7 | 5 0 | SPT | Poorly graded sand | SP | | | | | 5 | 3 | 70 | 20 | 2 | | | | | | | | | | | | | |

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Mini Bypass Road, Thiruvonnur Nada (PO) Thiruvannur,
Kozhikode, Kerala, 673029.

# Grain Size Distribution of Soil Test Report

Report No: ML23/W-02188/1
Issue No: 1
Report Date: 04/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkumoodu, Kayamkulam |
| Tel / Email: | - |

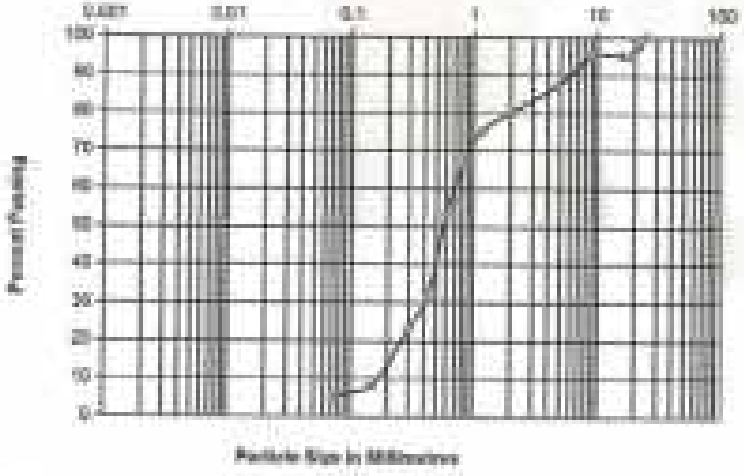
IR-1010743238008481217F

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 24/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 3.00m |
| Work Order ID: | ML23/W-02188 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02188/84 | Source*: | BH 01, Depth 3.00m |
| Date Sampled: | 13/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Marikkumoodu, Kayamkulam | Date Tested : | 25/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 3.00m |
| Tested By: | GK | Client Sample Desc.*: | Soil, BH 01, Depth 3.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution - Wet & Dry Sieving

Method: IS: 2720 (Part 4)-1985




| Sieve Size (mm) | % Passing | Project Limit |
|---|---|---|
| 25.00 | 100 | - |
| 19.00 | 96 | - |
| 16.00 | 95 | - |
| 9.500 | 94 | - |
| 4.750 | 87 | - |
| 3.000 | 80 | - |
| 1.180 | 75 | - |
| 0.850 | 67 | - |
| 0.600 | 53 | - |
| 0.425 | 31 | - |
| 0.300 | 23 | - |
| 0.150 | 8 | - |
| 0.075 | 5 | - |

For and on behalf of MatterLab

## Comments

*Information provided by client

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These results relate only to the samples tested.



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Where Quality Matters

Matter Materia Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvennur Nada (PO) Thiruvennur,
Kozhikode, Kerala, 673029.

# Grain Size Distribution of Soil Test Report

Report No: ML23R-021882
Issue No : 1
Report Date:04/07/2023

| | |
|---|---|
| **Client:** | IFE Global |
| **Address:** | Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 626030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kayamkulam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Marikkumoodu, Kayamkulam |
| **Tel / Email:** | - |

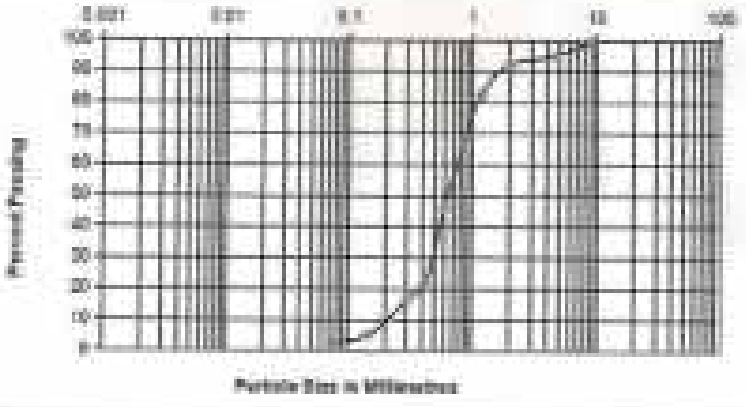
IR-W1C107423000004813F

## Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 24/06/2023 | **Client Sample Ref.*:** | Soil, BH 01, Depth 5.00m |
| **Work Order ID:** | ML23/W-02188 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02188/07 | **Source*:** | BH 01, Depth 5.00m |
| **Date Sampled:** | 12/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2131 - 1981 | **Sample Size(kg):** | 5 Approx |
| **Sample Location*:** | Marikkumoodu, Kayamkulam | **Date Tested :** | 25/06/2023 - 27/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil, BH 01, Depth 5.00m |
| **Tested By:** | DK | **Client Sample Desc.*:** | Soil, BH 01, Depth 5.00m |
| **Test Location:** | MatterLab - Kozhikode | | |

## Particle Size Distribution - Wet & Dry Sieving

Method: IS: 2720 (Part 4)-1985




| Sieve Size (mm) | % Passing | Project Limit |
|---|---|---|
| 9.500 | 100 | - |
| 4.750 | 95 | - |
| 2.000 | 92 | - |
| 1.180 | 82 | - |
| 0.850 | 68 | - |
| 0.600 | 48 | - |
| 0.425 | 33 | - |
| 0.300 | 18 | - |
| 0.150 | 5 | - |
| 0.075 | 2 | - |

For and on behalf of MatterLab

**Comments:**
*Information provided by client

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These results relate only to the samples tested.



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Kozhikode, Kerala, 673029.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23R-021689
Issue No : 1
Report Date: 04/07/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavanett Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kayamkulam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Marikkumoodu, Kayamkulam |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 24/06/2023 | **Client Sample Ref.*:** | Soil, BH 01, Depth 1.20m |
| **Work Order ID:** | ML23/W-02188 | **Sample Submitted By*:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02188/S1 | **Source*:** | BH 01, Depth 1.20m |
| **Date Sampled:** | 13/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2131 - 1981 | **Sample Size(kg):** | 8 Approx |
| **Sample Location*:** | Marikkumoodu, Kayamkulam | **Date Tested :** | 26/06/2023 - 27/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil, BH 01, Depth 1.20m |
| **Tested By:** | VY | **Client Sample Desc*.:** | Soil, BH 01, Depth 1.20m |
| **Condition of Soil:** | Natural | **Period of Soaking:** | 24 Hrs |
| **Test Location:** | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.4; Cone Penetrometer | Liquid Limit,% | 18 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | Could not be determined | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | Non-plastic | - |

For and on behalf of MatterLab

**Comments**

* Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/W-02188/4
Issue No : 1
Report Date:04/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkunnoodu, Kayamkulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 24/06/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 1.50m |
| Work Order ID: | ML23/W-02188 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02188/S2 | Source*: | BH 01, Depth 1.50m |
| Date Sampled: | 13/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Marikkunnoodu, Kayamkulam | Date Tested : | 25/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 1.50m |
| Tested By: | GK/DK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 1.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 1.79 | - |

SREELESH T.V
Head, Civil Laboratory

For and on behalf of MatterLab

**Comments**

*Information provided by client

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# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R/021888
NABL No : 0
Report Date: 04/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveratt Building, Kanjanoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkumoodu, Kayamkulam |
| Tal / Basalt: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 24/06/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02188 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02188/S5 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 13/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Marikkumoodu, Kayamkulam | Date Tested : | 25/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 3.50m |
| Tested By: | GK/DK | Client Sample Desc.*: | Soil (UDS-3), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: (377) Part 2) 1990 | Bulk Density of Soil, g/ml | 2.09 | - |

SREELESH T.V
Testing Engineer

For and on behalf of MatterLab

**Comments**
*Information provided by client

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# Permeability of Soil Test Report

Report No: ML23R-021668
Issue No : 1
Report Date:04/07/2023

| | |
|---|---|
| Client: | PE Global |
| Address: | Kavanad Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Kayanmulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkumoodu, Kayanmulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 24/06/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 1.50m |
| Work Order ID: | ML23/W-02168 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02168/52 | Source*: | BH 01, Depth 1.50m |
| Date Sampled: | 13/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Marikkumoodu, Kayanmulam | Date Tested : | 27/06/2023 - 28/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 1.50m |
| Tested By: | GK/DK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 1.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 1.24 E-04 | - |

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673028

# Permeability of Soil Test Report

Report No: ML23R-021667
Issue No : 1
Report Date: 04/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkumoodu, Kayamkulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 24/06/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 3.50m |
| Work Order ID: | ML23W-02166 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02166/55 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 13/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Marikkumoodu, Kayamkulam | Date Tested : | 27/06/2023 - 28/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 3.50m |
| Tested By: | OK/OK | Client Sample Desc.*: | Soil (UDS-3), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 1.45 E-04 | - |

SREELESH T.V
Head Soil Laboratory

For and on behalf of Matter Lab

**Comments**
*Information provided by client

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# SHEAR STRENGTH TEST REPORT

Report No: ML/STR-021888
Issue No : 0
Report Date:04/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavacad Building, Karayannur Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranadip Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkunnoodu, Kayamkulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 24/05/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02188 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02188/08 | Source:* | BH 01, Depth 3.50m |
| Date Sampled: | 13/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location:* | Marikkunnoodu, Kayamkulam | Date Tested : | 27/05/2023 - 29/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab - Kozhikode | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 3.50m |
| Tested By: | DK | Client Sample Desc.: | Soil (UDS-3), BH 01, Depth 3.50m |

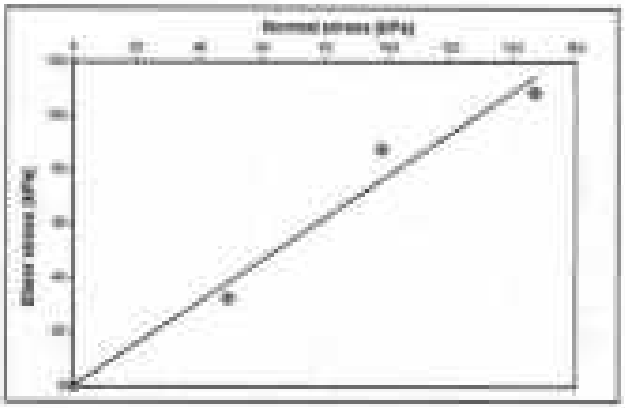
**Test Results** — Method: IS 2720 (Part 13)-1986

| | | |
|---|---|---|
| Area of specimen (cm²) | : | 36 |
| Height of specimen (mm) | : | 25 |
| Rate of strain (mm/min) | : | 1.25 |
| Test Condition | : | Unconsolidated Drained |
| Bulk Density (Mg/m³) | : | 2.08 |
| Moisture content (%) | : | 6.1 |
| Dry Density (Mg/m³) | : | 1.96 |

| Load increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Stress (mm) |
|---|---|---|---|
| 1 | 49 | 92.3 | 1.4 |
| 2 | 98 | 97.4 | 1.8 |
| 3 | 147 | 166.5 | 2.0 |

Cohesion Intercept (C'), kPa : 0

Angle of Internal friction (Φ') : 38°




For and on behalf of MatterLab

**Comments:**

*Information provided by client

Material tested was passing 4.75 mm test sieve, recompacted at maximum achievable density and moisture content

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# SHEAR STRENGTH TEST REPORT

Report No: ML23/R-02166/A
Issue No : 1
Report Date: 04/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Karaimat Building, Kaneyannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkunnoolu, Kayamkulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 04/06/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 1.50m |
| Work Order ID: | ML23/W-02166 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02166/02 | Source* | BH 01, Depth 1.50m |
| Date Sampled: | 13/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(Kg): | 5 Approx |
| Sample Location:* | Marikkunnoolu, Kayamkulam | Date Tested : | 27/06/2023 - 28/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab - Kozhikode | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 1.50m |
| Tested By: | DK | Client Sample Desc.: | Soil (UDS-1), BH 01, Depth 1.50m |

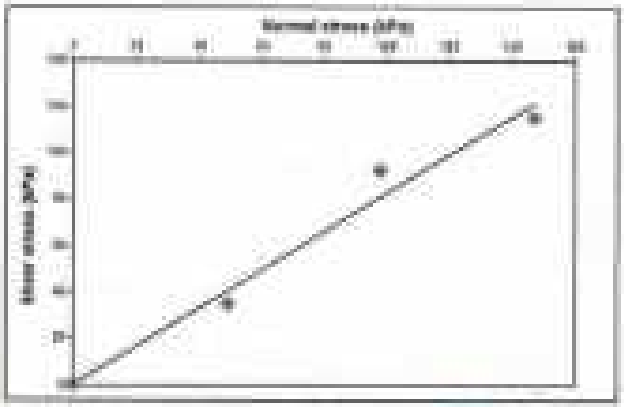
**Test Results** — Method: IS 2720 (Part-13)-1986

| | |
|---|---|
| Area of specimen (cm²) | 36 |
| Height of specimen (mm) | 20 |
| Rate of strain (mm/min) | 1.25 |
| Test Condition | Unconsolidated Drained |
| Bulk Density (Mg/m³) | 1.79 |
| Moisture content (%) | 8.0 |
| Dry Density (Mg/m³) | 1.66 |

| Load Increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Stress (mm) |
|---|---|---|---|
| 1 | 49 | 34.9 | 1.8 |
| 2 | 98 | 82.8 | 2.2 |
| 3 | 147 | 118.4 | 1.4 |

Cohesion Intercept (C'), kPa: 0

Angle of Internal Friction (ϕ'): 38°




For and on behalf of MatterLab

**Comments**

*Information provided by client.

Material tested was passing 4.75 mm test sieve, recompacted at maximum achievable density and moisture content

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Kozhikode, Kerala, 673029.

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/W-02198/02
Issue No: 1
Report Date: 24/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayan Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628003 |
| Contact: | Mr. Renjith Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Mankkumoodu, Kayamkulam |
| Tel / Email: | - |

ULR-TC702Xg Z 5 6 8 0 0 4 8 1 5 F

## Sample Details

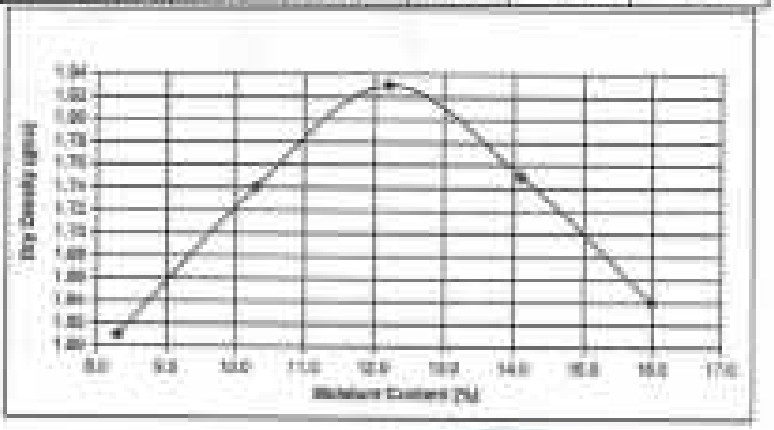
| | | | |
|---|---|---|---|
| Received Date: | 24/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 2.00m |
| Work Order ID: | ML23/W-02198 | Sample Submitted By*: | Geotechnical Division |
| Sample ID: | ML23/W-02198/03 | Source*: | BH 01, Depth 2.00m |
| Date Sampled: | 13/06/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Mankkumoodu, Kayamkulam | Date Tested : | 26/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 2.00m |
| Tested By: | GK | Client Sample Desc.: | Soil, BH 01, Depth 2.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Mould volume | $V_m$ (cm³) | 1000 | | | | |
|---|---|---|---|---|---|---|
| Test No: | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | $W_m$ (g) | 4353 | | | | |
| Mass of mould + compacted sample | W (g) | 5930 | 5979 | 6139 | 6099 | 5992 |
| Mass of sample | | 1737 | 1816 | 2046 | 1906 | 1839 |
| Wet density | $\rho = W/V_m$ | $\rho_w$ (kg/m³) | 1.74 | 1.82 | 2.05 | 2.00 | 1.84 |
| Mass of wet sample | | $W_w$ | 422.8 | 447.4 | 433.7 | 433.4 | 433.0 |
| Mass of dry sample | | $W_d$ | 392.4 | 405.6 | 386.0 | 379.8 | 379.8 |
| Moisture content | $w = (W_w/W_d)*100$ | w (%) | 8.3 | 10.3 | 12.3 | 14.1 | 15.0 |
| Dry density | $\rho_d = \rho/(1+w/100)$ | $\rho_d$ (kg/m³) | 1.61 | 1.74 | 1.83 | 1.76 | 1.64 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc | 1.83 |
| Optimum moisture content, % | 12 |
| Material retained on 20mm, % | 0 |
| Sample used | Single |
| Size of mould | 1000cm³ |
| Weight of rammer | 2.6 kg |




For and on behalf of MatterLab

## Comments

Information provided by client

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Kozhikode, Kerala, 673028.

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/W-02188/1
Issue No.: 1
Report Date: 04/07/2023

| | |
|---|---|
| Client: | IRE Global |
| Address: | Kaveradi Building, Kanapan Kaveradi Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkumoodu, Kayamkulam |
| Tel / Email: | - |

**Sample Details**

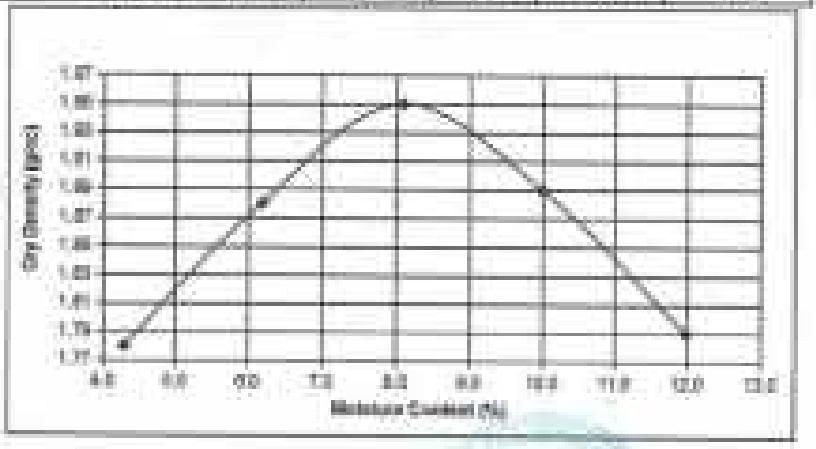
| | | | |
|---|---|---|---|
| Received Date: | 24/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 4.50m |
| Work Order ID: | ML23/W-02188 | Sample Submitted By*: | Geotechnical Division |
| Sample ID: | ML23/W-02188/S6 | Source*: | BH 01, Depth 4.50m |
| Date Sampled: | 13/06/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Marikkumoodu, Kayamkulam | Date Tested :- | 26/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 4.50m |
| Tested By: | GK | Client Sample Desc.: | Soil, BH 01, Depth 4.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ cm³ | 958 | | | | |
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4063 | | | | |
| Mass of mould + compacted sample | | W (g) | 5919 | 6059 | 6199 | 6139 | 6059 |
| Mass of sample | | | 1856 | 1996 | 2136 | 2076 | 1996 |
| Wet density | $(W-W_m)/V_m$ | $\gamma_b$ (Mg/m³) | 1.88 | 2.00 | 2.11 | 2.08 | 2.00 |
| Mass of wet sample | | $W_1$ | 407.7 | 403.0 | 443.8 | 440.1 | 416.4 |
| Mass of dry sample | | $W_2$ | 390.9 | 379.8 | 410.4 | 400.1 | 371.8 |
| Moisture content | $(W_1-W_2)/W_2)x100$ | w (%) | 4.3 | 6.2 | 8.1 | 10.0 | 12.0 |
| Dry density | $\gamma_b/(1+w/100)$ | $\gamma_d$ (Mg/m³) | 1.79 | 1.88 | 1.95 | 1.89 | 1.79 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc | 1.95 |
| Optimum moisture content, % | 8.1 |
| Material retained on 20mm,% | 0 |
| Sample used | Single |
| Size of mould | 1000cm³ |
| Weight of rammer | 2.6 kg |




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TC-10748

## Water Content of Soil Test Report

Report No: ML23/W-02158r2
Issue No: 1
Report Date: 01/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanad Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628008 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkunnoodu, Kayamkulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 20/07/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 1.50m |
| Work Order ID: | ML23/W-02158 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02158/52 | Source*: | BH 01, Depth 1.50m |
| Date Sampled: | 13/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Marikkunnoodu, Kayamkulam | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 1.50m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 1.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 8.0 | - |

SREELESH T.V
Head - Civil Department

For and on behalf of Matter Lab

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# Water Content of Soil Test Report

Report No: ML23R-021888/1
Issue No: 1
Report Date:01/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayancoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkunnoodu, Kayamkulam |
| Tel / Email: | - |

QLR-IC/ML23R2388888888F

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 28/07/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02188 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-021888/8 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 13/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | ≥ Approx |
| Sample Location*: | Marikkunnoodu, Kayamkulam | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 3.50m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-3), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (wc) % | 8.1 | - |

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Head-Civil Laboratory

For and on behalf of Matter Lab

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# TEST REPORT

Report No: ML23/R-02188/14
Issue No : 1
Report Date:01/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranajoy Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkumoodu, Kayamkulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 1.50m |
| Work Order ID: | ML23/W-02188 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02188/02 | Source*: | BH 01, Depth 1.50m |
| Date Sampled: | 13/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Marikkumoodu, Kayamkulam | Date Tested: : | 25/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 1.50m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 1.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 1.79 | - |
| | Dry Density,g/cc | 1.69 | - |

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Head-Civil Laboratory

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# TEST REPORT

Report No: ML23/W-02168/02
Issue No: 1
Report Date: 01/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ramdas Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkunnoolu, Kayamkulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02168 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02168/05 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 13/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 6 Approx |
| Sample Location: | Marikkunnoolu, Kayamkulam | Date Tested: | 29/07/2023 - 30/07/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 3.50m |
| Tested By: | DR. | Client Sample Desc.*: | Soil (UDS-3), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 2.00 | - |
| | Dry Density g/cc | 1.96 | - |

SREELESH T.V
Head-Civil Laboratory

For and on behalf of MatterLab

Comments:
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Page 1 of 1
End of test

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# Chemical Test Report of Soil

Report No: ML23/R-02574/2
Issue No: 1
Report Date: 06/10/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building,Kanayannoor Village,Kochanad,Ernakulam,Kerala - 628030 |
| Contact: | Mr.Ranabir Dey |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Owner: | KSWMP |
| Project Location: | Kayamkulam |
| Tel No: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 12/07/2023 | Client Sample ID:* | Soil and Rock |
| Work Order ID: | ML23/W-02574 | Source:* | Borehole - 1 |
| Sample ID: | ML23/W-02574/01 | Sampled By: | Geotechnical Division |
| Date Sampled: | 10/08/2023 | Date Tested: | 13/08/23 - 20/08/23 |
| Tested By: | MatterLab,Kozhikode | Test Method Variation: | None |
| Sample Location: | Markkumoodu Kayamkulam | | |

## CHEMICAL ANALYSIS - Test Method:IS 2720:2021 & CPHEEO Manual

| Test/Parameters | Units | Results |
|---|---|---|
| pH Value | - | 8.09 |
| Electrical Conductivity | mS/cm | 0.673 |
| Nitrogen (N) | % | 0.33 |
| Phosphorus (P) | % | 0.02 |
| Potassium (K) | % | 0.06 |
| Carbon | % | 1.52 |
| Carbon / Nitrogen Ratio | % | 8.61 |
| Biodegradable Factor | % | < 0.1 |
| **HEAVY METALS - Test Method: EPA 3050 (ICP OES)** | | |
| Arsenic (As) | mg/Kg | 4.0 |
| Cadmium (Cd) | mg/Kg | < 5.0 |
| Chromium (Cr) | mg/Kg | 134.6 |
| Copper (Cu) | mg/Kg | 18.9 |
| Lead (Pb) | mg/Kg | 24.9 |
| Nickel (Ni) | mg/Kg | 11.0 |
| Zinc (Zn) | mg/Kg | 282.9 |
| Mercury (Hg) | mg/Kg | < 0.1 |

ANWAR, P
Lab Manager-Chemistry

For and on behalf of Matter Lab

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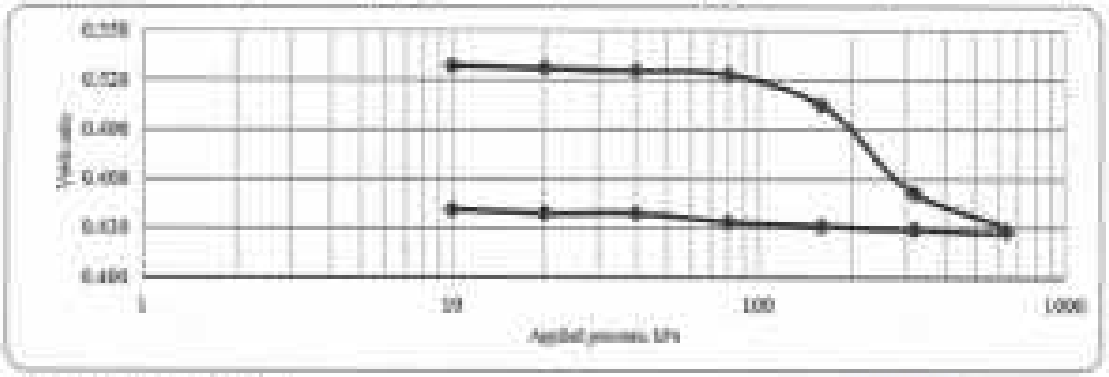
# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | | | |
|---|---|---|---|
| Date Received | 24/06/2023 | Report No. | ML23/R-S2168/S |
| Date Reported | 16/08/2023 | Client Ref. | Soil (UDS-1), BH 01, Depth 1.50m |

| | | | |
|---|---|---|---|
| Client | SPE Global | | |
| Adress | Kaveriatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 | | |
| Contact | Mr. Ranabir Dey | | |
| Project Number | - | | |
| Project Name | Geotechnical Investigation at Dumpsite in Kayamkulam | | |
| Consultant | - | | |
| Owner | KSWMP | | |
| Source* | BH 01, Depth 1.50m | Client Sample Ref*. | Soil (UDS-1), BH 01, Depth 1.50m |
| Sampled by | Geotechnical Division | Date Tested | 31/07/2023 - 10/08/2023 |
| Test Method | IS : 2720 ( Part 15 ) - 1986 | Test Location | MatterLab - Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | ML23/W-S2168/S2 | Initial diameter (mm) | 60 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Mankkumoodu, Kayamkulam |
| Initial voids ratio | 0.529 | Dry Density (Mg/m$^3$) | 1.701 |
| Moisture content (%) | 9.1 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 10 | 0.529 | 1356.13 | 0.050 |
| 20 | 0.527 | 525.94 | 0.100 |
| 40 | 0.525 | 527.88 | 0.050 |
| 80 | 0.523 | 526.56 | 0.038 |
| 160 | 0.504 | 519.45 | 0.151 |
| 320 | 0.451 | 495.06 | 0.272 |
| 640 | 0.428 | 104.04 | 0.049 |



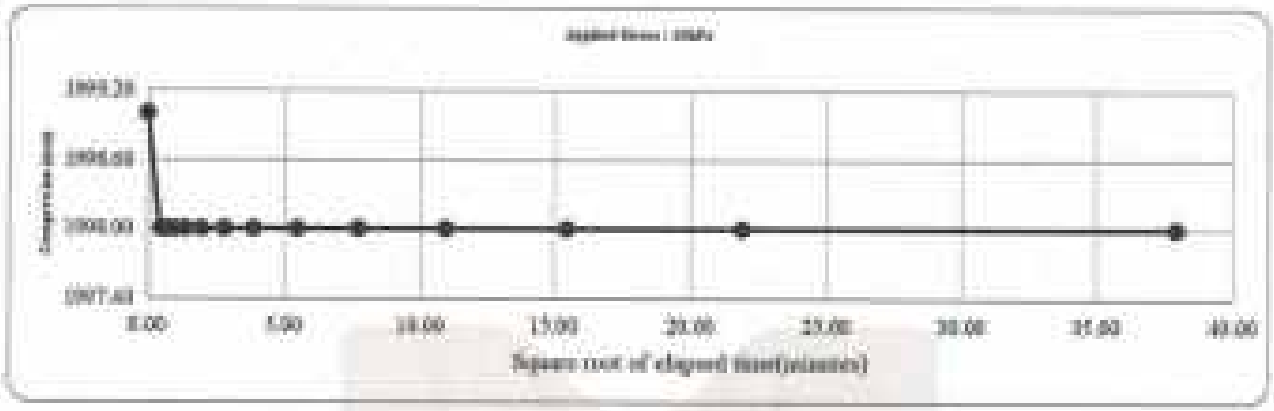

Preconsolidation Pressure: 160 kPa
Compression Index, $C_c$: 0.18
Recompression Index, $C_r$: 0.01

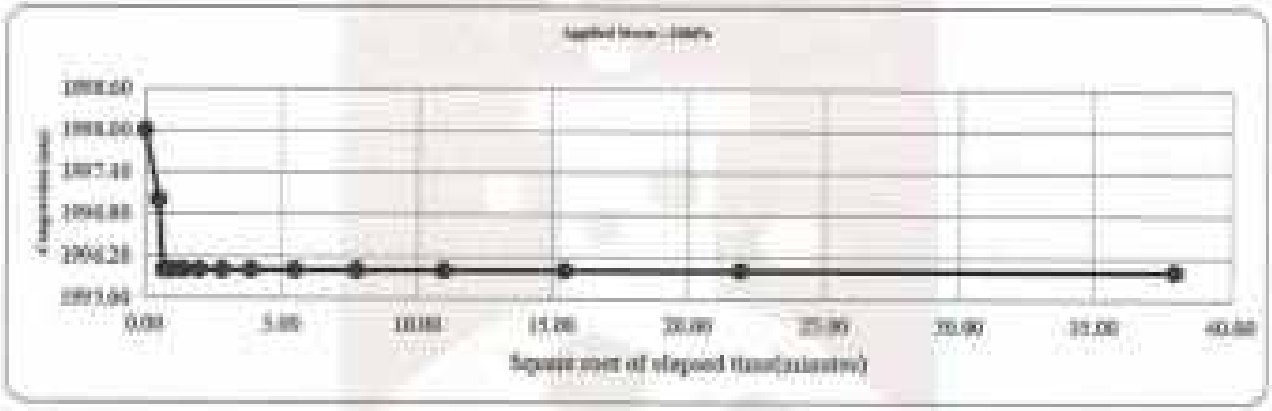
Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 3 of 3 & 4 of 3)
*Information provided by client

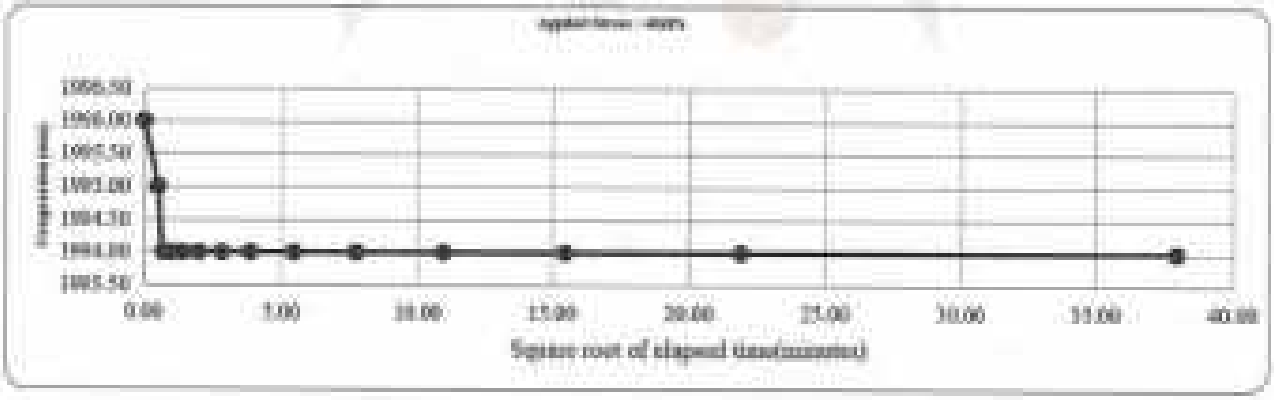


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Compression Vs square root of time curves



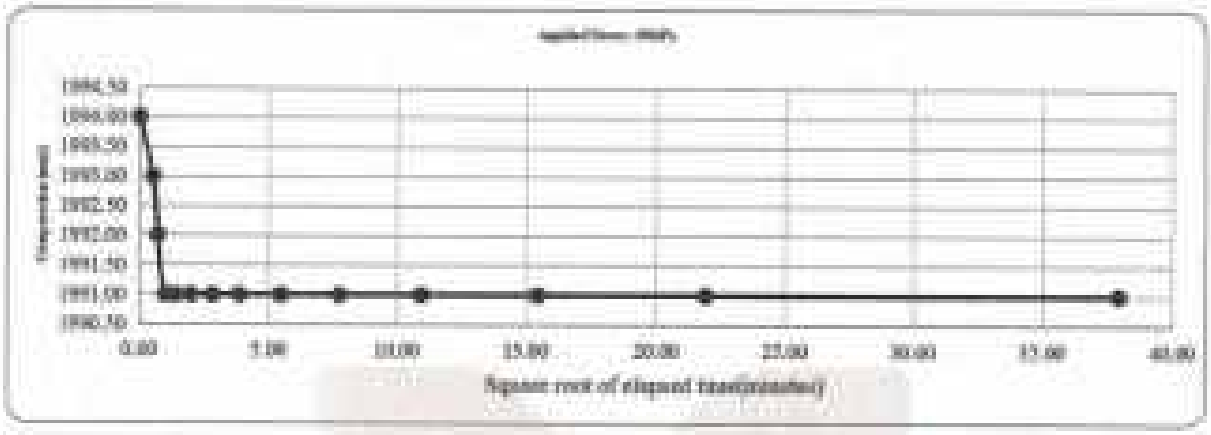



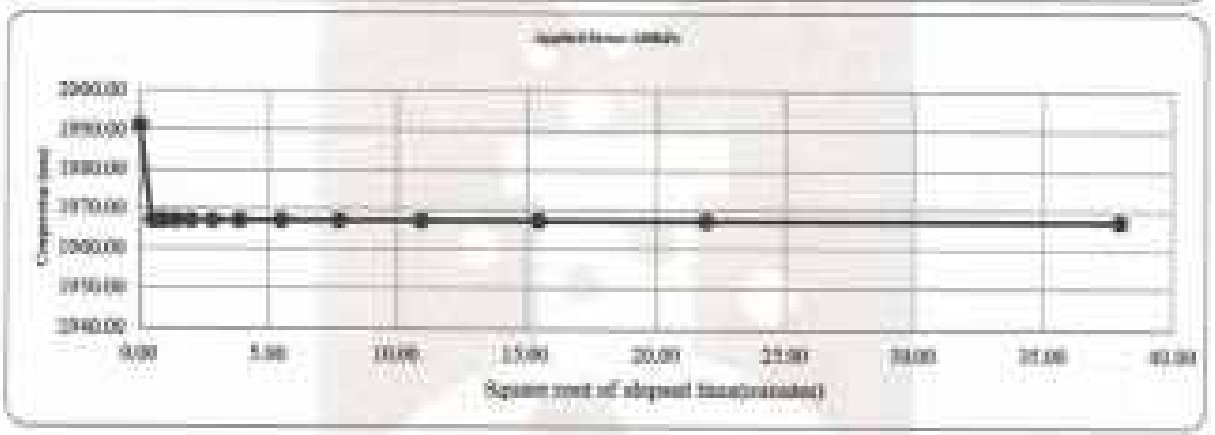



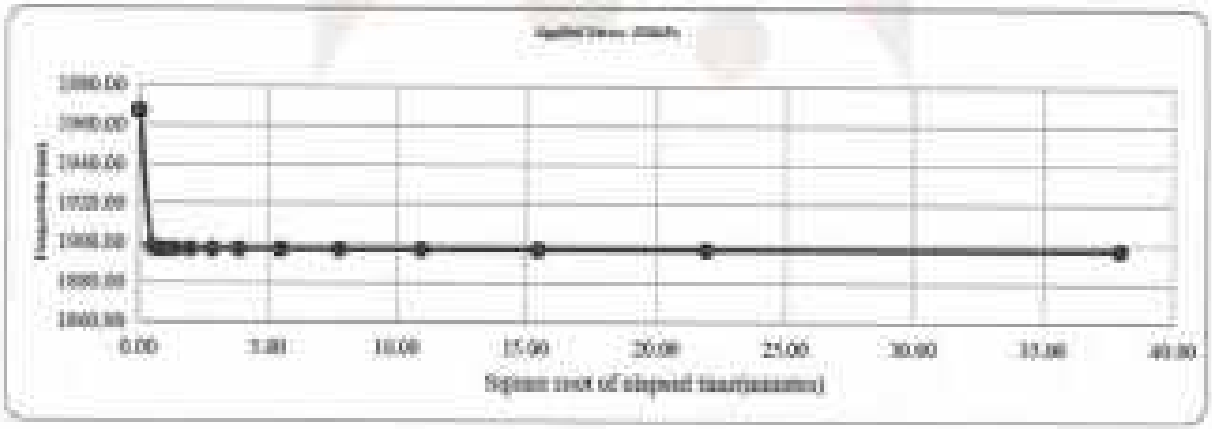
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**Compression Vs square root of time curves**



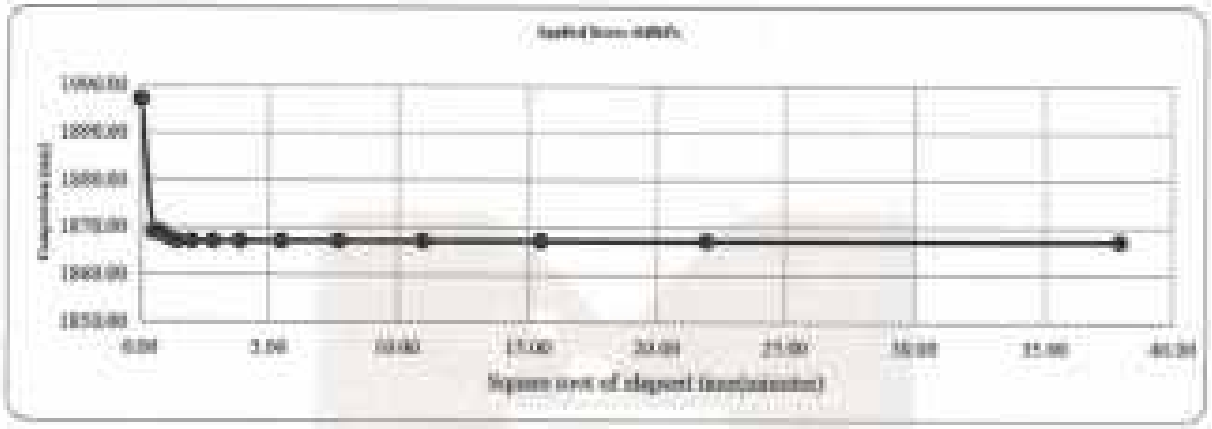



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**Compression Vs square root of time curves**




SREELESH T.V
Head - Soil Laboratory

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End of test

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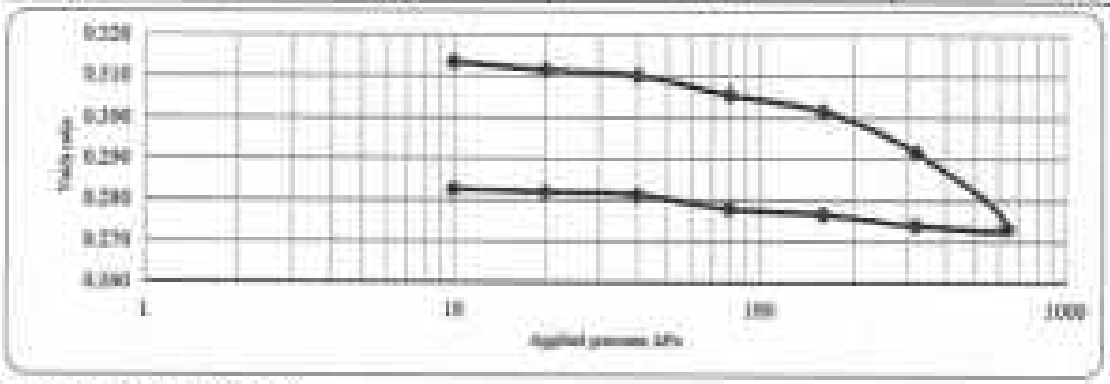
# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | | | |
|---|---|---|---|
| Date Received | 24/08/2023 | Report No. | ML23/R-02168/17 |
| Date Reported | 16/09/2023 | Client Ref. | Soil (UDS-3), BH 01, Depth 3.50m |

| | | | |
|---|---|---|---|
| Client | IPE Global | | |
| Adress | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 626030 | | |
| Contact | Mr. Ranadip Dey | | |
| Project Number | - | | |
| Project Name | Geotechnical Investigation at Dumpsite in Kayamkulam | | |
| Consultant | - | | |
| Owner | KSWMP | | |
| Source* | BH 01, Depth 3.50m | Client Sample Ref*. | Soil (UDS-3), BH 01, Depth 3.50m |
| Sampled by | Geotechnical Division | Date Tested | 31/07/2023 - 10/08/2023 |
| Test Method | IS : 2720 ( Part 15 ) - 1986 | Test Location | MatterLab - Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | ML23/W-02168/55 | Initial diameter (mm) | 60 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Marikkumoodu, Kayamkulam |
| Initial voids ratio | 0.315 | Dry Density (Mg/m$^3$) | 1.684 |
| Moisture content (%) | 8.1 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 10 | 0.313 | 1384.77 | 0.150 |
| 20 | 0.311 | 937.99 | 0.150 |
| 40 | 0.310 | 528.30 | 0.060 |
| 80 | 0.306 | 171.08 | 0.068 |
| 160 | 0.301 | 169.98 | 0.038 |
| 320 | 0.292 | 82.31 | 0.047 |
| 640 | 0.273 | 135.96 | 0.045 |




Preconsolidation Pressure: 221 kPa
Compression Index, $C_c$: 0.05
Recompression Index, $C_r$: 0.01

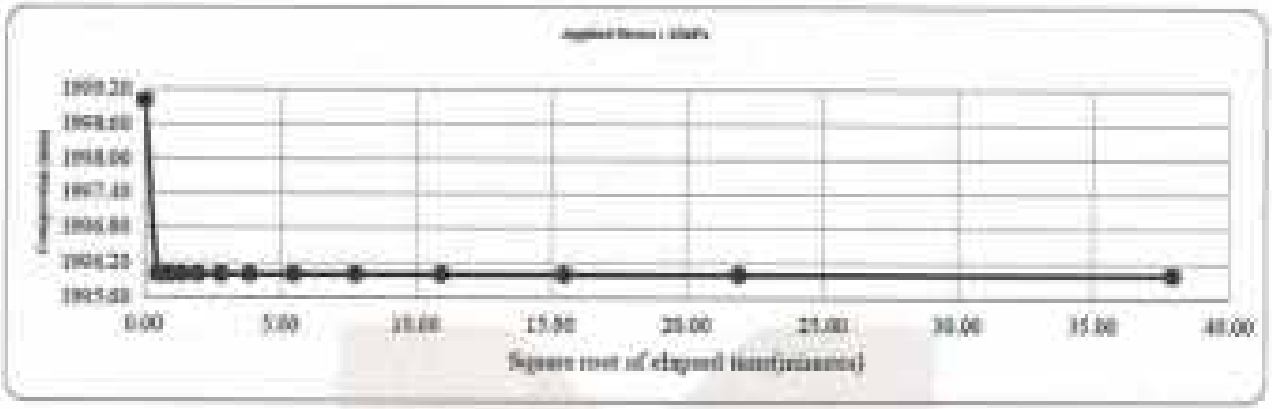
Sheet 1 of 4

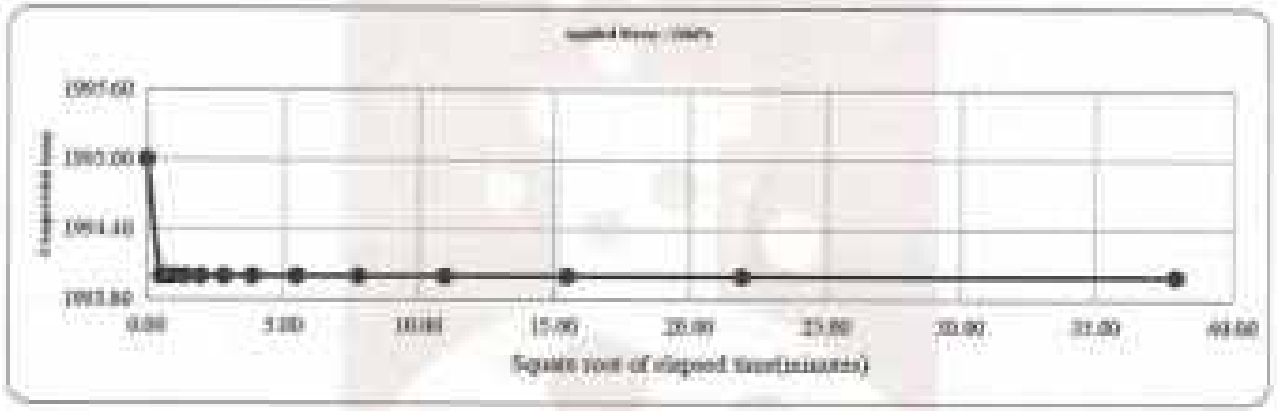
Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 2 of 5 & 3 of 5)
*Information provided by client

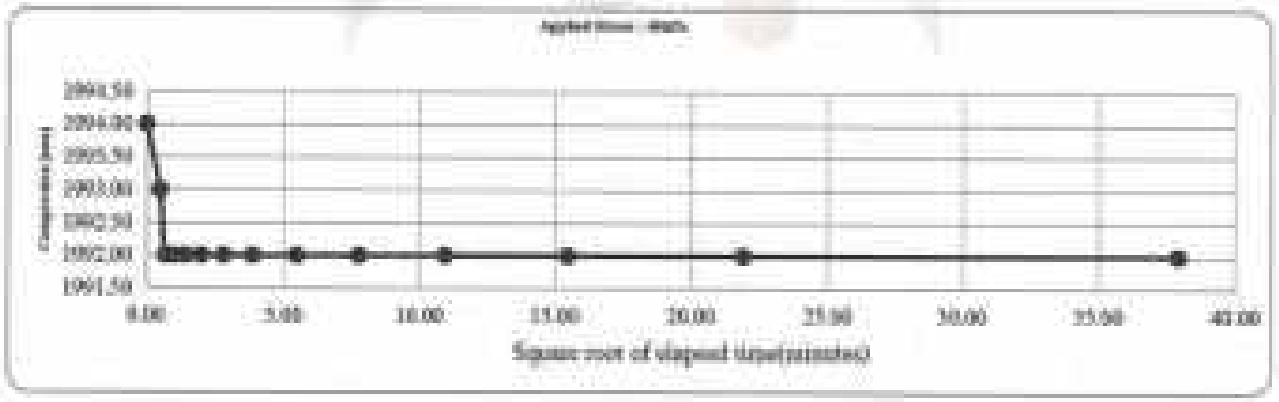
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Compression Vs square root of time curves



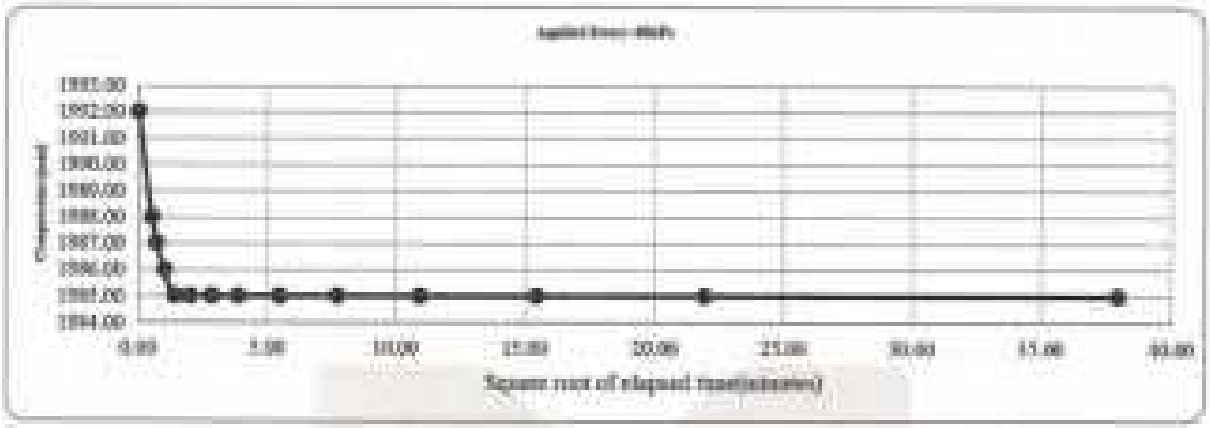



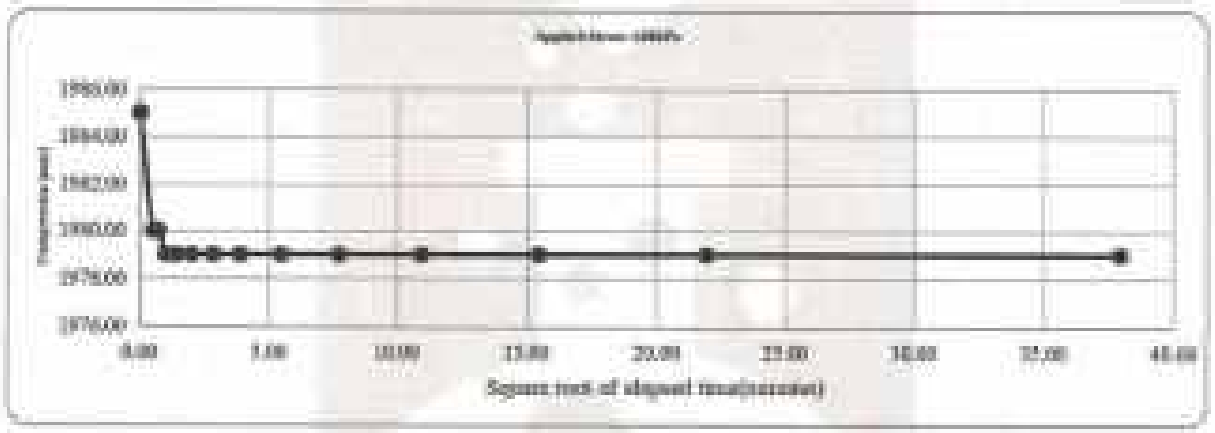


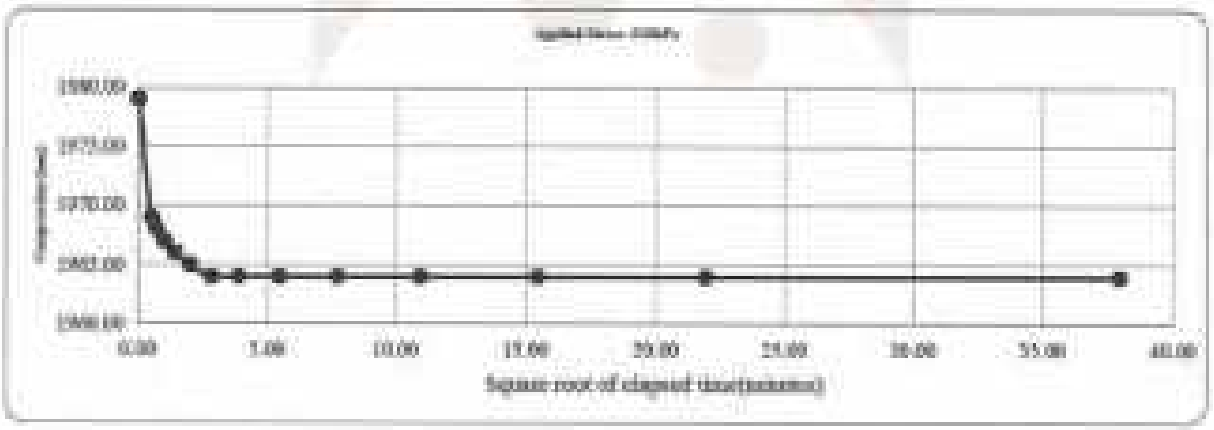

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Thiruvannur, Kozhikode, Kerala, 673029

Compressive Vs square root of time curve



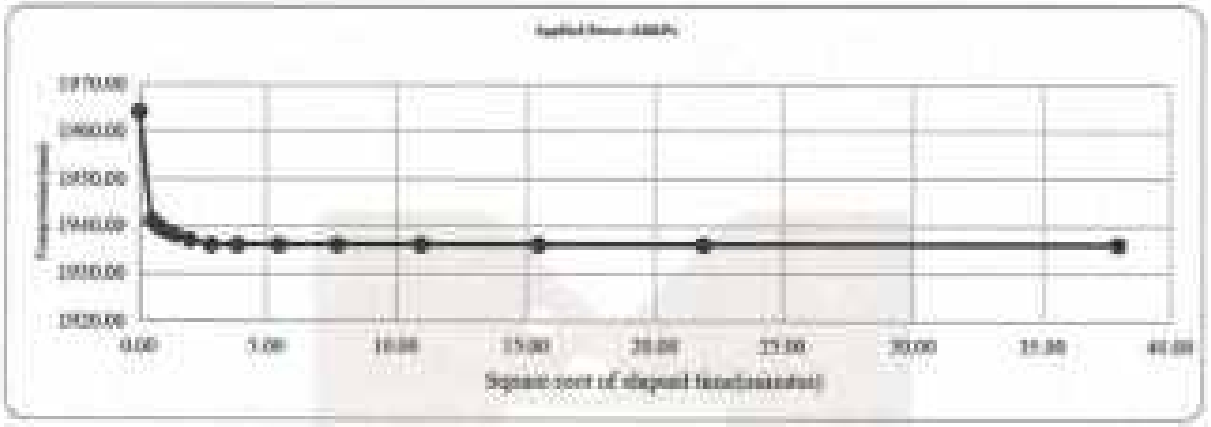



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Compression Vs square root of time curves




SREELESH T.V
Head-Skill Laboratory

For and on behalf of Matter Lab

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# Size Distribution of Solid Waste - Test Report

Report No: ML23/R-02166/18
Issue No.: 1
Report Date: 19/06/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavarattl Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628000 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kayamkulam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Marikkumoodu, Kayamkulam |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 10/06/2023 | **Client Sample Ref.*:** | MSW |
| **Work Order ID:** | ML23/W-02166 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02166/S8 | **Source*:** | - |
| **Date Sampled:** | 10/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | - | **Sample Size(kg):** | 15 Approx |
| **Sample Location*:** | Marikkumoodu, Kayamkulam | **Date Tested :** | 19/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | MSW |
| **Tested By:** | GK | **Client Sample Desc.*:** | MSW |
| **Test Location:** | MatterLab - Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4)-1985

| Sieve Size (mm) | % Retained |
|---|---|
| 80.0 | 16.5 |
| 37.5 | 16.4 |
| 10.0 | 23.5 |
| 4.0 | 24.7 |
| Passing | 18.9 |

For and on behalf of MatterLab

**Comments**

*Information provided by client

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# Field Density (Core-Cutter Method) of Solid Waste - Test Report

Report No: ML23/R-02188/19
Issue No: : 1
Report Date: 19/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkumoodu, Kayamkulam |
| Tel / Email: | - |

**Test Results:**

| | | | |
|---|---|---|---|
| Date Recieved: | 10/09/2023 | Client Ref:* | - |
| Work Order ID: | ML23/W-03188 | Layer | - |
| Sample ID: | ML23/W-02188/SS (1-2) | Depth of test (mm): | - |
| Sample Description: | MSW | Date Tested | 10/09/2023 - 11/09/2023 |
| Source* | - | Tested By | GK |
| Location* | Marikkumoodu, Kayamkulam | Method Variation | None |
| Test Methods : | IS 2720 : Part 28 : 1975-(DRY DENSITY OF SOILS IN PLACE BY THE CORE-CUTTER METHOD)<br>IS 2720 : Part 2 : 1973 -(DETERMINATION OF WATER CONTENT) | | |

| Test No. | 1 | 2 |
|---|---|---|
| Sample ID | SS-1 | SS-2 |
| Test Location | Marikkumoodu, Kayamkulam | |
| Weight of wet Material (g) | 1206 | 1260 |
| Volume of core-cutter ($cm^3$) | 992 | 1008 |
| In-situ Bulk Density ($g/cm^3$) | 1.21 | 1.25 |
| In-situ Water Content (%) | 24 | 23 |
| In-situ Dry Density ($g/cm^3$) | 0.97 | 1.02 |

SREELESH T.V
Civil Laboratory

For and on behalf of MatterLab

**Comments:**
*Informations provided by client

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Thiruvennur, Kozhikode, Kerala, 673029

# Moisture Content of Waste Test Report

Report No: ML23/R-02168/23
Issue No: 1
Report Date: 19/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Mankkumoodu, Kayamkulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 10/08/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-02168 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02168/S8 | Source*: | - |
| Date Sampled: | 10/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 15 Approx |
| Sample Location*: | Mankkumoodu, Kayamkulam | Date Tested: | 14/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GK | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Moisture Content, % | 20 | - |

SREELESH TV
Field Civil Laboratory

For and on behalf of Matter Lab

## Comments

*Information provided by client

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# Solid Waste - Test Report

Report No: ML22/W-02188/01
Issue No: 1
Report Date: 19/08/2022

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Renatte Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkunnoodu, Kayamkulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 19/08/2022 | Client Sample Ref.*): | MSW |
| Work Order ID: | ML22/W-02188 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML22/W-02188/S8 | Source*): | - |
| Date Sampled: | 19/08/2022 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 10 Approx |
| Sample Location*: | Marikkunnoodu, Kayamkulam | Date Tested : | 19/08/2022 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GK | Client Sample Desc.*): | MSW |
| Test Location: | Mattertab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Waste Materials retained on | | | |
|---|---|---|---|---|---|
| | | 80 mm | 37.5 mm | 10 mm | 4 mm |
| CPHEEO (2000) | Percentage of Plastic Waste, % | 81.2 | 23.3 | 30.9 | Nil |
| | Percentage of Cloth Waste, % | 2.2 | Nil | Nil | Nil |
| | Percentage of Glass Waste, % | Nil | Nil | 3.8 | Nil |
| | Percentage of Wood Waste, % | Nil | Nil | Nil | Nil |
| | Percentage of Construction Debris, % | 16.6 | 30 | Nil | Nil |
| | Percentage of Bio Fraction, % | Nil | Nil | Nil | Nil |
| | Percentage of Gravel, % | Nil | 46.7 | 65.3 | 100 |
| | Rubber, % | Nil | Nil | Nil | Nil |
| | Metals, % | 0.0 | 0.0 | Nil | Nil |

SREELESH T.V
Chief Laboratory

For and on behalf of Matter Lab

**Comments**

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# Solid Waste - Test Report

Report No: ML23/R-02188/22
Issue No : 1
Report Date: 19/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanapanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkumoodu, Kayamkulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 10/08/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-02188 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02188/S8 | Source*: | - |
| Date Sampled: | 10/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 15 Approx |
| Sample Location*: | Marikkumoodu, Kayamkulam | Date Tested : | 14/08/2023 - 15/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GK | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | TestParameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Silt & Clay, % | 14 | - |

SREELESH TV
Chemical Laboratory

For and on behalf of Matter Lab

## Comments

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Thiruvannur, Kozhikode, Kerala, 673028

# Solid Waste Size Analysis - Test Report

Report No: ML23/W-02188/23
Issue No : 1
Report Date:19/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranajoy Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kayamkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Marikkunnoodu, Kayamkulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 10/05/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-02188 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02188/S8 | Source*: | - |
| Date Sampled: | 10/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 10 Approx |
| Sample Location*: | Marikkunnoodu, Kayamkulam | Date Tested: | 14/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | MV | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results** — Test Method: CP16200 - 3000

| Type of Waste Material | 80 mm | | 37.5 mm | | 19 mm | |
|---|---|---|---|---|---|---|
| | Minimum Size of a Single Waste Material, $m^2$ | Maximum Size of a Single Waste Material, $m^2$ | Minimum Size of a Single Waste Material, $m^2$ | Maximum Size of a Single Waste Material, $m^2$ | Minimum Size of a Single Waste Material, $m^2$ | Maximum Size of a Single Waste Material, $m^2$ |
| Plastic Waste | 0.4524 | 1.0002 | 0.0098 | 0.2709 | 0.0149 | 0.0876 |
| Cloth Waste | 0.2480 | 0.3488 | - | - | - | - |
| Glass Waste | - | - | - | - | 0.0011 | 0.0270 |
| Construction Debris | 0.7288 | 0.0714 | 0.1443 | 0.3380 | - | - |
| Metals | 0.0154** | | 0.0089 | 0.0154 | - | - |

For and on behalf of Matter Lab

**Comments**

*Information provided by client

** Only one piece of metals included in the waste composite

Page 1 of 1
End of test

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## TEST REPORT



**Ref.No: PL/RT/SW/1455/2023** **Date of Issue: 28/06/2023**

(ULR NO:TC658923000000001455F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water
Sample Location : Kayamkulam- Murikkummoodu
Gps Reading : N- 09°10'24.29"
E -76°31'24.07"

Sample code : F/1455/2023
Date of Sample Collected : 20/06/2023
Date of receipt of sample : 21/06/2023
Date of analysis started : 21/06/2023
Date of completion of analysis : 28/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 –1983RA2017 | 6.35 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 –1983RA2017 | 250 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 46.8 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 290 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 174 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 58 mg/l | --- | -- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 101 mg/l | 200 mg/l | -- |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 64 mg/l | -- | -- |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 34.71 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 25.98 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 –1989RA2014 | 2.8 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 5.51 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 1.37 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.5 mg/l | 1.5 mg/l |

Conti...

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

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Continuation of Test Certificate No: 1455/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 300 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | --- | --- |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/SW/5284/2023**

**Date of Issue: 28/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water
Sample Location : Kayamkulam- Murikkummoodu
Gps Reading : N- 09°10'24.29"
E -76°31'24.07"

Sample code : F/5284/2023
Date of Sample Collected : 20/06/2023
Date of receipt of sample : 21/06/2023
Date of analysis started : 21/06/2023
Date of completion of analysis : 28/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | --- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | --- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27$^0$ C ) | IS 3025 (P) 44 -1993RA2014 | 6.3 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 12 mg/l | --- | -- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 4.5 mg/l | --- | -- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
SREEJA RAMESH
QUALITY MANAGER

*End of the report*

...shall be analysed for analysis. This test report shall

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**TEST REPORT** 

| **Client Name & Address** | **Certificate No:** | **PL/RT/5286/2023** |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 28/06/2023 |
| | Date of monitoring | 20/06/2023 |
| | Date of sample received: | 21/06/2023 |
| | Date of analysis | 21/06/2023 |
| | Sample Description | Waste Analysis - Kayamkulam-Murikkummoodu |
| | Sample Location | Gps Reading : : N-09 °10'24.183" E -76°31'19.261" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 46.3 |
| 02 | Bulk Density | | | USEPA | $kg/m^3$ | 546 |
| 03 | Density | | | USEPA | $g/cm^3$ | 0.4875 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 2574 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 4.75 | 4 + | | | 100 |

* End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD.

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

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ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5285/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 28/06/2023 |
| | Date of monitoring | 20/06/2023 |
| | Date of sample received: | 21/06/2023 |
| | Date of analysis | 21/06/2023 |
| | Sample Description | Waste Analysis - Kayamkulam-Murikkummoodu |
| | Sample Location | GPS Reading : N- 09 °10'24.347" E -76°31'19.024" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 41.3 |
| 02 | Bulk Density | | | USEPA | $kg/m^3$ | 501 |
| 03 | Density | | | USEPA | $g/cm^3$ | 0.4845 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 2754 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 4.75 | 4 + | | | 100 |

* End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD.

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

# POLUCHEM LABORATORIES PVT LTD

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

Phone: 0484-2544030, 8281982322, 9747400085. www.poluchem.com, poluchem@gmail.com

TC-6569

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/154/2023 (ULR NO:TC658923000000000154F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 28/06/2023 |
| | Date of monitoring | 20/06/2023 |
| | Date of sample received | 21/06/2023 |
| | Date of analysis Started | 21/06/2023 |
| | Sample description | Ambient air –Kayamkulam-Murikkummoodu |
| | Sample Code | G/F/154/2023 |
| | Sample Location | GPS Reading : N- 09 °10'24.126"<br>E -76°31'17.392" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 64.2 $\mu g/m^3$ | 100 $\mu g/m^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 27.8$\mu g/m^3$ | 60 $\mu g/m^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 6.4 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 9.3 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 1.1 $mg/m^3$ | 4 $mg/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5277/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 28/06/2023 |
| | Date of monitoring | 20/06/2023 |
| | Date of sample received | 21/06/2023 |
| | Date of analysis Started | 21/06/2023 |
| | Sample description | Ambient air –Kayamkulam-Murikkummoodu |
| | Sample Code | G/F/5277/2023 |
| | Sample Location | GPS Reading : N- 09 °10'24.126"<br>E -76°31'17.392" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | <1 $\mu g/m^3$ | 400 $\mu g/m^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 $\mu g/m^3$ | 1 $\mu g/m^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 6 $ng/m^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 20 $ng/m^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 $\mu g/m^3$ | 180 $\mu g/m^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 $\mu g/m^3$ | 5 $\mu g/m^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 $ng/m^3$ | 1 $ng/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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SREEJA RAMESH
QUALITY MANAGER

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5287/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 28/06/2023 |
| | Date of monitoring | 20/06/2023 |
| | Date of sample received: | 21/06/2023 |
| | Date of analysis | 21/06/2023 |
| | Sample Description | Waste Analysis –Kayamkulam-Murikkummoodu |
| | Sample Location | Gps Reading : : N- 09 °10'24.347"<br>E -76°31'19.024" |

**CHEMICAL PARAMETERS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 7.72 |
| 02 | Biodegradable Factor | USEPA | % | 2.3 |
| 03 | Total carbon | USEPA 9060A | % | 3.8 |
| 04 | Phosphorus(P) | USEPA | % | 0.018 |
| 05 | Nitrogen(N) | USEPA | % | 0.21 |
| 07 | Potassium(K) | USEPA | % | 0.017 |
| 08 | C/N Ratio | USEPA | .. | 18:1 |
| 09 | Calorific Value | ASTM D 5865 | K.cal/kg | 2867 |

-Conti.....

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**TEST REPORT** 

| **Client Name & Address** | **Certificate No:** | **PL/RT/5287/2023** |
|---|---|---|
| M/s. IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 28/06/2023 |
| | Date of monitoring | 20/06/2023 |
| | Date of sample received: | 21/06/2023 |
| | Date of analysis | 21/06/2023 |
| | Sample Description | Waste Analysis –Kayamkulam-Murikkummoodu |
| | Sample Location | Gps Reading : : N- 09°10'24.347"<br>E -76°31'19.024" |

**TOXICITY ANALYSIS- HEAVY METALS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 10 | Iron (Fe) | USEPA 3050 | % | 1.8 |
| 11 | Arsenic(As) | USEPA 3050 | mg/kg | <0.1 |
| 12 | Selenium(Se) | USEPA 3050 | mg/kg | <0.1 |
| 13 | Nickel(Ni) | USEPA 3050 | mg/kg | <0.1 |
| 14 | Zinc (Zn) | USEPA 3050 | mg/kg | 24.5 |
| 15 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 |
| 16 | Copper (Cu) | USEPA 3050 | mg/kg | 3.86 |
| 17 | Chromium(Cr) | USEPA 3050 | mg/kg | 6.5 |
| 18 | Lead(Pb) | USEPA 3050 | mg/kg | 16.1 |
| 19 | Mercury(Hg) | USEPA 3050 | mg/kg | <0.1 |
| 20 | Manganese(Mn) | USEPA 3050 | mg/kg | 97.4 |

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For and on behalf of
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SREEJA RAMESH
AUTHORIZED SIGNATORY

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/155/2023 (ULR NO:TC658923000000155F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 28/06/2023 |
| | Date of monitoring | 20/06/2023 |
| | Date of sample received | 21/06/2023 |
| | Date of analysis Started | 21/06/2023 |
| | Sample description | Ambient air –Kayamkulam-Murikkummoodu |
| | Sample Code | G/F/155/2023 |
| | Sample Location | GPS Reading : N- 09 °10'23.94"<br>E -76°31'17.945" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 74.4µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 25.1µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 6.2 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 8.7 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 1.0 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

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POLUCHEM LABORATORIES (P) LTD

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5278/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 28/06/2023 |
| | Date of monitoring | 20/06/2023 |
| | Date of sample received | 21/06/2023 |
| | Date of analysis Started | 21/06/2023 |
| | Sample description | Ambient air –Kayamkulam-Murikkummoodu |
| | Sample Code | G/F/5278/2023 |
| | Sample Location | GPS Reading : N- 09°10'23.94"<br>E -76°31'17.945" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 $\mu g/m^3$ | 400 $\mu g/m^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 $\mu g/m^3$ | 1 $\mu g/m^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 6 $ng/m^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 20 $ng/m^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 $\mu g/m^3$ | 180 $\mu g/m^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 $\mu g/m^3$ | 5 $\mu g/m^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 $ng/m^3$ | 1 $ng/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
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## TEST REPORT



**Ref.No: PL/RT/5283/2023** **Date of Issue: 28/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Leachate
Sample Location : Kayamkulam- Murikkummoodu
Gps Reading : N-09 °10 '24.114"
E -76°31'18.084"

Sample code : F/5283/2023
Date of sample collected : 20/06/2023
Date of receipt of sample : 21/06/2023
Date of analysis started : 21/06/2023
Date of completion of analysis : 28/06/2023

| Parameters tested | Test method | Results |
|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 7.81 |
| Total Dissolved Solids(Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 5395 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 57 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 1429 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 380 mg/l |
| B O D (3 days at 27° C) | IS 3025 (P) 44 – 1993RA 2014 | 98.6 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 254 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 196 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 1.3 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.36 mg/l |
| Cyanide as $CN^-$ | IS 3025 (P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | 0.87 mg/l |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 2.4 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 5.4 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory
SREEJA RAJESH
QUALITY MANAGER

*End of the report*

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TC-6565

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/SD/5279/2023(ULR NO:TC658923000000005279F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 28/06/2023 |
| | Date of monitoring | 20/06/2023 |
| | Monitoring Location | Kayamkulam- Murikkummoodu<br>GPS Reading : N- 09 °10'24.208"<br>E -76°31'17.945" |
| | Sample Description | Ambient Sound Level |

| HOURLY INTERVAL | | RESULT | HOURLY INTERVAL | RESULT |
|---|---|---|---|---|
| 20.06.2023 | 14.00 Hrs | 62.3 dB (A) | 07.00 Hrs | 56.3 dB (A) |
| 15.00 Hrs | | 59.8 dB (A) | 08.00 Hrs | 57.4 dB (A) |
| 16.00 Hrs | | 57.6 dB (A) | 09.00 Hrs | 55.6 dB (A) |
| 17.00 Hrs | | 59.4 dB (A) | 10.00 Hrs | 56.3 dB (A) |
| 18.00 Hrs | | 58.6 dB (A) | 11.00 Hrs | 57.4 dB (A) |
| 19.00 Hrs | | 51.2 dB (A) | 12.00 Hrs | 60.2 dB (A) |
| 20.00 Hrs | | 47.6 dB (A) | 13.00 Hrs | 58.6 dB (A) |
| 21.00 Hrs | | 49.5 dB (A) | | |
| 22.00 Hrs | | 46.3 dB (A) | | |
| 23.00 Hrs | | 45.3 dB (A) | | |
| 21.06.2023 | 00.00 Hrs | 48.9 dB (A) | | |
| 01.00 Hrs | | 51.2 dB (A) | | |
| 02.00 Hrs | | 50.3 dB (A) | | |
| 03.00 Hrs | | 53.4 dB (A) | | |
| 04.00 Hrs | | 54.6 dB (A) | | |
| 05.00 Hrs | | 55.3 dB (A) | LeqDay | 55.7 dB (A) |
| 06.00 Hrs | | 54.3 dB (A) | LeqNight | 51.2 dB (A) |

Limits: Industrial Area Day Time-75dB(A),Night Time- 70dB(A),Commercial area Day Time -65 dB(A),Night Time55dB(A),
Residential area Day Time -55 dB(A),Night Time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am

*End of the Report *

For Poluchem Laboratories (P) Ltd.

Authorised Signatory

SREEJA RAMESH
QUALITY MANAGER

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## TEST REPORT



**Ref.No: PL/RT/GW/1452/2023**
(ULR NO:TC658923000000l452F)

**Date of Issue: 28/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Ground water-1
Sample Location : Kayamkulam- Murikkummoodu
Gps Reading : N- 09 °10'33.434"
E -76°31'08.457"

Sample code : F/1452/2023
Date of sample collected : 20/06/2023
Date of receipt of sample : 21/06/2023
Date of analysis started : 21/06/2023
Date of completion of analysis : 28/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.02 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 8 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 3.4 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 320 µS/cm | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 198 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 4 mg/l | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 56.56 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 12.95 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 57.17 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 40.81 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.19 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

SREEJA P.NAIR
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 1452/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 130 | Shall not be detectable in any 100 ml sample |
| E.coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/5280/2023** **Date of Issue: 28/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Kayamkulam- Murikkummoodu
Gps Reading : N- 09 °10'33.434"
E -76°31'08.457"

Sample code : F/5280/2023
Date of Sample Collected : 20/06/2023
Date of receipt of sample : 21/06/2023
Date of analysis started : 21/06/2023
Date of completion of analysis : 28/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P)54-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P)41-1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P)47-1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P)42-1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P)59-2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P)48-1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P)49-1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025(P)58-2006RA2017 | 8 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025(P) 34-1988RA2014 | BDL(MDL- 1mg/l) | --- |
| Total Chromium as Cr | IS 3025(P)52-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P)37-1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Conti..

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**ACCREDITED BY KSPCB AS "A" GRADE LABORATORY**




Continuation of Test Certificate No: 5280/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorised Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

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## TEST REPORT



**Ref.No: PL/RT/GW/1453/2023** **Date of Issue: 28/06/2023**

(ULR NO:TC658923000000l453F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulum
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector

Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014

Sample description : Ground water-2

Sample Location : Kayamkulam- Murikkummoodu
Gps Reading : N- 09°10'14.796"
E -76°31'30.571"

Sample code : F/1453/2023

Date of sample collected : 20/06/2023

Date of receipt of sample : 21/06/2023

Date of analysis started : 21/06/2023

Date of completion of analysis : 28/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.09 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 30 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 33.7 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 510 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 312 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 28 mg/l | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 137.36 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 112 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 53.08 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 79.47 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 1.3 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 3.4 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

Conti...

SREEJA RAMESH
QUALITY MANAGER

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CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

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Continuation of Test Certificate No: 5281/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 170 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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**TEST REPORT**

ACCREDITED BY KSPCB AS "A" GRADE LABORATORY



**Ref.No: PL/RT/GW/5281/2023**

**Date of Issue: 28/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-2
Sample Location : Kayamkulam- Murikkummoodu
Gps Reading : N- 09°10'14.796"
E -76°31'30.571"

Sample code : F/5281/2023
Date of Sample Collected : 20/06/2023
Date of receipt of sample : 21/06/2023
Date of analysis started : 21/06/2023
Date of completion of analysis : 28/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P)54-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P)41-1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P)47-1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P)42-1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P)59-2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P)48-1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P)49-1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025(P)58-2006RA2017 | 20 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025(P) 34-1988RA2014 | BDL(MDL- 1mg/l) | --- |
| Total Chromium as Cr | IS 3025(P)52-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P)37-1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Conti..

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Continuation of Test Certificate No: 5281/2023

## RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH

QUALITY MANAGER

POLUCHEM LABORATORIES PVT LTD

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TC-4588

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## TEST REPORT



**Ref.No: PL/RT/GW/1454/2023** **Date of Issue: 28/06/2023**

(ULR NO:TC658923000000l454F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Ground water-3
Sample Location : Kayamkulam- Murikkummoodu
Gps Reading : N- 09°10'21.558"
E -76°31'16.262"

Sample code : F/1454/2023
Date of sample collected : 20/06/2023
Date of receipt of sample : 21/06/2023
Date of analysis started : 21/06/2023
Date of completion of analysis : 28/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.94 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 6 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 1.4 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 210 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 136.5 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 6 mg/l | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 58.58 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 68 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 17.35 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 1.88 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.24 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

Conti...

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 5282/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 170 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Polachem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Polychem Laboratories (P) Ltd

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## TEST REPORT

**Ref.No: PL/RT/GW/5282/2023**

**Date of Issue: 28/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : Kayamkulam- Murikkummoodu
Gps Reading : N- 09 °10'21.558"
E -76°31'16.262"

Sample code : F/5282/2023
Date of Sample Collected : 20/06/2023
Date of receipt of sample : 21/06/2023
Date of analysis started : 21/06/2023
Date of completion of analysis : 28/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P)54-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P)41-1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P)47-1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P)42-1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P)59-2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P)48-1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P)49-1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025(P)58-2006RA2017 | 14 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025(P) 34-1988RA2014 | BDL(MDL- 1mg/l) | --- |
| Total Chromium as Cr | IS 3025(P)52-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P)37-1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Conti..

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Continuation of Test Certificate No: 528/2013

## RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and melaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RANGAN
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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N
E
W
S
T
5.9L
1.28
31.66
10.00
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2.83
1.00
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10.00
10.00
10.00



Contour Map



Site Operational Proposal Plan

Land shall be reclaimed i.e. all the legacy waste will be removed till it reaches the surface of the earth/soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the contractor to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to biweekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site.



# Part B
# Social Impact Assessment

**Kayamkulam Dumpsite**
**Alappuzha District**



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# 1.Introduction

Dumpsite is an open piece of land where all kind of waste are being openly dumped for long period without any scientific disposal practice. Dumpsite mainly emits gas and contaminated water as well as wind-blown litter and dust. Through dumpsite remediation these negative impact on health would be addressed finally; this may be defined as a process by which disposed waste in an existing dumpsite is excavated and either reused or disposed in scientific manner. However, during the execution there are some potential health hazards for the people those who would be directly engaged in the remediation work.

Along with the health hazards some social impacts are there. There is no land issue but there is the chance of traffic congestion during the execution as because within 200 metres of the location there are more than 100 houses so proper traffic management plan and installation of public disclosure board is necessary here. As no rag picker's livelihood depends upon this dumpsite so their livelihood would not be at stake due to the remediation work and there is no tribal population resident in the nearby location of the dumpsite.

This report provides an overview on the potential social risks envisaged during the social screening and transect walk along with the mitigation measures of that risk of the remediation sub project of the Kayamkulam dumpsite; it also oversees the budding social benefits of the remediation works.

## 1.1 Kayamkulam Municipality

Kayamkulam municipality is located in Karthikapally taluk in Alappuzha district. The Kayamkulam Municipality has an area of 21.79 sq km and extends to the Keerikad, Kayamkulam, Krishnapuram and Pathiyoor villages. The panchayaths of Chettikkulangara, Pattiyoor panchayaths in the North, Krishnapuram Panchayath in the east, Devikulangara Panchayat in the west and Kayamkulam Kayal are the boundaries of Kayamkulam. Kayamkulam town is located on the coast. The Kayamkulam municipal area is about 6 km east of the Arabian Sea. It has three soils that are sandy loam, mud soil and marshmallows. Kayamkulam city is from the west to east and slopes and plains. Kayamkulam was the original capital of the old Odanadu region.

After the development of the region gradually came to be known as the capital of the region. The construction of Kayamkulam town was established in 1905 as the Town Improvement Committee. In 1907, Kayamkulam was declared Town Municipality. In 1956, the municipal area was expanded by adding the suburbs. Four Muslim schools were established long before the government started education institutions. The main cultural centers are Kayamkulam Municipal Library, Mahatma Gandhi Memorial Library, KPAC and Yadavadhara Arts Club. Kayamkulam is an important trading center of Alappuzha district. It was famous for salt processing and marketing in ancient times. Cashew processing is the main industry in Kayamkulam today. Traditional industries such as coir making, and cottage industries such as straw making industries are also active. There are three ways of road transport, rail transport, and waterways. The major roads that pass through this include NH-47, the ancient Kayamkulam-Punalur road and Kayamkulam-Thiruvalla road.

**Some basic information of Kayamkulam is presented in the table below**

| SOCIO ECONOMIC PROFILE DATA | |
|---|---|
| District Name | Alappuzha |
| Taluk Name | Karthikapally |
| Town Name | Kayamkulam (m) |
| Total Population of Town | 68634 |
| Total Male Population of Town | 32784 |
| Total Female Population of Town | 35850 |
| Total Scheduled Castes Population of Town | 4477 |
| Total Scheduled Castes Male Population of Town | 2311 |
| Total Scheduled Castes Female Population of Town | 2166 |
| Total Scheduled Tribes Population of Town | 137 |
| Total Scheduled Tribes Male Population of Town | 75 |
| Total Scheduled Tribes Female Population of Town | 62 |

***Data Source: ULB baseline Data (Annual plan)***

**1.2 Murikkumoodu dumpsite**

The 105-year-old Murukkumoodu dumpsite was one of the oldest sites in Kerala which was recently closed permanently by the Kayamkulam municipality. As per the municipality, the site was initially used for the burial of dead bodies. later that site was started to use as dumpsite. Initially the area was not inhabited by humans, currently the area is highly populated. This is in Murukkumoodu, specifically in Ward 22. It covers an area of 80 cents and falls within the jurisdiction of Kayamkulam Municipality in Karthikapally taluk, Alappuzha district. The GPS coordinates of the site are 9.17356" N 76.52152 "E. The dumpsite is located within the existing common solid waste management facility of the Kayamkulam Municipality. The facility includes a Material Collection Facility (MCF), and a Resource Recovery Facility (RRF). The dumpsite has a very narrow (3.5mtrs) road access. There are public utilities, like shops, temple, on this road. There are at least 20 households within 200 meters of the dumpsite. Therefore, there is an immediate residential impact from the dumpsite remediation project. Currently 88 HKS workers are engaged in the existing MCF & RRF.



### 1.3 Socio economic baseline of host community

It is identified that there are around 20 households situated within the 200 meters from the dumpsite. Almost 100 households located in the abutting vicinity. Socio-economically this community may be considered as a mixed community. There is no rag picker and ST settlements. There are 3-4 shops and one temple which may be considered as public utilities. The dumpsite has very narrow road access which may create traffic congestion in the time of remediation of the dumpsite. The HKS workers engaged in the MCF & RRF located in the same compound may be engaged in other MCF/ RRF to continue their livelihood.

### 1.4 Vulnerability mapping of host community

During the survey phase, it is identified that there are no scheduled tribes, rag pickers and other vulnerable communities living near the dumpsite. However, the community staying in nearby locality of the dumpsite; their health is always vulnerable. During remediation work the issue should considered with the high priority, especially for the aged and children. There are 40 nos of elderly people with above 60 years and the number of below 14yrs children are around 25; the cancer victims are 2, the number of persons suffering from asthma and other allergic diseases are 16; there is 1 expecting mother in the nearby community. This information gathered from the female representative of ULB level GRM committee. As because the proximity of the dumpsite and habitation is very close; the bio mining process may create vulnerabilities such as mobility, sound, water, and air pollution etc.

*Table 1Vulnerability Details*

| Sl. No. | Particulars | Number |
|---|---|---|
| 1 | Elderly people with above 60 years | 40 |
| 2 | Children below 14yrs | 25 |
| 3 | Cancer victims | 2 |
| 4 | Persons suffering from asthma and other allergic diseases | 16 |
| 5 | Expecting Mother | 1 |

***Data source: Ward level health data of ULB***

## 2. Data Collection

Data collection process taken place to gather relevant information regarding the dumpsite through primary and secondary sources. The following stapes were followed to collect data.

### 2.1 Social Screening

The social screening has been conducted with a social screening checklist to identify the potential social risks which are presently existing and can be anticipated during the dumpsite remediation. Major findings during the screening process are shown below.

Kayamkulam dumpsite is very close to the habitation/settlements. Around 100 household are there in which 20 households are located within 50 metres from the dumpsite. The dumpsite has only one narrow road access, thus there may be disruptions in the routine traffic of the local people and commercial establishments. The access of public utilities/ facilities may be disturbed. Alternative livelihood may be required for the HKS workers in the MCF & RRF located in the same compound temporarily during the remediation time. Other social risks anticipated are shown below.

- Health issues of the host community.
- Occupational and health hazards of the workers engaged in remediation process
- Labour issues among the workers/labours engaged in remediation process
- Gender based violence issues towards the women workers and neighbouring community.

As per the social screening, it is envisaged that there are some adverse social impacts on dwellings, labour, livelihood, community resources of host and other vulnerable communities There are no scheduled tribes, rag pickers and other vulnerable communities living near the dumpsite. Since there are some considerable risk factors in respect to the social and economic conditions of the host communities, the sub project can be categorized as "Substantial Risk".

2.2 **Transect walk**

A transect walk was conducted in and around the dumpsite on 24.5.2023. The aim of the transect walk was to assess the site and gather information about its location, potential social risks, existing infrastructure and the impact on surrounding communities. The group explores environmental and social resources, conditions and systems by observing, asking, listening, looking and producing a transect diagram. Information collected can be used to reveal land use practices, hazards and vulnerabilities to inform disaster mitigation and water management. Representatives from ULB, households, civil society organizations and officials were present during the visit.

### 2.2.1 General observations from transect walk and social screening

- Dumpsite is very close to the habitation/settlements. Awareness shall be given to the entire community residing in the abutting areas about the remediation process for seeking cooperation and support.
- The approach road of the dumpsite is very it may cause traffic congestion in the course of remediation work.
- The provision of alternative livelihood of the HKS workers should be arranged as during remediation work their jobs may be seized.
- It is an old dumping yard which is not functional, but the dumped waste is legacy in nature, less biodegradable waste is present in the site. Same time the presence of flammable plastic waste content is much higher. And the nearest fire station is located 5 kilometres away from the site.
- During the transect walk, it was observed that there are no rag pickers associated with the dumpsite. Therefore, there are no livelihood risks for rag pickers in this context.
- As for this sub project there is no need for additional life so no impact on land, customary rights, is observed.

### 2.2.2 Findings from transect walk

- The approach road of the site is very narrow which indicates during remediation work traffic congestion may happened so traffic management measures should be in place.
- Arrangements for alternative livelihood shall be made for the HKS workers engaged in the existing MCF & RRF of the site as their job may be seized in the time of remediation work
- As the site is located in the densely populated area so it is expected that all remediation work will take place in the day time only.

**2.3 Focus Group Discussion (FGD)**

One FGD was conducted dated on 04-11-2023 in NSS hall with the residents living near to the dumpsite. In the discussion that followed, people shared their concerns. Below are the concernsraised by the participants and their solutions.

| Concern | Mitigation measures |
|---|---|
| What are the things to be done to control the dust thatmay arise? | Covering and watering around the site can help prevent dust from comingout |
| The site is surrounded by forest, it would be better if steps were taken to clear the trees. | The chairperson informed that steps will be taken todecongest the premises. |
| After removing the garbagefrom here, what will this place be used for | Solid waste treatment plants, MCF systems, inoculum manufacturing units and value-added products from waste can be generate employment and income for the locals. |
| How many feet will be dug toremove waste? What machines are used for this? | It was understood from thetests that there is waste up to 2 feet deep. This is the removal of waste at such adepth. The main machinesused for this purpose are conveyor belt and JCB. Tipper lorries will also be used to remove the sortedwaste. |

The participants unanimously said that they will do all the help to change this as soon aspossible. The dumpsite clearing activity videos are shared in the ward whatsup group to allay theconcerns of the local community.

## 3. Stakeholder analysis

The remediation process requires collaboration of the following stakeholders.

| SL No | Stakeholder | Remark/Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| **Primary Stakeholders** | | |
| 1 | Residents who are staying nearby the site – Murukkumoodu. | Since the residents who are staying nearby the site who falls under the catchment area (200 metres) are the primary beneficiary of this program and they are responsible to support the program and report or take up any immediate issues affect them during the remediation process through established GRM for this purpose. |
| 2 | Kayamkulam Municipality | a. The Kayamkulam municipality will be benefited through this process in the following:<br>• Longstanding litigation related to the dump site can be solved with various parties<br>• Since free land availability is scarce for SWM activity/Public utility, the ULB can make available 6.5 Acres of land in a prime location.<br>b. Tendering, finalization and deputing contractor/agency for remediation |
| **Secondary Stakeholders** | | |
| 1 | Govt institutions like PCB, KSEB, KWA, Health Department, etc | To deliver necessary approvals and provide necessary services for remediation purpose |
| 2 | ULB Officials | Support and monitoring of the process |
| 3 | KSWMP | Monitoring and evaluation |
| 4 | TSC/PMC | Technical support and consultation |
| 5 | Contractor | Execution of the remediation process |
| 6 | Service providers/HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| 7 | Labors of contractor/Agency at site | Execution of work by strictly following labour management plan and preventive GBV Action plan |
| 8 | Waste Generator in Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |

| | | |
|---|---|---|
| 9 | End recyclers | Process the inert and legacy waste safely after remediation |
| 10 | Media | Create an enabling environment for the successful completion of the project through positive reporting by the media. |
| 11 | Police | Ensure law and order in the area, if required |
| 12 | Fire and safety | Extend assistance in case of an emergency. |

## 4. Positive social impacts after remediation.

### a) Enhanced quality of life

The remediation can restore the aesthetics of the area, reducing visual blights, foul odour and improving air and water quality. According to the opinion of people residing in ward 22, the project can contribute to an improved sense of well-being. Also, it results to a clean and hygienic work environment for the workers engaged in MCF and RRF.

### b) Livelihood and employment of vulnerable community

It is identified that no rag pickers are currently engaged in collecting waste from the dumpsite or making a living from it. Therefore, the proposed dumpsite rehabilitation project will have no impact on housing or livelihood of any rag pickers.

### c) Economic opportunities

Municipality planned to carry out the remediation process in a scientific manner and thereby to reuse the land for future development activities. The total extend of this land is 80 cents. Municipality is planning to renovate the existing MCF with different civil works located in the dump site premise and one new RRF has been planned to construct in this compound. These projects will create more job opportunities to the people who are looking for employment in waste management sector. The value of land will also increase.

### d) Access to service

It is observed that the project will not affect access to any facilities, services, or natural resources as there is enough space/land available in the exiting site.

## 5. Site specific required action plans

- **Labour Management Plan**

Maximum of 12 labours are expected to be engaged in remediation process at a time. A detailed labour Management plan has been formulated and followed at site by the contractor.

- **Labour Influx Management Plan**

Since the site is not away from the habitation, the influx of labour may affect the host community at any way.

- **Preventive GBV Action plan**

The HKS workers will not be engaged in the same site during remediation work. However, if any women were in the remediation work for them and host community GBV action plan is required.

- **Citizen Engagement Plan Action**

Since the dumpsite is situated in the thickly populated area with a past history of protest,a detailed citizen engagement plan is required.

**Livelihood impact and land requirement**

As per the detailed assessment of potential social risk during the remediation process, the identification from social screening with screening checklist, transect walk and focus group discussion indicates that there will be a chance of temporary loss of livelihood of HKS members in the existing MCF and RRF located in the same site. A detailed impact assessment shall be conducted by the TSC, and Livelihood Action Plan will be prepared accordingly

It is identified that land acquisition is not required as sufficient land is available.

## 6. Conclusion.

The social screening and transect walk at the Kayamkulam dumpsite provide insights for the dumpsite remediation project. As there are households residing within 200 meters of the site, the immediate residential impact is there. Not only that, the presence of public utilities/facilities and the history of hazards highlight the need for careful planning and implementation to ensure the safety and well-being of the community. The availability of land and law social risk for the implementation of dumpsite remediation activities are positive factors of the project.

# Annexure 1

## Citizen Engagement Plan

### 1 Brief introduction about the project

Dumpsite is an open piece of land where all kinds of waste are being dumped for long- long years back. Dumpsites mainly emit gas and contaminated water as well as wind-blown litter and dust. Through dumpsite remediation these negative impacts on health would be addressed finally; this may be defined as a process by which disposed wastes in an existing dumpsite are excavated and either reused or disposed of in a scientific manner. However, during the execution there are some potential health hazards for the people who would be directly engaged in the remediation work. The site used to receive untreated unorganized mixed waste stream, there is a possibility of biomedical and hazardous items within the accumulated waste in the dumping ground.

Along with the health hazards some social impacts are there. There is no land issue but there is the chance of traffic congestion during the execution as because within 200 meters of the location there are around 100 houses so a proper traffic management plan and installation of a public disclosure board is necessary here. As no rag picker's livelihood depends upon this dumpsite so their livelihood would not be at stake due to the remediation work and there is no tribal population resident in the nearby location of the dumpsite.

### 2. Stakeholder identification

**a) Waste Generators*:*** The nearby community, viz., resident, commercial establishments, different institutions are the waste generators.

**b) Service Providers:** The service provider may be considered a primary and secondary. Primary service providers are the HKS workers, where the secondary service providers are all concerned staff including the ward councilors, office bearers of the Kayamkulam municipality.

**c) Agency Workers for Remediation Work:** For this project the agency workers will play the most crucial role so basic orientation of the project along with some other awareness programs like GBV, OHS etc. are very pertinent here.

### 3. Socio-economic profile of the community

Kayamkulam municipality is in Karthikapally taluk in Alappuzha district. The Kayamkulam Municipality has an area of 21.79 sq km and extends to the Keerikad, Kayamkulam, Krishnapuram and Pathiyoor villages. The panchayaths of Chettikkulangara, Pattiyoor panchayaths in the North, Krishnapuram Panchayath in the east, Devikulangara Panchayat in the west and Kayamkulam lake are the boundaries of Kayamkulam. Kayamkulam town is located on the coast. The Kayamkulam municipal area is about 6 km east of the Arabian Sea. It has three soils that are sandy loam, mud soil and marshmallows. Kayamkulam city is from the west to east and slopes and plains. Kayamkulam was the original capital of the old Odanadu region.

After the development of the region gradually came to be known as the capital of the region. The construction of Kayamkulam town was established in 1905 as the Town Improvement Committee. In 1907, Kayamkulam was declared Town Municipality. In 1956, the municipal area was expanded by adding the suburbs. Four Muslim schools were established long before the government started education institutions. The main cultural centers are Kayamkulam Municipal Library, Mahatma Gandhi Memorial Library, KPAC and Yadavadhara Arts Club. Kayamkulam is an important trading center of Alappuzha district. It was famous for salt processing and marketing in ancient times. Cashew processing is the main industry in Kayamkulam today. Traditional industries such as coir making, and cottage industries such as straw making industries are also active. There are three ways of road transport, rail transport, and waterways. The major roads that pass through this include NH-47, the ancient Kayamkulam-Punalur road and Kayamkulam-Thiruvalla road.

### 4. Vulnerability data of host community:

There are no scheduled tribes, rag pickers and other vulnerable communities living near the dumpsite. However, the community staying in the nearby locality of the dumpsite; their health is always vulnerable. During remediation work that issue should be considered with the high priority, especially for the aged and children. There are 40 aged persons and the number of below 14yrs children is around 25; the cancer victim is 2, the number of persons suffering from asthma and other allergic diseases is 16; there is 1 expecting mother in the nearby community. This information was gathered from the female representative of the ULB level GRM committee. Because the proximity of the dumpsite and habitation is very close; the bio mining process may create vulnerabilities such as mobility, sound, water, and air pollution etc.

**Table. Vulnerability Mapping in Respect of Health Issue**

| Sl. No. | Particulars | Number |
|---|---|---|
| 1 | Aged Persons (60+ yrs) | 40 |
| 2 | Children below 14 yrs. | 25 |
| 3 | Cancer Victim | 2 |
| 4 | Persons suffering from asthma and other allergic diseases | 16 |

***Source: Ward level health data of ULB***

### 5. Need of the plan:

The management of municipal solid waste is one of the main functions of all Urban Local Bodies (ULBs) in the country. All ULBs are required to meticulously plan, implement, and monitor all systems of urban service delivery especially that of municipal solid waste. As per the 74th Constitution Amendment Act, the SWM Rules, 2016 and the State Municipal Laws, ULBs are primarily responsible for the provision of municipal solid waste management services which includes the following initiatives regarding dumpsite:

- Stop land filling or dumping of mixed waste soon after the timeline as specified in rule 23 for setting up and operationalization of sanitary landfill is over.
- Investigate and analyze all old open dumpsites and existing operational dumpsites for their potential of bio- mining and bioremediation and where so ever feasible take necessary actions to bio-mine or bio-remediate the sites.
- Kayamkulam dumpsite is very close to the habitation/settlements. 100 households are there, around 20 households are located within 50 mtrs from the dumpsite. The dumpsite has only one narrow road access which is being used by the nearby community also. It is not functional now, but a huge quantity of legacy waste has already been dumped there. So, it is the need of the time to remediate all the dumped legacy waste from there.

## 6.Objective of the plan

- To reduce pollution effects
- To protect groundwater sources
- To reduce the health hazards of the host community
- To improve the aesthetic ambience of the locality
- To improve workers friendly environment for those engaged in the MCF& RRF located in the same site

## 7. Stakeholder concern

### a) Waste Generators:

The waste generators will comply with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future; not only that their cooperation during the remediation work is highly expected.

### b) Service Providers:

Officers and the council members are responsible for tendering, finalization and deputing contractor/agency for remediation & arranging alternative livelihood of the HKS workers engaged in the MCF, RRF functional in the same compound and monitoring the day to day project activities. HKS workers, and the other staff engaged directly to collect the waste from the doorstep of the waste generator expected to collect and segregate the waste properly to prevent further dumping after remediation

### c) Workers for Remediation Work:

All the labours, drivers, supervisors, security staff of the contractor/ agency engaged in the remediation work directly are the main player of the to make it successful. They will play the most crucial role in remediation work and not only that during the execution they may be primary contact person of the neighbourhood community.

**8. Public disclosure**: Project-related information shall be disclosed through a public consultation and making relevant documents available in public locations. The project agencies and associated line departments shall provide relevant safeguards information promptly, in an accessible place, and

the manner and language understandable to affected persons and other stakeholders. For illiterate people, other suitable communication methods will be used.

The following documents shall be made available at the offices of municipality, Bus stand, Local Police Station, Project site and other public places for public reference and shall also be uploaded on respective websites.

(i) Summary of project (in English and local language - Malayalam)

(ii) Draft ESMF Report (in English; translated summary in Malayalam)

(iii) Environmental monitoring reports

(iv) Grievance addressing measures

## 9. Activities proposed

**9.1 Community/citizen Awareness**: Before remediation work community / citizen awareness regarding the whole process of remediation work is the precondition for smooth execution of the project. Informed community is always the power bank of the proper and time bound execution of any community-based development work. During the execution of the process regular interaction with the host community is also required. They are the important stakeholder of the total process.

**9.2 Awareness to Service providers:** All primary and secondary service providers should come under awareness activity under the remediation work; the mode of communication may vary depending upon their status of primary or secondary, but the total process of the remediation work should be imparted. They should be intimated regarding the benefit of the activity and their important role in this concern.

**9.3 Awareness to the Agency Workers**: All the labors, drivers, supervisors, security workers of the agency who would be awarded for the work should be aware about the project and their responsibility, the community, issues concerned with GBV, OHS, basic labour laws. They should also be aware about the important services like fire, police, and health facilities for emergency situations.

## 10 Citizen Engagement Plan Matrix

| S. No | Engagement Challenge | Impacts on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| 1 | Awareness on project activities - bio mining | Proper awareness will be created. | Exposure visit | PIU/Contractor |
| 2 | Awareness boards. | Proper awareness will be created. | Installation of boards and signages. | Contractor |
| 3 | Health and safety education. | Do's and Don'ts will be cleared. | Orientation session. | Contractor / PIU / DPMU |
| 4 | Traffic management | Schedules are to be finalized. | Planning meeting. | PIU |

**Budget**

| S. No | Activity | Specification | Quantity | Cost |
|---|---|---|---|---|
| 1 | Exposure visits to Alappuzha | Road trip - vehicle hire. | 12 Pax | [redacted] |
| 2 | Sign boards | Printed boards | 10 Nos | [redacted] |
| 3 | Site specific IEC / trainings | Meetings | 200 Pax | [redacted] |
| | Total | | | [redacted] |

# Annexure -2

## Preventive GBV Action Plan

**1. Sub project information**

Bioremediation of existing dumpsite in ward 22 of Kayamkulam Municipality

**1.1 Details of labours**

The project is under pre planning stage. ULB must finalize contactor/Agency for Remediation. So, the exact number of Labors are not available. But approximately we can expect maximum of 12 labors

| | |
|---|---|
| Total number of labors | : 12 (Approx.) |
| Category of labors (Age/sex/gender) | : Not available |
| Data of migrant labors, if any | : Not available |

**2. GBV Issues likely to be identified at site**

1. Issues against female workers at site
2. Lack of safe and Gender friendly toilets at work sites
3. Disparity in work and wages based on gender
4. Threat of GBV or Sexual Exploitation Abuse (SEA) incidents to female members of the host community

**3. Activities under GBV Action plan**

**3.1 Formation of Internal Complaints Committee**

The committee should be Presided by a senior woman, and more than half of the total Committee members should be women. There should be an external member who has experience in dealing with issues related to women. Preferably a Social Worker /Advocate/NGO Representative.

**3.2 Placing of ICC informatory board at Work site**

| Insert Logos of KSWMP,WB,AIIB | | | |
|---|---|---|---|
| Project Name (KERALA SOLID WASTE MANAGEMENT PROJECT) | | | |
| Sub Project Name:_____ | | | |
| Internal Complaints Committee | | | |
| Sl.No | Name | Designation | Contact Number |
| | | | |
| | | | |
| | | | |
| EMERGENCY CONTACT NUMBER | | | |

**3.3Gender Sensitization trainings for Labors**

The Project expect around 12 labors will be employed in a day and women participation in the labor force is limited, even the project is taking precaution to protect and prevent any GBV incidence at the site. Taking into consideration all these aspects, the project plan to conduct a half day sensitization program in the following subjects, viz. the type of GBV, the action to be taken by the victim, the laws and the support organizations which extend support to the victim of GVB and the role of ICC and their contact details etc.

**3.4Sensitization for host community members special focus on female**

The citizen engagement plan has proposed an activity of host community meeting in which the importance and expected social risk of GBV will be discussed and the mitigation measures inbuilt in the project will be elaborated to the host community members especially to the women.

**3.5 Allocation of Gender friendly and safe toilet facilities for women**

Project has taken special care to arrange a separate toilet, wash and rest facility for female workers to protect their privacy and safety, and the same must be arranged by the contractor.

**3.6 Keeping of wage register at site to restrict wage disparity based on gender**

The project actively opposes gender-based wage disparity at any site funded under the KSWMP-supported SWM project. To ensure gender parity in various aspects such as wages, division of labor, and facilities, an appropriate monitoring mechanism, such as a wage register, should be maintained for the scrutiny of the project implementers.

**4 Details of GBV Service Providers identified**

The government of Kerala has constituted a help desk under Kudumbashree to support or to prevent and extend support to the GBV victims, and their details are given below.

Kudumbashree Snehitha Gender Help Desk

Contact Number – 0477-2230912
Toll free number - 18004252049

**5 GBV (Preventive) Implementation plan Matrix**

| Sl No | Activity | Timeline | Primary Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 1 | Formation of Internal complaint committee | Pre-Construction Phase. | Contractor/ULB | DPMU |
| 2 | Placing of ICC informatory Board at worksite | Pre-Construction Phase. | Contractor | DPMU/TSC |
| 3 | Gender sensitization Training to labors | During Construction | Contractor/TSC | DPMU |
| 4 | Group Discussion with female host community members | Pre-Construction Phase. | ULB | TSC |
| 5 | Ensuring Gender friendly and safe toilet facilities | Construction stage | Contractor | TSC |
| 6 | Keeping Wage Register at site | Construction stage | Contractor | TSC |

**Budget**

| Sl No | Particulars | Cost |
|---|---|---|
| 1 | Placing of ICC informatory board at site | [redacted] |
| 2 | Gender sensitization trainings to labor | [redacted] |
| 3 | FGD among female host community members | [redacted] |
| | **Total Cost** | [redacted] |

**6 Monitoring plan**

| Activity | Monitoring Indicators | Means of Monitoring | Reporting Period | Responsibility |
|---|---|---|---|---|
| Formation of Internal complaint committee | Minutes of Meeting/Bye Law of Committee/Reports | Verification of Minutes of Meeting and Reports | 15 days after commencement of work | DPMU |
| Placing of ICC informatory Board at worksite | Photos of Board placed | Physical verification | 15 days after the commencement of work | DPMU |

| | | | | |
|---|---|---|---|---|
| Gender sensitization Training to labors | Attendance and Photographs | Verification of Documents | 5 days after the commencement of work | DPMU |
| FGD among female host community members | Attendance and Photographs | Verification of Documents | 5 days after the commencement of work | DPMU |
| Ensuring Gender friendly and safe toilet facilities | Gender friendly signage's, Condition of latches, Floor Condition, Status of Flush | Physical verification | Before Commencement of work | DPMU |
| Keeping Wage Register at site | Photographs | Verification of Register | 5 days after the commencement of work | DPMU |

# Annexure-3

## Labour Management Plan

### 1 INTRODUCTION

**1.1** PROJECT TITLE:

Project for the remediation of abandoned dumpsite at Murukkumoodu, owned by Kayamkulam municipality

**1.**2 PROJECT AREA

The Murukkumoodu dump site of Kayamkulam municipality is situated ward 22, covering an area of 01.05 acres.

### 2. SCOPE AND STRUCTURE OF THE LABOUR MANAGEMENT PLAN

The scope of the LMP shall be as outlined in the World Bank's ESMF. The engagement will be planned as an integral part of the project's social assessment and project design and implementation. This document has 10 chapters. This chapter viz., chapter 1 served as introduction. Scope and structure of LMP is provided in chapter 2. An overview of labour use in the project is presented in chapter 3. Key potential labour risks are listed in chapter 4. Legislative framework governing labour employment in India/Kerala is discussed in chapter 5. Implementation Arrangements, policies and procedures follow in the subsequent chapter. Grievance redressal mechanism, contractor management are presented in the last chapters.

### 3. OVERVIEW OF LABOUR USE ON THE PROJECT

**3.1** Details of Labors

The proposed remediation process at Murukkumoodu requires following category and number labors

| Sl.No | Equipment | Category of labours | Required No.of labours |
|---|---|---|---|
| 1 | One trommel | Labours for waste segregated purpose | 5 |
| 2 | One excavator | Operator | 1 |
| 3 | One JCB | Operator | 1 |
| 4 | One small tipper | drivers | 1 |

| | | | |
|---|---|---|---|
| 5 | Support Staff | Security | 2 |
| 6 | | Supervisor | 2 |
| **Total Labors** | | | 12 |

## 4. ASSESSMENT OF KEY POTENTIAL LABOUR RISKS

### 4.1 Project Activities:

The bioremediation of the dumpsite at Muruldumoodu includes the following activities.

- Mobilization of plant and machinery for bio-mining
- waste excavation and forming of windrow
- Spraying with inoculum and waste stabilization
- Waste segregation and refinement
- sorting materials into recyclable, RDF, compost and inert
- Transport to the authorized recyclers and end users

### 4.2 Key Labour Risks

It is assessed that key labour risks would be associated with health and safety risks related to the construction activities such as exposure to physical hazards during construction activities such as: use of heavy equipment, exposure to noise and dust, falling objects, exposure to hazardous materials and exposure to electrical hazards from the use of tools and machinery. lack of proper sanitation facilities, availability of separate toilet for women workers. As the construction activities will involve hazardous work, persons under the age of 18 will not be employed by the Project. Many workers will be exposed to occupational health and safety hazards, primarily including but not limited to:

- Injuries/accidents/ fatalities leading to even death, while at work.
- Inadequate accommodation facilities at work force camps, including inadequate sanitation and health facilities.
- Non-payment of wages by Employer.
- Non-payment of benefits (compensation, bonus, maternity benefits etc.) by Employer
- Discrimination in Employment (e.g., abrupt termination from employment, working conditions, wages, or benefits etc.)
- Engagement of child labour.
- Sexual harassment at work sites.
- Forced labour or trafficking.
- Security of women workforce.
- Inadequate facilities for pregnant women and lactating mothers.
- Inadequate facilities for the children of the workforce at workforce camp sites

- Possibility of Gender based violence as the work is mostly carried out within the premises of the existing facilities like MCFs/ RRFs etc where female SWM workers are engaged.
- Absence or inadequate or in accessible emergency response system for rescue of labour/workforce.
- Health risks of labour relating to HIV/AIDS and other sexually transmitted diseases.
- Unclear terms and conditions of employment.
- Discrimination and denial of equal opportunity in hiring and promotions/incentives/training opportunities.
- Denial for workers' rights to form workers organizations, etc.
- Absence of a grievance redressal mechanism for labour to seek redressal of their grievances/issues.

## 5. BRIEF OVERVIEW OF LABOUR LEGISLATION: TERMS AND CONDITIONS

| Sl No | Applicable Acts | Details |
|---|---|---|
| 1. | Employees Compensation Act 1923: | The Act provides for compensation in case of injury, disease or death arising out of and during employment |
| 2. | Contract Labour (Regulation & Abolition) Act 1970 | The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. |
| 3. | Minimum Wages Act 1948: | The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. |
| 4. | Payment of Wages Act 1936: | It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the workers. |
| 5. | Equal Remuneration Act 1976: | The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training, and promotions etc. |
| 6. | Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: | The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to |

| | | |
|---|---|---|
| | | be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc. |
| 7. | Child Labour (Prohibition & Regulation) Act 1986: | The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in the Building and Construction Industry. |
| 8. | Employees State Insurance Act 1948: | The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the Central Government. The Act also provides for benefits to dependents of insured persons in case of death because of an employment injury. |
| 9. | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: | This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee |
| 10. | Industrial Disputes Act 1947: | the Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing the establishment. |
| 11. | Trade Unions Act 1926: | The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. |

## 6. RESPONSIBILITY MAPPING

The ULB (Urban Local Body) will award the proposed work to the contractor through competitive bids. The contractor will be responsible for hiring labourers for both civil and skilled work. In the recruitment process, the contractor is obligated to provide opportunities to members of the host community who possess the necessary skills and willingness to engage in the activities available at the dumpsite for remediation.

The contractor is required to adhere to existing labour laws in the state of Kerala while employing labourers, ensuring compliance with all applicable welfare measures mandated by the relevant labour legislation and rules. Additionally, the contractor is responsible for implementing measures to protect

and assist vulnerable groups of workers, including individuals with disabilities, migrant workers, and women workers. These protective measures should be explicitly outlined in the work agreement.

Furthermore, the contractor must prioritize occupational health and safety measures for the laborers. The ULB will actively monitor the contractor's compliance with legal and welfare requirements. The ULB will also organize training sessions for the workers and establish a forum at the ULB level to address any grievances raised by the workers.

It is a prerequisite for the contractor to possess a valid Labor License, and all laborers working on the site must be registered with the appropriate authorities. This comprehensive approach ensures the well-being and fair treatment of workers throughout the remediation project.

## 7. CODE OF CONDUCT

A code of conduct needs to be incorporated with the contract under the project. The contractor should conduct continuous awareness generation and training activities to ensure that the workers abide by the code of conduct. While preparing the code of conduct, following aspects should be ensured.

- Compliance with applicable laws, rules, and regulations of the jurisdiction
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment (PPE), preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment)
- The use of illegal substances
- Non-Discrimination (for example based on family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction)
- Interactions with community members (for example to convey an attitude of respect and non-discrimination)
- Sexual harassment (for example to prohibit use of language or behavior, towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate)
- Violence or exploitation (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favours or other forms of humiliating, degrading or exploitative behaviour)
- Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behaviour with children, limiting interactions with children, and ensuring their safety in project areas)
- Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by their employer and not open areas)
- Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favours, are not provided to any person with whom there is a financial, family, or personal connection)
- Respecting reasonable work instructions (including regarding environmental and social norms)

- Protection and proper use of property (for example, to prohibit theft, carelessness, or waste)
- Duty to report violations of this Code
- No retaliation against workers who report violations of the Code, if that report is made in good faith.

**8. SYSTEMATIZING THE CODE OF CONDUCT**

Awareness raising: The contractor is required to conduct ongoing awareness-raising and training activities to ensure that workers consistently adhere to the Code of Conduct. Additionally, the contractor must take measures to ensure that local communities are well-informed about the Code of Conduct, enabling them to report any concerns or instances of non-compliance. This proactive approach aims to foster a shared understanding of ethical standards and accountability within both the workforce and the surrounding communities.

**9. TRANSPARENCY IN CONTRACT SPECIFIC TERMS AND CONDITIONS**

All contracts must contain

- Wages: Specific wages and payment modality, timeline
- Working Hours: hours of work, maximum number of hours that can be worked on the project, overtime, compensation
- Leaves: rest per week, annual leave, maternity leave, sick leave
- Benefits: medical treatments in case of accidents or otherwise
- Notice of termination of employment and details of severance payments in a timely manner
- Collective agreements that apply to the project, other specific terms, and conditions
- Details of the grievance redressal mechanism

## LABOUR MANAGEMENT PLAN MATRIX

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To complete the registration by the Principal Employer, the ULB, as per the provisions of the Contract Labour (Regulation & Abolition) Act 1970 (CL Act), Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979 (ISML Act) and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 (BOCW Act) and procure certificate to that effect. | 3 Registration Certificates to be procured by the ULB under CL Act, ISML Act and BOCW Act respectively. | Before Awarding works | Registration Certificate issued by District Labour Officer under CL Act, ISML Act and BOCW Act | PIU |
| To Procure license under CL Act, ISML Act and registration under BOCW Act by the contractor | 2 Licenses and One registration under CL Act, ISML Act and BOCW Act respectively. | Before commencing the work at site | License and registration certificate issued by the competent Authority. | Contractor |
| To procure Workmen Compensation insurance policy proportionate to the number of labour force deployed. (By the Contractor) | One insurance policy. | Before commencing work at site | Copy of insurance policy | Contractor |
| To display a copy of the certificate of registration at the conspicuous place at the premises where the building and other construction work is being carried on.<br><br>To establish a labour information signboard at camp site by including following details like, date of payment of wages, working hours, holidays, wages rates for different categories of labours and name and contact details of local labour inspector and his/ her office and emergency contact numbers. | One notice board<br><br>One notice board | As soon as the work is started.<br><br>Do | Photographs of the notice board where the license is displayed.<br><br>do | Contractor |

| | | | | |
|---|---|---|---|---|
| To conduct pre- employment medical examination (as per the provisions of BOCW Act)- to ensure medical fitness of the employee. | All workers must be examined | No of workers employed by the contractor | Pre-Medical Examination certificate issues as per Rule 223(C) of BOCW Act (Form No. IX) by the Registered Medical Practitioner. | Contractor |
| To conduct Periodical Medical Check-ups (once in every six months) | All workers must be examined. | No of workers employed by the contractor | Medical Examination certificate issued by a registered medical practitioner. | Contractor |
| To provide safe drinking water- the contractor must provide safe drinking water at worksite as well as camp site* (Guideline is provided along with this document) | As per requirement | During the entire contact period | Photographs of supply of potable water, Bill of water purchase. | Contractor |
| To arrange first Aid facility at work site as well as camp site (Specifications and items to be maintained in the box is mentioned in this document) | As per requirement | During the entire contract period | First Aid Register, Bill of purchase, photographs of First Aid kit | Contractor |
| To arrange separate First Aid room at work site | Allot one specified room | To be made available during the construction period | Photographs of the facility | Contractor |
| To provide first Aid training to selected labourers or staff members through an authorized agency. | One training with authorized agency | Within one month of commencement of the work | Training records & Photographs | Contractor |
| To establish linkage with local hospitals/ health care institutions for emergency medical assistance | Tie up with at least one hospital | Within one month of the commencement of the work | Letters issued by the hospital or correspondence and agreement with the hospital. | Contractor |

| | | | | |
|---|---|---|---|---|
| To establish rest room at work site or camp site | | Before the commencement of the work | Photographs of the rest room | Contractor |
| To maintain essential registers and records like Form A (Registration of employees), Attendance Register, Wages Register, and other registers like incidents registers including Accident register, Harassment complaints, recovery register, Maternity leave, Termination etc | | As and when the work starts | Copy of registers. | Contractor |
| Constitute GRC for labours (maximum members to be six. Number of members from employer and employee to be equal. Female members should be minimum 50%. ) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| Constitution of ICC (minimum members to be four. The presiding member should be a senior female employee) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| To publish the abstract of labour laws within the premises of the labour camp.<br>1. The Payment of Wages Act<br>2. The Employee compensation Act<br>3. The Building and Other Construction Workers (RECS) Act<br>4. The Contract Labour (A&R) Act<br>5. The Child and Adolescent Labour (P&R) Act<br>6. The Maternity Benefit Act<br>F | Abstract of Six acts | As and when the camp is established | Photos of the notices published. | Contractor |
| To establish code of conduct and provide induction trainings | | As and when new employees are joined | Training reports and other documents | Contractor |
| Conduct HIV/AIDS awareness programmes | As per requirement | Once in six months | Reports, photographs etc | Contractor |

| | | | | |
|---|---|---|---|---|
| All the Drivers should possess effective and valid Driving License | Drivers should be selected after verification of DL | As and when drivers are appointed | Photocopy of license ids to be collected | PIU |
| All the vehicles involved in the project shall be insured to cover the third-party risk | Vehicle must be allowed to be plied in the project only after procurement of third-party insurance to the vehicle | As and when vehicles are plied in the project | Photocopy of insurance is to be collected | PIU |

**Budget for LMP**

| S.No | Item | Cost |
|---|---|---|
| 1 | Labour compliance as per LMP | [redacted] |

Annexure-4

## LABOUR INFLUX MANAGEMENT PLAN

| RISK | MITIGATION MEASURES | IMPLEMENTATION RESPONSIBILITY | MONITORING INDICATORS | MONITORING RESPONSIBILITY |
|---|---|---|---|---|
| Social and Community wellbeing | 1. Joint Meeting with the community by ULB officials and Elected members | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Economic and Livelihood Issues | 1. Skilled /Unskilled jobs for the Community members in the sub-project | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Accommodation /labour camp | 1. Ensure basic amenities are provided to the labourers ( Toilets. Water .Kitchen facilities etc)<br>2. Daily briefing to the labourers | Contractor | • Risk identification report<br>• Proposed action/mitigation plan<br>• List of facilities in labour camp<br>• Details of labours | TSC/DPMU |
| Communicable Diseases | 1. Access to Medical Check-up<br>2.Awaresness to the labours | Contractor | • SOP for prevention of communicable disease and health wellbeing on worksite and labour camp | TSC/DPMU |

| | | | | |
|---|---|---|---|---|
| | | | • Report on medical check-up | |
| Crimes | 1. Intimation to the Local police about the camp | Contractor | Work site complaint register<br>Number of cases reported, and action taken | TSC/DPMU |
| Child Labour | 1. Ensure Aadhar card of all laborers at the site | Contractor & TSC | • Number of child labour issues reported<br>• Data of labours | ULB/DPMU |
| Gender-based violence, including sexual harassment child abuse and exploitation | 1.Gender sensitization briefing to the labourers | Contractor/TSC | • Number of cases reported<br>• Action taken report<br>• Number of cases resolved<br>• Time taken for resolving complaints | ULB/DPMU |
| Laour licenses | To be ensured by the contractor | Contractor/PIU | Number of labours having license | DPMU |

**Summary of SMP budget**

| S.No | SMP Activity | Cost |
|---|---|---|
| 1 | Labour Management Plan | [redacted] |
| 2 | Labour Influx Management Plan | [redacted] |
| 3 | Preventive GBV action plan | [redacted] |
| 4 | Citizen Engagement Plan | [redacted] |
| Total | | [redacted] |

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

**SUBMITTED BY**

**KERALA SOLID WASTE MANAGEMENT PROJECT (KSWMP)**

# Part A

# Environmental Impact Assessment

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# SUMMARY

**INTRODUCTION:** Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio mining of multiple Legacy Waste Dumpsites in various districts. Bio mining and bioremediation of Koothattukulam dumpsite figures in Cluster 1. The selected dumpsite is Koothattukulam which is falling under this cluster 1 and is located near Ward no 15 Koothattukulam municipality, Ernakulum District.

**RATIONALE FOR THE PROPOSED SUB-PROJECT:** Koothattukulam ULB proposes bio mining and bioremediation of the Koothattukulam legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

**PROPOSED SUB-PROJECT DETAILS:** Koothattukulam dumpsite is located at a distance of 1.0 km from the centre of Koothattukulam town in SE side and encompasses a total area of 0.29 acres of land. The geographical coordinates of the dumpsite are 9°51'49.2" N & 76°35'27.3" E. The volume of legacy waste to be remediated in the dumpsite is 2061.41 Cu.m. The legacy waste is presented about 0.8 m above and 3.0 m below the ground level respectively. Hence bioremediation of the dumpsite is essential to mitigate the environmental impacts.

**APPLICABLE NATIONAL, STATE LEGISLATIONS AND TECHNICAL GUIDELINES:** To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed.

**THE WORLD BANK SAFEGUARDS POLICIES, AND KSWMP ESMF**: The World Bank policies and directives on environmental and social safeguards have been adhered to the proposed dump site remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are ensured.

**SUB-PROJECT SCREENING AND ITS CATEGORIZATION:** The subproject site has been screened for potential impacts due to proposed developments. On the basis of Environmental screening report and baseline consideration, Potential odour nuisance and air borne microbial contamination which may have moderate environment impacts to the surroundings during remediation period. Considering all the above factors, also the time extent of the impact during remediation stage and the mitigation measures proposed, the sub-project has been considered as E2 category.

**ENVIRONMENTAL BASELINE:** Physiographically, Koothattukulam in and around topographical features, is gentle slope and undulating terrain zone. The favourable time for remediation is between October-2023 to March-2024 non-monsoon period. As per Wind rose diagram, the predominant wind directions are blowing from West and WSW direction throughout the year. As per the geotechnical investigation, the subgrade soil was encountered at 3.0 m below the waste depth of the dumpsite and the predominant soil is gravelly clay. The dumpsite is surrounded by predominantly of Dry cultivation land use and the same will act as odour attenuation during remediation. The cultural heritage zone near dumpsites is Koothattukulam Mahadeva temple at a distance of 1.1 Km in SE direction. Hence, no significant physical impact to the heritages sites is envisaged during remediation. The total number of vehicles that will be operational at the dumpsite is 5 numbers per day which increase the traffic load by only 0.1% per hour and reducing the impacts to negligible. As per the district disaster management plan-2015 and flood vulnerability map the dumpsite is not under flood prone zone.

**DESCRIPTION OF ENVIRONMENTAL PARAMETERS:** The analysed air pollution data indicates that the levels are within acceptable limits of NAAQs. The ambient Noise Levels are well within the National Ambient Noise standards for Commercial Area for both day and night. The ground water quality results indicate that the dumpsite has not caused any major increase of the parameters and the quality parameters are within the IS 10500:2011, except the color and coliforms which are found to be higher than the above said standard. Similarly, the surface water sample shows that it is not largely influenced by the dumpsite as the quality is

within the limits of IS 2296, except for color, iron BOD value of about 4.1 mg/l and COD of 12 mg/l. The leachate monitoring data indicates, the TDS is about 367 mg/l, while the suspended solids is about 142 mg/l. The chlorides are 52.1 mg/l, while the COD, BOD are 480 mg/l and 110 mg/l respectively.

**SOCIO-ECONOMIC BASELINE:** Koothattukulam Municipality has population of 17253, literacy rate of 96.65%, Density of population of 744/Sq. Km as per Census 2011. The dump site is situated in the land owned by the Municipality. They have full authority to plan and implement the remediation process in this land. The remediation process will be conducted by an experienced agency decided by the Municipality with the supervision of a ULB level project implementation unit.

**SOCIO-ECONOMIC ENVIRONMENT:** The dumpsite remains in close proximity to 40 houses in 200 m, a fire station, a veterinary hospital and a beverage outlet are situated within 200 metres of the dumping yard. A Weekly market place is also functioning in the adjacent plot; it shares the same compound wall. The wall is around 5ft high. There will not be any livelihood loss or resettlement issues observed directly connected with the remediation process. The site is covered with a compound wall and gate.

**ANALYSIS OF ALTERNATIVES:** After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

**ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS:** Environment: During operational phase (bio-remediation), the main potential nuisances caused by a dump site are fugitive dust, odour, foul gases, smoke from the site (in case of fire), and leachate generation. Birds, vermin, and rodents, littering, noises both from machineries operating at the site and waste collection vehicles. Social: No specific social risk is identified for initiating the remediation process except the occupational hazards to the workers engaged in the remediation process. It can be overcome by using adequate protective measures properly.

In connection with the dumpsite only one family is residing in an aerial distance of 200 m and the remediation process will not affect them in any way.

**ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN:** The management plan proposed are for pre-remediation as well as during remediation stage. The mitigation measures are recommended for impacts from air, noise, water, leachate, health and safety, OH&S aspects. The proposed monitoring plan includes leachate, surface and ground water monitoring for a period of once in three months. The cost of [redacted] is required for implementation and supervision of EMP.

**SOCIAL MANAGEMENT AND MONITORING PLAN:** The social management plan proposed are for pre-remediation as well as during remediation stage. The mitigative measures proposed addressing concern of local community about remediation work, labour management issues, health and safety risks of labours, gender discrimination.

**EMERGENCY PREPAREDNESS PLAN:** The identified emergency situations which may arise from remediation activities are fire risk in summer, occupational health and safety related risks. The Koothattukulam police station at 1.0 km, Taluk hospital at 1.0 km, Koothattukulam Fire and Rescue station at 0.2 km are the nearest emergency services. Periodic Compliance monitoring system will be done by the contractor during remediation.

**PUBLIC CONSULTATION AND INFORMATION DISCLOSURE: A** Transect walk was carried out on 06.06.2023 covering the surrounding area of the dump site. Effective IEC drive to be initiated to engage with the community to build support as the activity will create positive impact. Warning sign boards and project information boards with full details of grievance redressal mechanism along with all related contact details will be installed at site during the process at the site. Site control measures should be enforced to prevent unauthorized personnel into the work site.

***Note: All the references to Social Impact Assessment and Social Management Plan may be referred to Part B- Social Impact Assessment which is a separate document attached along with this document.***

KSWMP

# സംഗ്രഹം

[redacted]

[redacted]

[redacted]

[redacted]

# CHAPTER 1 INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-Financing Framework agreement and as agreed Project Co-Lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio-mining of multiple Legacy Waste Dumpsites in various districts. There are 19 dumpsites identified for remediation under the Kerala Solid Waste Management Project. Several others have been taken up for remediation directly by the ULBs. Currently, 7 dumpsites are considered from three districts (Ernakulum, Alappuzha and Idukki) falling under Package B, selected by Kerala Solid Waste Management Project (KSWMP) for remediation. One of the selected dumpsite is Koothattukulam which is in Ward no 15 of Koothattukulam municipality, Ernakulum District.

## 1.2 The Rationale for the Proposed Sub-Project:

Koothattukulam dumpsite in Koothattukulam Municipality at ward no.15 has a total waste quantity of 2061.41 cum, spreading over 30 Cent. The site is located between Lat- 9°51'49.2" N and Long - 76°35'27.3" E and has an elevation of MSL +40 (m), with a flat terrain but a nullah flows at a distance of 20m from the dumpsite boundary in the southern side. During the monsoon season, due to the presence of a nullah near the site, leachate from waste flows towards the nullah, which then joins the Uzhavoor River on the western side of the site and the Uzhavoor River is at a distance of 1.2 km from the dumpsite in the southern side. Koothattukulam ULB proposes bio-mining and bioremediation of the Koothattukulam legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio-mining and bioremediation, it is proposed to undertake an

Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

## 1.3 Proposed Sub-Project Details:

Koothattukulam dumpsite is located at a distance of 0.65 km from the centre of Koothattukulam town in south-east side and encompasses total area of approximately 40 cents of land. Out of this, 30 cents of land are covered with solid waste. The dumps site is not very far from human settlement. The coordinates of the dumpsite are 9°51'49.2" N & 76°35'27.3" E. It is located in ward no. 15 of the municipality. Koothattukulam municipality holds the ownership of the dumpsite. In the northern direction, the municipal cattle market is located adjacent to the dumpsite. In the eastern direction, the existing Material Collection Facility (MCF) of Koothattukulam is within the compound of the dumpsite. The southern side provides access to the dumpsite, with the Nadappuram Bypass - Sreedhareeyam Hospital Rd passing through it. A small nullah flows southern side of the dump site within the distance of 20 m in the southern direction. In the northwest direction, there is a settlement located at a distance of 40 meters from the dumpsite. The exact date for start of the dumpsite was not available with municipality; however approximately it had started 40 years ago, the information has been gathered during field visit.

Currently, the quantity of waste dumped at this site is about 2061.41 cum. As of now 75 % of the area is covered with solid waste. The legacy waste present at site is about 0.8 m above and 3 m below from the existing ground level. Since there is a possibility of leachate pollution and other environmental issues associated with the open dump, bioremediation is essential to mitigate the impacts. Dumpsite reclamation involves excavation, screening, and separation of material from dumpsites into various components such as soil, recyclable materials, and residues.

## 1.4 Objectives and Scope of the EIA & SIA:

As per indicative categorization for dumpsite bio-mining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (40 cents), waste spread (30 cents) and absence of environmentally sensitive features around, this subproject is individually considered as E2, and EIA is prepared accordingly. Required monitoring and analysis are carried out considering the possible impacts.

The EIA & SIA process involves the identification of the potential environmental issues in the project and trying to address them during design interventions. The EIA & SIA further carries out impact prediction and evaluation of residual environmental and social issues of a Project. It then goes on to outline the proposed mitigation measures for residual impacts and enhancement measures for positive impacts which the Project will implement.

## 1.5 Structure of the Report:

The Consolidated EIA & SIA report has been structured into the following Chapters:

- Introduction and Project Description.
- Policy, Legal and Administrative Framework presents a review of the existing Institutions and legislation relevant to the project at the National and the State levels;
- Environmental Assessment Methodology discusses sequence of tasks carried Out in preparing EIA;
- Existing Environmental Scenario presents a consolidated picture of the existing Environmental setting of the project;
- Assessment of Potential Impacts identifies and quantifies the potential impacts on each of the environmental components due to the proposed project development;
- Analysis of Alternatives discusses the criteria for analysis of alternatives of technology for remediation.
- Mitigation Measures presents an elaborate listing of the nature of impacts on each of the environmental components and the avoidance and mitigation measures suggested.
- Public Consultation details the stages and types of public consultations carried out during the project preparation stage and people's perceptions of the project benefits and the Potential impacts;

# CHAPTER 2 POLICY AND REGULATORY FRAMEWORK

## 2.1 Applicable National, State Legislations and Technical Guidelines

**National Environmental Rules and Regulations: -**

To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed. A summary of environmental legislation/regulations relevant to project is furnished in the following **Table-2.1**.

*Table 2.1 Summary of Environmental Legislation /Regulations*

| Sl. No. | Act / Rules | Purpose | Applicable (Yes / No) | Reason for Applicability | Authority |
|---|---|---|---|---|---|
| 1 | Environment Protection Act, 1986 | To protect and improve overall environment. This is an umbrella Act. | Yes | As all environmental notifications, rules and schedules are issued under this act. | MoEF&CC, CPCB, SPCB |
| 2 | Solid Waste Management Rules, 2016 | To manage collection, transportation, Segregation, Treatment, and disposal of solid wastes (other than Hazardous water, Plastic Waste, Bio Medical waste) | Yes | Dumpsite remediation/ biomining | MoEF&CC, CPCB, SPCB |
| 3 | Air (Prevention and Control of Pollution) Act, 1981 | To control air pollution by controlling emission of air pollutants as per the prescribed standards. | No | No, Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 21 of Air (Prevention and control of Pollution) Act 1981. | State Pollution Control Board, Kerala |
| 4 | Water Prevention and Control of Pollution) Act, 1974 | To control water pollution by controlling discharge of pollutants as per the prescribed standards | Yes | Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 25 of this Act. | State Pollution Control Board, Kerala |
| 5 | The Noise Pollution (Regulation and Control) Rules, 2000 & amendments | The standards for noise for day and night have been promulgated by the MoEF&CC for various activities. | Yes | This act will be applicable for all construction equipment deployed at worksite and in operation. | State Pollution Control Board, Kerala |
| 6 | Public Liability and Insurance Act, 1991 | Protection from accidents. | Yes | This act will be applicable for providing immediate relief to the persons affected by accident occurring during work | State Pollution Control Board, Kerala |
| 7 | Central Motor Vehicle Act 1988 | To check vehicular air and noise pollution. | Yes | This rule will be applicable to vehicles deployed for construction activities and construction Machinery. | Motor Vehicle Department |
| 8 | The Plastic Waste Management Rules, 2016 | For the storage and disposal of plastic wastes through authorized vendors. | Yes | This act will be applicable for the storage and disposal of all the plastic wastes. | State Pollution Control Board, Kerala |
| **Other applicable Rules** | | | | | |
| 9 | Construction & Demolition, Waste Management Rules, 2016 | | | | |
| 10 | Batteries (Management and Handling) Rules, 2001 | | | | |
| 11 | E-Waste (Management) Rules, 2016 | | | | |

| | |
|---|---|
| 12 | Kerala Municipality Act, 1994 & Rules |
| 13 | Hazardous & Other Wastes (Management And Transboundary Movement) Rules, 2016 |
| 14 | Bio-medical Waste (Management & Handling) Rules, 1998 |

**Applicable Social and Other Legislation**

**Other legislations applicable to Sub-project activities under the project**

- Workmen's Compensation Act 1923 (the Act provides for compensation in case of injury by accident arising out of and during the course of employment);
- Payment of Gratuity Act, 1972 (gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years);
- Employees PF and Miscellaneous Provision Act 1952 (the Act provides for monthly contributions by the employer plus workers);
- Maternity Benefit Act, 1951 (the Act provides for leave and some other benefits to women employees in case of confinement or miscarriage, etc.);
- The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 is introduced to prevent and provide redressal of complaints of sexual harassment.
- The Protection of Women from Domestic Violence Act, 2005 defines domestic violence, describes the powers and duties of protection officers, service providers and lists the procedures for obtain reliefs.
- Contract Labor (Regulation and Abolition) Act, 1970 (the Act provides for certain welfare measures to be provided by the contractor to contract labour);
- Minimum Wages Act, 1948 (the employer is supposed to pay not less than the Minimum Wages fixed by the Government as per provisions of the Act);
- Payment of Wages Act, 1936 (it lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers);
- Equal Remuneration Act, 1979 (the Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees);
- Payment of Bonus Act, 1965 (the Act provides for payments of annual bonus subject to a minimum of 83.3% of wages and maximum of 20% of wages);
- Industrial Disputes Act, 1947 (the Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal

and what are the requirements for laying off or retrenching the employees or closing down the establishment);

- Industrial Employment (Standing Orders) Act; 1946 (the Act provides for laying down rules governing the conditions of employment);
- Trade Unions Act, 1926 (the Act lays down the procedure for registration of trade unions of workers and employers. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities);
- Child Labour (Prohibition and Regulation) Act, 1986 (the Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labour is prohibited in Building and Construction Industry);
- Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979 (the inter-state migrant workers, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home to the establishment and back, etc.);
- The Building and Other Construction Workers Act (BOCW), 1996 is a social welfare legislation that aims to benefit workers engaged in building and Other Constructions Works.

## 2.2 The World Bank Safeguards Policies, and KSWMP ESMF

The World Bank policies and directives on environmental and social safeguards have adhered to the dumpsite remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are summarized in the following table.

**Environmental Codes of Practices (ECoP):** The ECoPs provide guidelines for environmental management of bio-mining and bio-remediation activities which are seen to be of limited extent of impacts/risk, temporary and reversible, and readily managed with good practices during the implementation. The following key points should be considered.

**Key Points of ECoP to be considered:**

- The bio-mining activities and preparatory activities shall follow the "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" published by CPCB in February 2019.
- Bio-mining methods include Tractor Tiller, Trench method, Cone Method, windrow, Thin Layer Method, etc. More appropriate may be the Cone method for legacy waste and window for relatively fresh waste.

- Leachate channelization and treatment facility shall be set up before starting the bio-mining works. Works shall take place only during the non-monsoon period; and there shall be suitable precautions to prevent any rainwater disturbing the operations (like seasonal unexpected rains, storm water, runoffs from other sources).

- Ballistic separator and trommel may be used for screening. Screened fractions into which waste is segregated include RDF, inert, Compost, and C&D wastes.

**Applicable World Bank Operational policies**

- OP 4.01 Environmental Assessment Help to ensure the environmental and social soundness and sustainability of investment projects. Support integration of environmental and social aspects of projects in the decision-making process
- OP 4.04 Natural Habitats Promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions.
- OP 4.09 Pest Management includes training to prevent risk to human beings or animals from Bio-culture, enzymes, insecticides and such formulations used for remediation.
- OP 4.11 Physical Cultural Resources (PCR) includes resources of archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites), aesthetic, or other cultural significance. Assist in preserving PCR and in avoiding their destruction or damage. PCR
- WB General EHS Guidelines Recommendations of these guidelines would be incorporated in EMP & SMP and Bidding document for this project.

The Environmental Management Framework (EMF) has been prepared to assist screening, assessment, and management of environmental risks of all solid waste management projects at an early stage during the planning and integration mitigation hierarchy during the subproject design, implementation, and operation. The framework helps provide specific guidance on the policies and procedures to be followed for environmental assessment along with the roles and responsibilities of the implementing agencies.

# CHAPTER 3 ENVIRONMENTAL AND SOCIAL BASELINE

## 3.1 Project Location of the site

Koothattukulam dumpsite is located at a distance of 0.65 km from the center of Koothattukulam town in south-east side and encompasses total area of 40 cents of land. Out of this, 30 cents of land is covered with solid waste. The coordinates of the dumpsite are 9°51'49.2" N & 76°35'27.3" E. The dumpsite is surrounded by municipal cattle market in Northern direction, MCF in the Eastern direction and a Settlement in the NW side at a distance of 40m from the dumpsite. A small nullah flows in southern direction of the dump site at a distance of 20 m. In the surrounding area of the dumpsite, around 3-5 households are residing within a 100m radius, and one household is located at 25m. Nangelil Ayurveda Hospital 200m away, Devamatha Hospital 300m away from the project location. The google map image showing the location of Koothattukulam dumpsite is shown below in **Figure: 3.1**.




*Figure 3. 1 Google Image Showing the Locations of the existing Dumpsite at Koothattukulam*

## 3.2 Methodology for Environmental Baseline Studies

The baseline appraisal should consider all aspects of the environment that may be altered by the proposed project. These can be categorized as physical, biological or socioeconomic attributes. The baseline should be based upon the findings of the screening and scoping studies. Surface water and sediments, groundwater, air quality, noise, soils and land use Biodiversity Socio-economic (social), cultural heritage, traffic and transport Physical Biological Socio-economic. The scope of the baseline study, including attributes that will be appraised, and the geographical extent of the analysis, will typically have been agreed with the relevant decision makers as an outcome of the scoping phase. It is important to re-emphasize that the scope (and detail) of the baseline study should be commensurate with the size and scale of the project and hence the potential changes that the project may have upon the environment and society. The baseline study will typically be developed in three stages:

**Desktop study:** Office-based exercise during which readily available existing information (i.e. that can be used to describe the existing environment) is collected and reviewed to ensure its appropriateness for use within the EIA & SIA;

**Field study:** The stage within which additional data is captured in the field, with the intent of addressing any gaps that have been identified in the existing knowledge base; and

**Reporting stage**: Collation of the captured information into the baseline report.

The below table indicates the environmental attributes and location of monitoring.

*Table 3. 1 Environmental Attributes*

| Sl. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | Upwind direction in North East boundary of the dumpsite. | The AAQ locations were chosen based on the Wind rose data obtained for Koothattukulam. The most predominant wind direction are from West and WSW. |
| | | | Downwind direction in West South West (WSW) boundary of the dumpsite | |
| 2 | Noise (1 Location) | Ambient Noise level [E(P)] for 24 hours | At the entrance of the dumpsite. | Most vulnerable point in the site in regards of Noise quality is due to entry and exit of the waste loading and unloading |

| Sl. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| | | | Distance 4 m from the boundary of dumpsite. | vehicle. Please note that the site is devoid of proximity to any sensitive receptors within a 200 m radial circle . |
| 3 | Surface water (2 Location) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, Ecoli and Total coliforms (IS 10500-2012). | Surface water sampling location Upstream and downstream of nallah at 20 m from the dumpsite. | Surface water sample points are selected based on the water flow from upwards to downwards and for this site, it is South-East to South-west. |
| 4 | Ground water (2 Locations) | Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total coliform (IS 10500-2012). | Groundwater sampling location at 47 m distance in Southern direction.<br>Groundwater sampling location at 35 m distance in North East direction. | |
| 5 | Bore Hole (1 location) | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coeff of permeability, Strength compressibility (vertically-3 samples per borehole). | Centre of the dumpsite | Volume of legacy wastes were found to be higher in the center part of the dumpsite during investigation. So the bore hole test was performed in the center. |

| Sl. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| | | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammonical nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | Centre of the dumpsite | |
| 6 | Waste & Environmental Analysis | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | Centre of the dumpsite | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor | 1 sampling location | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. |

## 3.3 Environmental Audit of the Existing Dumpsite

There is a-functional MCF for dry waste within the Koothattukulam dumpsite compound. The MCF is not supported under KSWMP under this subproject. However, an environmental audit of the facility is important as this may be used as an associated facility to which some recyclables may be channelized to and since it is situated at the same site, might be impacted during the bio-mining activities.

*Table 3.2 Environmental Audit of Existing facilities*

| S. No | Aspects | Remarks |
|---|---|---|
| 1 | Structural Characteristics | Area - approx. 100 (in Sq. m)<br>Buffer/setback around the MCF – 3 ft<br>Distance from waste pile of dumpsite- 10 m.<br>Roof: (GI Sheet Roof. Good condition) |

| | | |
|---|---|---|
| | | Floor (Cement Floor, Good Condition)<br>Walls: (Concrete, Good Condition)<br>Doors & windows: Available, but during bio-mining dust emission and odor can impact the MCF facility. |
| 2 | Functional Characteristics (MCF & BSF Units) | Activities in the MCF: Functional<br>Materials and condition of stacking: Yes<br>Activities spilling out onto the dumpsite: Yes<br>Access to the MCF (Common access for MCF & Dumpsite. Both are in the same premises.)<br>No: of workers - 40 |
| 3 | Facilities (MCF & BSF Units) | Parking area-NIL<br>Loading/unloading Area- NIL<br>Storage room & area: NIL<br>Worker snack/rest areas: NIL<br>Worker / other washrooms & sewerage: Yes<br>Water supply for Cleaning, Washroom: Yes<br>Greenbelt: NIL |

## 3.4 Physiography and Climate

**Physiography**

Koothattukulam is situated in the southern part of India, in the western coastal region. The topography of the region is characterized by gentle slopes and undulating terrain, typical of the Western Ghats and the coastal plains of Kerala. The town have a mix of flat and slightly hilly areas, with elevation changes depending on the specific location within the town.

**Climate**

Summer season begins from March and ends in May. The climate in Koothattukulam during the season is moderately hot and humid. Like all other places in Kerala, Koothattukulam experiences heavy showers during monsoon season. Most of the precipitation here falls in June - August with an average of 568 mm. The warmest month of the year is March with an average temperature of 31 °C. January is the coldest month, with temperatures averaging 23.5 °C. So, the favourable time for remediation is between October-2023 to March-2024 non-monsoon period. As per wind rose diagram, the most predominant wind directions are blowing from WSW and West direction, hence it was being considered for AAQ monitoring location. The wind rose diagram for Ernakulam is shown in **Figure: 3.2.**



**Source:** meteoblue

*Figure 3. 2 Wind rose Diagram for Ernakulam*

## 3.5 Hydrology, Hydrogeology, and Soil

**Hydrology**

Koothattukulam municipality is situated within the Muvattupuzha river basin, making its hydrology closely interconnected with this vital water system. The municipality's hydrological characteristics are influenced by the intricate network of rivers, streams, and tributaries that form the Muvattupuzha river basin. Notably, a small nullah flows southward in close proximity to the dumpsite.

**Hydrogeology**

The occurrence and movement of ground water is mainly controlled by factors like physiography, geological setting, etc. The ground water table level ranging from 2 to 5 mbgl during most of the year.

**Geology**

The geology of Koothattukulam is predominantly of charnockite group. The geology map of Ernakulam District is shown in **Figure: 3.3.**

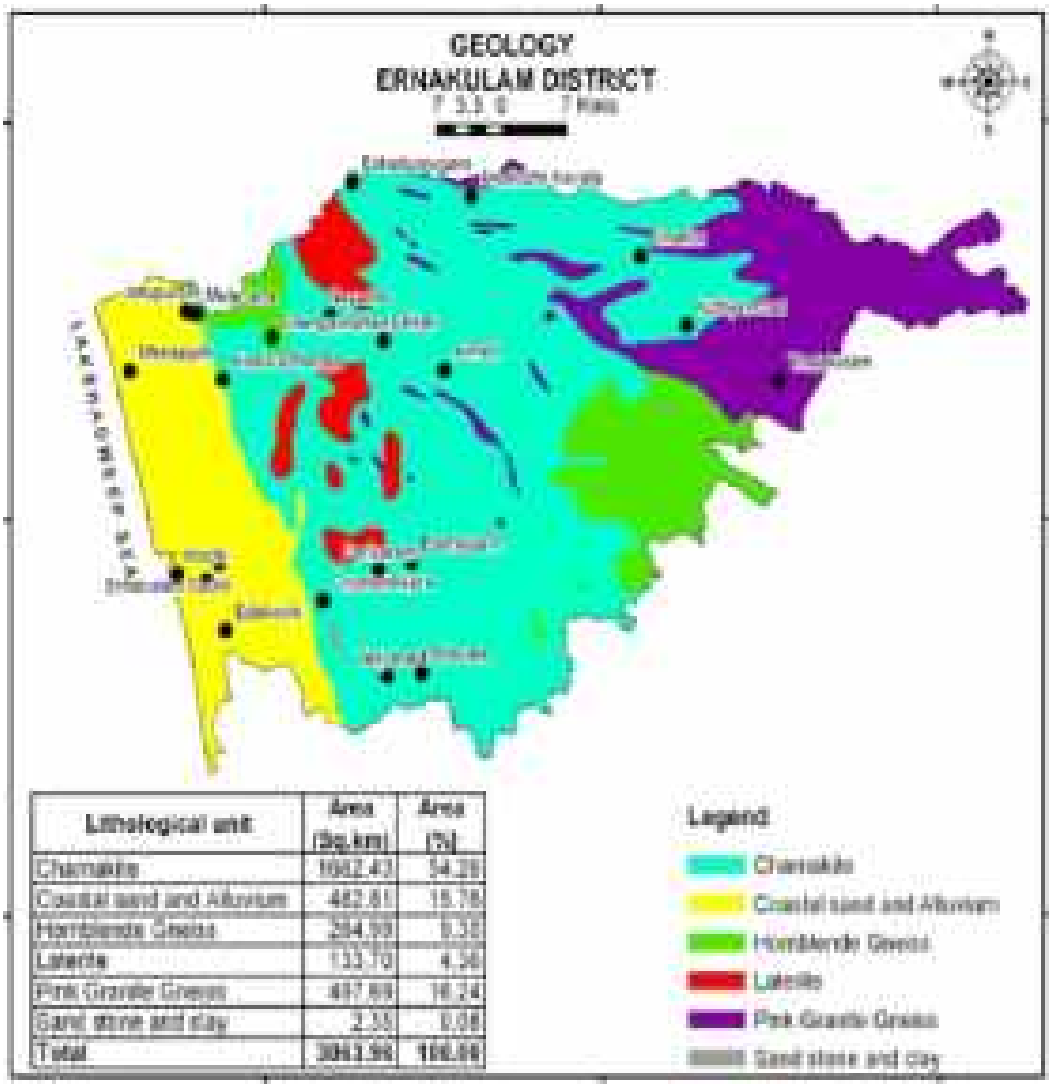
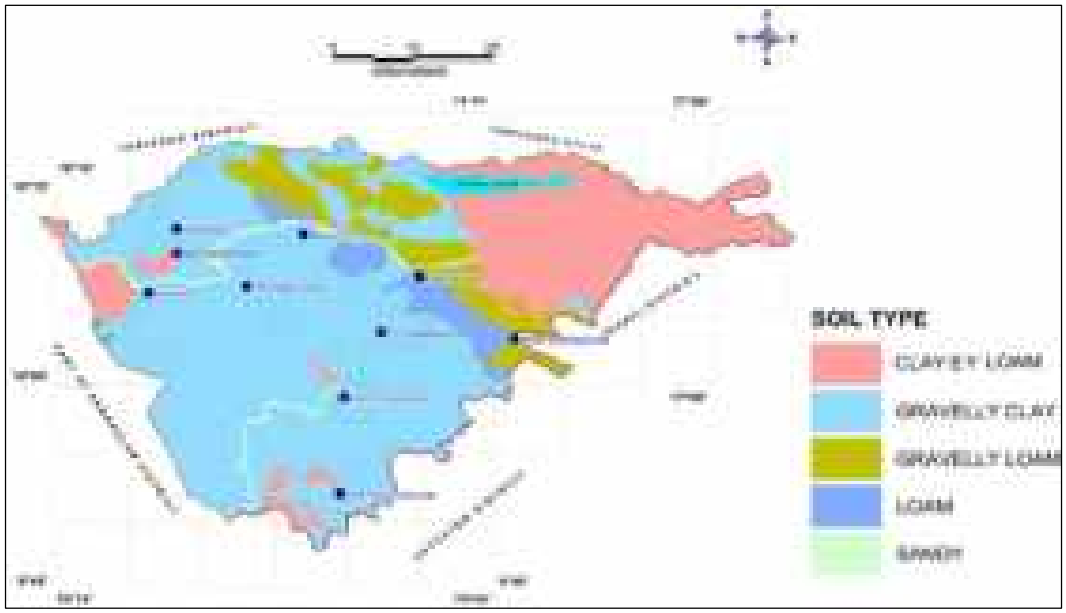



*Figure 3. 3 Geological Map of Ernakulam District*

**Soils**

As per the geotechnical investigation, the soil was encountered at 3 m below the waste depth of the dumpsite and the predominant soil is gravelly clay. The detailed geotechnical investigation report is enclosure in the FR. The soil type of Ernakulam is shown in **Figure: 3.4.**




***Source:*** *CGWB, Ernakulum*

*Figure 3. 4 Map Showing Soil Type of Ernakulam District*

## 3.6 Land Use & Land Cover

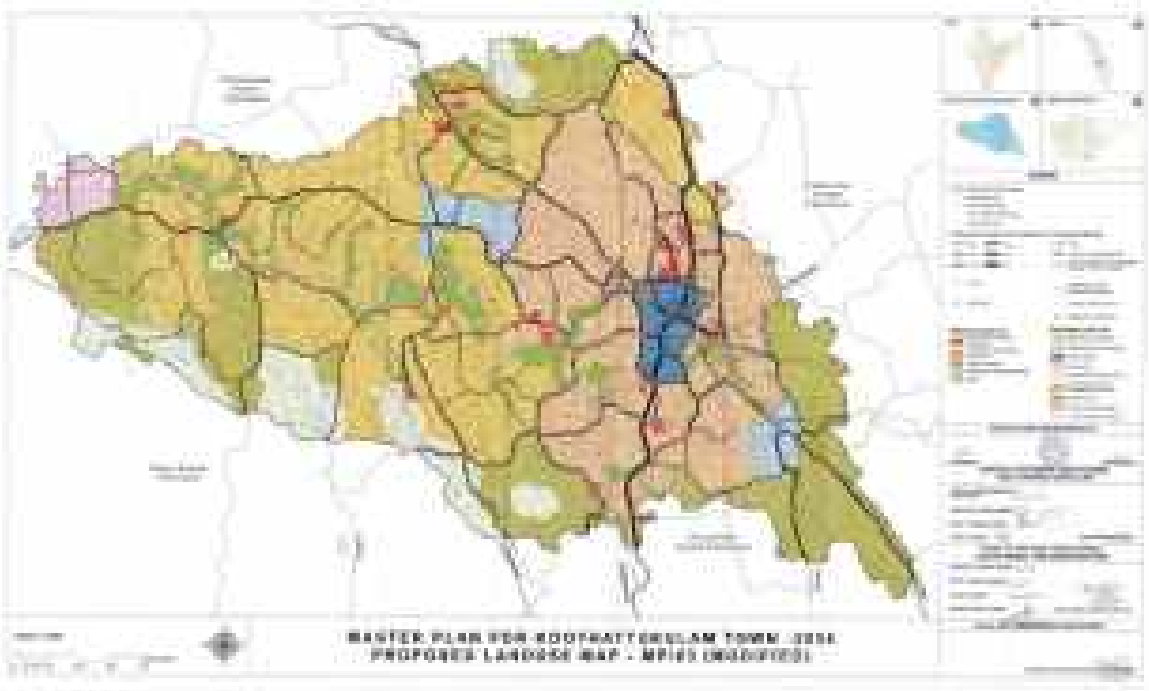
The land use survey of 2009 revealed that the predominant land use of Koothattukulam Municipality is residential. 18.38% of the total area is under residential use. Existing land use analysis shows following breakups as shown in table 3.3. The glaring aspect of existing land use of Koothattukulam municipality is blessed with potential resources such as agriculture land and water bodies.

The highest percent of land use falls under the category residential/agricultural mix, which includes mainly dry agriculture lands where in residential developments are co- existent. The main cash crops are: rubber, paddy, coconut, areca nut, ginger, turmeric, kacholam and pepper.

*Table 3.3 Landuse & Landcover Map of Koothattukulam Municipality*

| Landuse | | | Area in ha | % of Total Area | % of Developable Area |
|---|---|---|---|---|---|
| Residential | | | 421.65 | 18.19 | 18.38% |
| Commercial | | | 31.76 | 1.37 | 1.38% |
| Industrial | | | 12.98 | 0.56 | 0.56% |
| Public & Semi public | | | 42.65 | 1.84 | 1.86% |
| Open space | | | 0.23 | 0.01 | 0.01% |
| Traffic & Transportation | | | 85.77 | 3.7 | 3.73% |
| Agricultu re | Dry Agriculture | Plantation | 1168.51 | 50.41 | 50.91% |
| | | Mixed crops | 397.08 | 17.13 | 17.3% |
| | | Total | 1565.58 | 67.54 | 68.22% |
| | Wet Agriculture | | 129.34 | 5.58 | 5.64% |
| | Agriculture Total | | 1694.93 | 73.12 | 73.87% |
| Barren Land | | | 0.93 | 0.04 | 0.04% |
| Vacant Land | | | 3.71 | 0.16 | 0.17% |
| Water body | | | 23.41 | 1.01 | |
| **Total** | | | **2318.01** | **100** | **100** |

**Source:** Masterplan for Koothattukulam Municipality



**Source:** Masterplan for Koothattukulam Municipality

*Figure 3. 5 Map Showing Landuse of Koothattukulam Municipality*

## 3.7 Cultural Heritage

In Koothattukulam, the Koothattukulam Mahadeva temple is of great significance from different viewpoints such as historical, architectural, archaeological and cultural. The temple has a prominent place among the 108 famous Shiva temples in Kerala.

## 3.8 Ecology and Biodiversity

The wild faunal species present are, mainly dogs, rodents and flies, seen near to the dumpsite. Also, crow, egrets, and other birds are seen feeding on the wastes. The flora includes shrubs, tubers, and trees.

## 3.9 Site Connectivity

The state highway –MC Road is passing about 500 m away in the SW direction from the dumpsite. As per IRC, the highest design service volume is 3600 PCUs/Hr which has not been achieved during the peak period. There will be a marginal increase in traffic of medium sized vehicle (trucks) due to the forward linking of recovered products from dump site (i.e. For compost, plastic and other recyclable waste). The total number of vehicles will be operational at the dumpsite is 5 numbers per day which increase the traffic load by only 0.1% per hour. These vehicles will operate within an operational period of 8 hours per day, reducing the impacts to negligible.

## 3.10 Natural Disasters

As per the district disaster management plan-2015 and flood vulnerability map, the dumpsite is not under flood prone zone.

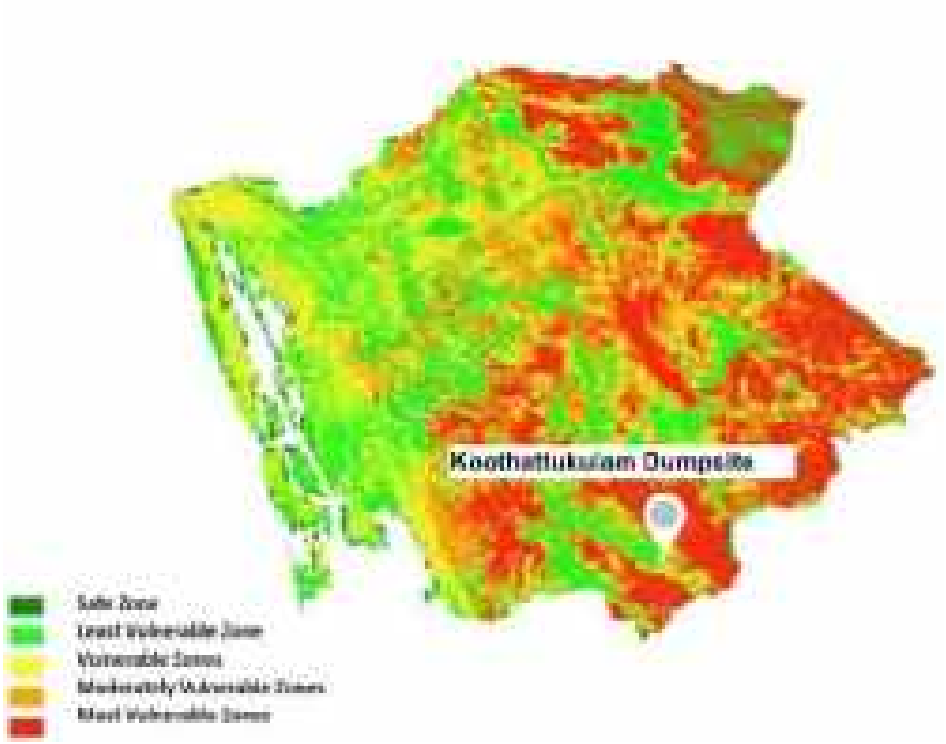



*Figure 3. 6 Map Showing Flood Vulnerability Map of Ernakulam District*

## 3.11 Description of Environmental Parameters

*Table 3. 4 Description of Environmental Baseline Parameters*

| No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| 1 | Water Supply<br><br>a) Surface water<br>b) Ground Water | A) Surface water: Nullah is 20 m from the site in Southern direction and Surface water sample was collected and the test results showed – all parameters are well within limits except BOD. | Site Drainage & leachate Impacts due to bio-mining activity (esp during any seasonal rain) is important as far as the nearby soil |

| No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | | B) Ground Water collected from 2 different locations (Residences within 200m radius)– all parameters are well within limits except for colour and Turbidity. | & water environment are concerned. |
| 1.2 | Leachate | Sample collected within the dumpsite in the southern side. The data indicates that the TDS is about 367 mg/l while the suspended solids is about 142mg/l. The chlorides are low at 52.1 mg/l, while the COD, BOD are 480 mg/l and 110 mg/l respectively. The measured parameter values are found to be below the permissible limits. The heavy metals are found to be low, hence the soil is unlikely to be contaminated by heavy metals from the waste. | |
| 1.3 | Air Quality | Air samples were collected from 2 locations along the boundary of the dumpsite and results found to be well within the permissible limits | |
| 1.4 | Noise Level | Noise Level monitoring samples collected at a distance of 4 m at the entrance of the dumpsite. Since the dumpsite is in a commercial area; Daytime (6:00 AM - 10:00 PM): The permissible noise level is 65 dB in a commercial area; Nighttime (10:00 PM - 6:00 AM): The permissible noise level is 55 dB in a commercial area should be considered. The observed values ranges from 48 dB (A)– 56.5 dB (A) Day time which is within the permissible limit. | Proper remedial measures for increased noise level shall be ensured by the contractor while bio mining activity. |

# CHAPTER 4 ANALYSIS OF ALTERNATIVES

## 4.1 Alternative 1: Zero or No Project Alternative (without Dumpsite Remediation)

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevent further contamination of the site. If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows.

1. Foul Odor Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.

2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.

3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.

4. Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the surrounding environment, disrupting natural habitats and causing long-term ecological imbalances.

5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

## 4.2 Alternative 2: Mode of Execution / Management Alternative

Koothattukulam Municipality intends to complete the remediation project as earlier. However, considering the time required for mobilization, installation, sieving and handling recoverable etc., a time frame of about six months will be considered. The broad timeline chart for the execution of this project is given in below **Table – 4.1**.

*Table 4. 1 Timeline Chart For Execution*

| Sl. No. | Task Name | M 1 | M 2 | M 3 | M 4 | M 5 | M 6 |
|---|---|---|---|---|---|---|---|
| 1 | Planning & Mobilization | ■ | | | | | |
| 2 | Foundation & Civil Works (Cover Shed installation) for machineries , Hiring & Installation of Machineries, Electrical Works | ■ | | | | | |
| 3 | Excavation of Legacy Waste | | ■ | ■ | | | |
| 4 | Site Development for Windrows & Leachate Collection | | | ■ | ■ | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | Windrow Formation & Spraying of Bio culture | | | | | | |
| 6 | Sieving Operations | | | | | | |
| 7 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | | | | | |
| 8 | Project Closure Activities:<br>• Levelling of Reclaimed Land using Bio-soil<br>• Handover the available infrastructure at site to the ULB<br>• Closure Report Submission to ULB, | | | | | | |
| 9 | Buffer Period (Rainy Season) | - | | | | | |

## 4.3 Alternative 3: Technology Alternatives

The selection of the appropriate method or technique for remediation is determined by considering several parameters. These include the significant aspects and suitability of remediation types such as,

1. Capping without land recovery,
2. Bio-mining – reclamation/recovery of 100% land
3. Capping with partial land recovery.

Additionally, factors like available resources such as manpower, machinery, finances, and physical site conditions, including the quantity and characteristics of legacy waste, Environmental baseline, social concerns, regulatory compliance (KSPCB/NGT), the need for complete land recovery, and opportunities for utilization of processed aggregates/by-products are taken into account.

After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

# CHAPTER 5 ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

Bio mining and bioremediation of existing legacy dumpsites brings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more man-days at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, bio-mining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration) are important in this case. In addition to the below mentioned,

(i) Drainage and leachate flow into regional waterbodies (& esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies,
(ii) Pollution on land/soil, dust and odour nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks,
(iii) Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and
(iv) Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at this stage, while some would be known only based on the project details that would be known from the work plan of the contactor once on board.

## 5.1 Impact Assessment Methodology

Impacts are assessed based on Magnitude, Duration, and Significance of the impacts and sensitivity of the receptors present within the 500 m aerial distance of Koothattukulam dumpsite.

### 5.1.1 Magnitude and Duration of Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Bio-mining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;
- The spatial extent of the potential impact;
- Reversibility of the Impact;
- Legal standards and established criteria.

- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table Aspects for Determining the Magnitude of Impacts. Magnitude is assessed as medium, considering shorter duration of the activity. However, magnitude of cumulative impacts of various dumpsite remediation might be High.

*Table 5. 1* Aspects for Determining the Magnitude of Impacts

| Aspects | Large | Medium | Small | Negligible |
|---|---|---|---|---|
| **Duration of the potential impact** | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or Less than the lifespan of the program | Temporary with no detectable potential impact |
| **Spatial extent of the potential impact** | Regional – much beyond project boundaries | Beyond immediate Program components, site boundaries or local area | Within program boundary (but cumulative impact of various dumpsite biomining activities will be on larger extent) | A specific location within program component or site boundaries with no detectable potential impact |
| **Reversibility of potential impacts** | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months | Baseline remains constant |
| **Legal standards and established professional criteria** | Against national/approved standards and or international guidelines/obligations | Complies with limits given in national standards but not confirming to international lender guidelines in one or more parameters | Meets minimum national standard limits or international guidelines | Not applicable |
| Likelihood of potential impacts occurring | Commonly occurs under typical operating or construction conditions (Certain) | Usually seen occurring under most | Occurs under abnormal, exceptional or emergency | Unlikely to occur |

| | | | | |
|---|---|---|---|---|
| | | situations (Likely) | conditions (Occasional) | |

NOTE: Anticipated Project Duration - 5 to 6 months

### 5.1.2 Sensitivity of Receptor

The sensitivity of a receptor shall be determined based on a review of the population (including proximity/ numbers/ vulnerability) and the presence of features on the site or the surrounding area. In the surrounding area with 200 m there are 40 Households (With one household situated 25m from the boundary of the dumpsite on the northwest side, located on an elevated ground) and Nangelil Ayurveda Hospital 200m away, Devamatha Hospital 300m away from the dumpsite. But there is not much of sensitive receptors near to the dumpsite. Hence sensitivity of receptors will not affect much to the bio-remediation process of the dump site and can be categorized as low Vulnerable receptor capacity to absorb proposed changes or/and good opportunities for mitigation.

### 5.1.3 Significance of the impact

The significance of the project impact is tabulated below: -

| **Project Details** | **Sensitivity** | **Vulnerability of Resource** | **Importance of Resource** |
|---|---|---|---|
| No project Impacts | Medium | Medium | Medium |
| Project with Bio Remediation (mining) | Low | Low | Low |

Overall, Bio mining will have a Low impact, with more of a positive Impact on the Environment and Human health in longer term.

**Source-Pathway-Receptor Analysis**

A) **Source:** The source of contamination is the legacy waste remaining and being deposited at the Koothattukulam closed dumpsite, more specifically the landfill gas and leachate generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. In this case the waste is more than 40 years old, as dumping had started in year 1981 and still functional. The total waste volume is 2061.41 cu. m with the dumpsite spread over 30 cents and the legacy waste is about 0.8 m above and 3 m below from the existing ground level. In addition to the landfill gas and leachate, windblown dust and litter are also considered as sources of contamination.

B) **Pathways:** The following pathways for migration of contaminants have been identified: Wind- The main pathway for litter and dust dispersion is the wind. As long as the waste is kept uncovered, the dust and litter will continue to be blown off the dumpsite to the surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. Rainwater runoff through the dumpsite acts as a pathway for transport of leachate to the soil and groundwater. The rainwater flowing off the dumpsite towards the eastern side along the boundary of the dumpsite. Since, there is boundary wall

in the eastern side and the site area is a flat terrain the water will not get out of the dumpsite. But, during heavy rainfall, the runoff from the dumpsite will flow towards the nullah and join the Uzhavoor River that flows within the town region.

The leachate flows with groundwater and acts as the pathway. Surface water contaminants like run-off from the dumpsite, leachate and windblown dust and litter that reach nearby surface water bodies like canals and rivers are further transported by surface waters and in this case the surface water acts as the pathway.

C) **Receptors:** Receptors are air, surface water (drain passing through residential areas) and ground water. For drinking purpose, they mainly use municipal water supply (about 40 Nos Households within 200 m and 1 households at 25m distance), soil, flora, fauna and humans. In the case of remediated dumpsite, the most prominent group of receptors are the nearby residences. As the dump is not contaminated by hazardous wastes, remediation would improve the pollution scenario provided the bio-earth used is pollution free and of good quality. However, other impacts are expected on the final destinations of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF/MRFs in the region. Depending on the locations of end use of fractions retrieved from bio-mining, the contractor shall assess the impacts on communities and workers on site & nearby; and near locations of end-use. Key impacts may result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after bio-mining activity, activities in bio-mined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post bio-mining activity.

## 5.2 Impacts on Air Environment

Key impacts on air include:

- Emission of Methane and other Greenhouse gases; and its impacts on scavengers, workers on site/other facilities on site (MCF in this case), nearby communities of Ward 15.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odour, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.

## 5.3 Impacts on Water Environment

**Ground water**

- Borehole data indicates waste upto depth of 3m with clayey strata after that. Hence it is expected that the ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. Slightly high BOD levels of the drain and ground water wells around are indicative of leachate and runoff pollution. Oozing & pooling of leachate & it draining to nearby areas during rains

would be an important aspect to be managed during bio-mining to prevent ground water contamination

- Leachate samples: BOD, COD, TDS exceeding limits may impact the ground water quality in nearby residences, wells, and long term soil pollution.
- Borehole data: Dump below water table may impact water resources and wells nearby.
- Ground beneath the dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. There are no parameters exceeding the permissible limits for heavy metals.

**Surface water**

- The dumpsite experienced flooding during 2018 floods but the site is not in the flood plain as per KSDMA Map. The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas. Nalluh is at a distance of 20 m from the dumpsite in the southern side.
- Gentle slope is in the Eastern Direction. At Western and southern direction, (end direction) there are residential households and dry vegetation. During rainy season leachate from the site flows to the Eastern side of dumpsite. Since, the dumpsite is having boundary leachate flowing outside the dumpsite is not possible, but during heavy rainfall the runoff may flow towards the nearby nalluh. It is important to contain and treat leachate from the proposed bio-mining activities on site. Treated leachate may be recirculated or used for other purposes.

## 5.4 Impact due to Odour

Dumpsite of organic, or partly organic waste, always results in anaerobic degradation of the waste and consequently, the production of landfill gas, consisting mainly of methane, $H_2S$, Ammonia, and carbon dioxide. If not properly managed the gas can cause odor problems in the neighborhood and since landfill gas is a highly potent greenhouse gas it will also contribute to the increased level of greenhouse gases (GHG) in the atmosphere. Dumpsite gas may also increase the risk of fires or explosions at the landfill site and surroundings.

## 5.5 Impact on Noise

A potential nuisance is a noise from transport of vehicle and machinery operating during remediation phase of the Dumpsite and transports of waste to the Dumpsite. The topography is favorable to attenuate noise to the surroundings. The distance to nearby residential areas is at 30m with 3 households. Hence, the impact will be higher during remediation to the residents.

## 5.6 Impacts on Soil

- Historic land use assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it shall be

excluded from the site as bio-mining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.

- Spillover of activities to nearby road and land would result in pollution of all types on these areas. Hence it is important to restrict all activities to the site for legacy waste bio-mining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.

- Ground beneath dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. In Koothattukulam, all heavy- metals are falling within the limit as per Fertilizers Control Order 1985 and its amendments. Koothattukulam does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste (including legacy asbestos), e-waste or biomedical waste is found while biomining, same shall be retrieved, transported, treated and disposed as per specific waste guideline of the Central Pollution Control Board, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste), Feb 2019) and World Bank EHS Guidelines. A plan shall be prepared to auditing of all wastes, management, eliminating pollution & OHS risks; and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.

## 5.7 Other impacts on Biodiversity - Fauna/Flora

- There are no sensitive biodiversity areas within 10 km of the site. However, since the project involves transport of wastes, it is important to consider the impact beyond the project boundaries. Within 36 Km from the site, there is an Idukki Wild life sanctuary.
- Fauna: impacted by direct consumption of the solid wastes, sharps, entanglement, or by consumption of plants and/or animals contaminated by wastes, or as a result of leachate effects on groundwater and surface water.
- Flora: Plants near open dumpsites can be impacted directly by the waste, dust or smoke from burning. Disturbance to vegetation due to machinery, trampling by foot, vehicle or animals, or contamination by waste or leachate, the migration of landfill gas, or as a result of burning or smoke.
- Disturbance to other fauna and flora on site: onsite activities including those related to MCF may also impact fauna/flora through high noise levels of pre-construction / construction activities.
- Biodiversity of existing site: Available biodiversity of existing site is mentioned in the Environmental Baseline session and there is no key species identified which are listed by IUCN.

## 5.8 Other Impacts on existing or proposed activities on site/s

- There may be approvals from various agencies for bio-mining activities and associated facilities; depending on utilities and uses on site & associated activities. These permits shall be obtained prior to initiating activities on site.
- Impacts of bio-mining on existing facilities on site such as MCF, etc. (disturbance to activities & people due to dust, leachate, noise, odour; additional load of wastes to these facilities, vibration impacts & structural damage, etc).
- Post bio-mining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped, or if this is dumped elsewhere or not processed, it will lead to health and environmental issues. This alternate location, being associated facility need mitigation measures to avoid/minimize pollution, Health & Safety impacts on workers, communities. Also, forward linkages are considered as associated facilities/linked activities. Impacts of transportation of these fractions (traffic increase, odor, leachate, dust), impacts during rains & emergencies, handling, storage at the identified locations, reuse etc. shall be mitigated.

# CHAPTER 6 ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN

## 6.1 Proposed Environmental and Social Management Plan

The detailed Environmental and Social Management plan is presented in the below table.

*Table 6. 1 Proposed Environmental Management Plan*

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| *A* | **Planning and Pre-Construction Stage** | | | |
| | ***Planning for bio mining facility*** | | | |
| 1 | Bio mining & Bioremediation Plan & Capacities | • Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / biomined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these biomined material in line with the agreements with such facility owners and National, State regulations and WB EHS<br>• Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate Management Plan.<br>• The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers.<br>• Contractor to get all required licenses & permits before start of any activity on site | Contractor | SPMU/DPMU/ULB |
| 2 | Site Access Closure | • The total cessation of dumping in the site will be implemented before any works.<br>• All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public.<br>• The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance to indicate that the waste dump has been closed from the operation.<br>• To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br>• Grading shall be performed where necessary to provide a neat appearance | ULB or Contractor as per Bidding mechanism | SPMU/DPMU/ULB |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – *impact on air quality, odor, water contamination due to leachate, health and safety impacts of the people working in the site assessment* | ▪ Carry out site assessments as per Guidelines for Biomining of Legacy Waste Dumpsites of CPCB<br>▪ Consider safe biomining & gas / leachate generation from existing capped portion of the site<br>▪ Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means<br>▪ Provision of appropriate PPE's to the team undertaking the site assessments<br>▪ Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>▪ Plan for machinery operated which will be operated by skilled operators at all times.<br>▪ Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures.<br>▪ Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | TSC, ULB, Contractor | SPMU/DPMU/ULB |
| 4 | Absence / Delay in Permissions for Developing the biomining facility and associated works as per National regulations | ▪ Required permissions for undertaking biomining at the existing dumpsite and assessments conducted for undertaking biomining as per existing Laws, Regulations; including for associated infrastructure, DG Sets, Consent to Establish; and other licenses including those as per Labor Laws, before the start of works on site | Contractor, ULB | SPMU/DPMU/ULB |
| 5 | Dust impacts due to Site works, screening & stacking of retrieved wastes *(Air Pollution) and Visual Blight due to excavation* | ▪ Plan to Provide temporary high screen, buffers around the site before the start of work to curtail dust emissions<br>▪ Arrange a green belt as early as possible on the area of the site with no / less dump. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers)<br>▪ PPEs to be used by workers<br>▪ Awareness to communities & suggest to use PPEs | Contractor and or ULB depending on agreement on bidding mechanism/DPR | SPMU/DPMU/ULB |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 6 | Material sourcing, transport, and stacking of construction materials *(Occupational Health and Safety issues and Air noise pollution)* | ▪ Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism<br>▪ Prior intimation to nearby Primary Health Centre on work activities need for medical support, emergency support needs, type of laborers on-site and labor camp if any<br>▪ Materials shall be sourced only from approved quarries<br>▪ Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions.<br>▪ The driver should be with required license and follow speed regulations<br>▪ Materials shall be transported preferably through well-surfaced roads. If road it kuchcha, water sprinkling shall be done to prevent dust emission before and after truck passes<br>▪ Material transport and unloading activities should not result in noise disturbance to locals and should be during daytime<br>▪ Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors.<br>▪ Provide vehicle wheel wash area on site<br>▪ Workers to be provided with Personnel Protection Equipment (PPE) including safety boots, jackets, ear muffs, gloves.<br>▪ Proper rest area on site shall be provided with water, first aid, toilets | Contractor | SPMU/DPMU/ULB |
| 7 | The layout of Labour camp *(Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)* | ▪ Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp<br>▪ Nearby health center shall be informed about the labor camp & appropriate medical checkup shall be arranged periodically<br>▪ Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters)<br>▪ It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with landowners wherever the labour is accommodated<br>▪ Camp must not be provided in an area prone to Hazards<br>▪ Camp should be adequately at higher plinth levels to prevent water intrusion<br>▪ Rooms shall be of appropriate sizes with adequate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG)<br>▪ Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female labourers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc. | Contractor | Site engineer of SPMU, Labour Commissioner, PCB |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | ▪ The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security<br>(Refer ECOP section 06 and section 11 of EMF for KSWMP) | | |
| 8 | Nearness/disturbance to sensitive areas such as forests, wildlife habitations, etc. especially in case of providing support facilities *(Impacts on Fauna / Flora)* | ▪ Ensure site selection for any support facilities or activities (such as vehicle storage etc. if no in bio mining site) based on the screening checklist and the master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate, Reduce. Obtain requisite permissions from respective authorities such as Pollution Control Board, ULB etc.<br>▪ Identify appropriate government site to avoid land acquisition and resettlement impacts<br>▪ Covered and well-marked storage area with cut off drains & odour/fly/dust/ fire prevention shall be ensured for excavated wastes and washing, segregation of the same are to be arranged with due consideration to nearby residences, slope and other landuses | Contractor | SPMU/DPMU/ULB |
| 9 | Contamination of groundwater due to leaching. Leachate parameters; BOD, COD, TDS, Ecoli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution | ▪ During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant<br>▪ Depending on the contractors plan for biomining of the site, adopt plans to manage leachate | Contractor | SPMU/DPMU/ULB |
| 10 | Impacts on flora, fauna" consumption of wastes, leachate impacts, dust smoke burning, trampling/machinery | ▪ Movement routes of vehicles to be planned to avoid key fauna/flora on site<br>▪ Leachate collection & storage/treatment and recirculation shall be planned to avoid impacts on flora, fauna | Contractor | SPMU/DPMU/ULB |
| 11 | Nuisance hazards to neighboring areas | ▪ Ensure proper design and adequate compound wall; high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements | Contractor | SPMU/DPMU/ULB |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • In case of waste mound and site edges are sliding or unsafe; provide engineered retention walls. | | |
| 12 | Treatment & Disposal of wastes and rejects | • Contractor to Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & inert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventorised and quantified, including Biocarth, rejects, inerts. These shall be tested and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertiliser Control Order 1985 and their amendments. Asbestos Management Plan shall be prepared for management if Asbestos wastes retrieved if any<br>• Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period. | | |
| ***B*** | **Implementation or Biomining & Bioremediation stage and Construction of ancillary facilities such as access road improvements, compound walls, greenbelts, drainage etc.** | | | |
| | | **Implementation of biomining of the dumpsite** | | |
| 1 | Impact due to the vehicular movement *(Air and noise environment & Vehicular - Vehicular & Vehicular - Pedestrian Conflicts)* | • Vehicles and machinery are to be maintained so that emission conforms to National Ambient air quality standards.<br>• All vehicles and machinery should obtain Pollution Under Control Certificates<br>• HORN PROHIBITION signpost to be erected.<br>• Rumble strips/speed breaker to be provided on access roads.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emission standards prescribed.<br>• Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle<br>• Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements.<br>• Avoid heavy vehicle movement through Nadappuram Bypass – Sreedhareeyam Hospital Road during peak hours 7 a m to 10 a m mention: school hrs / peak hrs: and during important period / festivals when people use the road to access temple<br>• Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents. | Contractor, ULB | SPMU/DPMU/ULB |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 2 | Impact due to the use of heavy vehicle and equipment *(Air and Noise environment)* | ▪ Mixing equipment (in case of construction of ancillary facilities) should be well sealed and be equipped with a dust-removal device.<br>▪ Equipment Operators & labourers should wear dust masks, ear protection, and hard hats.<br>▪ Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load.<br>▪ Labor to be provided masks / PPEs.<br>▪ Construction / Biomining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spreading into neighboring sensitive land uses<br>▪ Noise standards at operation machines are to be strictly monitored to prevent exceeding of GOI noise standards.<br>  ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines.<br>  ▪ Using modern, well-maintained and regularly serviced vehicles.<br>  ▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>  ▪ Provision of earmuffs and ear protection to workers and employees in high noise areas.<br>▪ Workers in the vicinity of strong noise to wear protectors and their working time should be limited as a safety measure.<br>▪ As Koothattukulam dumpsite has sensitive receptors and settlement areas within 150m (1 house within 30 m radius) of it, noisy works shall be stopped from 22:00 to 06:00.<br>▪ Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum.<br>▪ Avoid noisy activities/machines near South side of the site where settlement exist within 50m. Noise barrier shall be provided at all noise-sensitive locations / for noise generating equipment such as DG sets, mixers (for ancillary facilities) especially near South side of the dumpsite<br>▪ Adopt required measures as per CPCB guidelines, and site & work specific safety requirements | Contractor | SPMU/DPMU/ULB |
| 3 | Impact during the construction activities *(water environment)* | ▪ Labour camps if any (depending on Contractors work plan & arrangements) are to be located away from water bodies.<br>▪ Vehicle washing or maintenance near water bodies are to be avoided.<br>▪ Contaminated water from construction / biomining activities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated on site. | Contractor | SPMU/DPMU/ULB |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 4 | Leachate and Runoff from biomining activities *(Soil contamination and groundwater contamination)* | ▪ Provide site cut off drain around the site to divert off stormwater from entering the site, and to prevent contaminating downstream resources with run off from the dumpsite<br>▪ Depending on the contractors plan for biomining of the capped area on site, implement leachate management to cause no harm to communities & environment<br>▪ Ensure stormwater drains will lead to drain outlets<br>▪ Provide leachate drains lined from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area<br>▪ Provide proper treatment of leachate and storm water that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by biomining activities like excavation and waste segregation and stabilization<br>▪ The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB.<br>▪ The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata<br>▪ Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff and hence reduce infiltration<br>▪ Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism<br>▪ Plan the works on-site only during non-rainy seasons and to complete the works before rains<br>▪ Store leachate preferably in aboveground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide for emergency containment additionally | Contractor | SPMU/DPMU/ULB |
| 5 | Soil decontamination from accumulated waste levels *(Impact on leachate, odor)* | ▪ Decontaminate the soil / stabilized layers remaining after sieving out wastes using windrow and bioculture of appropriate quality in line with standards / regulations or appropriate means as per CPCB Guidelines<br>▪ Vegetative layer using contaminant absorptive root varieties like Vetiver may be tried on soil and along the edge of the green belt or floating wetlands may be deployed in water channels nearby to maximize absorption of leachate in the soil by root-zone phytoremediation<br>▪ Soil and water testing shall be done and changes in contamination shall be noted. | Contractor | SPMU/DPMU/ULB |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 6 | Excavation of waste from the waste mound *(Health and safety impacts)* | ▪ The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound.<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided<br>▪ Machinery operated for excavation should be operated by skilled operators at all times.<br>▪ Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on wastes.<br>▪ Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound<br>▪ In case of the waste mound and site edges are sliding or unsafe; provide engineered retention walls or string boundaries.<br>▪ When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection & treatment mechanism. | Contractor | SPMU/DPMU/ULB |
| 7 | Transportation of wastes or retrieved or other material in overloaded and open vehicles *(Air, Odour nuisances; spills and littering impacts on Air, Water, Land)* | ▪ All vehicles shall carry only approved load of weight<br>▪ Regular cleaning of roads & drains and removal of spills if any.<br>▪ All waste transport vehicles shall be covered and movement shall be during non-peak hours.<br>▪ Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities.<br>▪ Adopt required measures as per CPCB guidelines, and site specific safety requirements. | Contractor | SPMU/DPMU/ULB |
| 8 | Occupational health and safety impacts of the workers during the biomining & construction of support facilities:<br>• Health impacts of exposure to a variety of harmful | ▪ Avoid direct & double handling of wastes through avoidance measures (suitable planning & equipment), engineering controls & use PPEs<br>▪ Work area & Labour camps shall be provided with First Aid and other related activities.<br>▪ Emergency Preparedness plans shall be prepared and implemented for all manpower working centers and its field extension centers.<br>▪ An Environment Health & Safety policy shall be prepared and implemented<br>▪ Adequate manpower shall be provided & manager & staff shall listen and act upon the manpower related grievances.<br>▪ Workers will be provided with PPE such as face mask, gloves, shoes, nose masks & goggles | Contractor, ULB | SPMU/DPMU/ULB |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | materials of waste-related pollutants.<br>• Accidental spillage of chemicals/other materials, biocultures or wastes etc; by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | ▪ Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed without slip, trip, fall especially on waste, leachate or trenches<br>▪ Proper training will be provided regarding the maintenance of health<br>▪ Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks & water supply), food, and water in a hygienic environment (with proper hand wash). Provide clean eating areas where workers are not exposed to contaminated, hazardous or noxious substances.<br>▪ First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus<br>▪ Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health checkups. Arrange daily health checkup for workers working on waste heaps<br>▪ Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals.<br>▪ Measures such as deferred timings and stretch break to be adopted<br>▪ Secure all installations from unauthorized intrusion and accident risks;<br>▪ Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every day start of works / activities. Key hazards would be (but not limited to) are flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and leachate from existing capped area on site, electric shocks, works with heavy machines & equipment, slips of men & material (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc.<br>▪ EHS specialist with adequate experience & third party supervision are important for bio-mining activity<br>▪ Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites<br>▪ Provide visitor orientation if visitors to the site need to gain access to areas where hazardous conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible<br>▪ Ensure the visibility of workers through their use of high visibility vests when working in | | |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | or walking through heavy equipment operating areas;<br>▪ Ensure moving equipment is outfitted with audible back -up alarms & flag men with whistles or speakers;<br>▪ Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit.<br>▪ Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenance to be marked well & safe kept before activity start near those in close proximity to this location, there is a transformer. Disallow worker exposure to noise level greater than 85 dBA for more than 8 hours a day without hearing protection<br>▪ All workers shall be registered as per prevalent labor laws (including a workforce of subcontractors) and provided insurance cover & others as per existing acts/laws<br>▪ Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractor's person/insurance agent<br>▪ While using heavy machinery like JCB, cranes, etc, inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle.<br>▪ While using heavy machinery like JCB, cranes, etc, inform communities to prevent children and others from going near operating / movement areas including roads.<br>▪ Flagmen shall be arranged if work is near schools, hospitals, major roads, and traffic control is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if possible<br>▪ A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs;<br>▪ No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor<br>▪ All works related to working at heights will be undertaken only during the daytime when sufficient sunlight is available;<br>▪ Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done;<br>▪ All excavation activities to be conducted in supervision of the site contractor; | | |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | ▪ Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured.<br>▪ All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans prepared and implemented, as per Banks Incident Reporting Tool | | |
| 9 | Risk of fire due to conditions leading to spontaneous combustion *(Air environment, disturbance to communities and workers, health impacts, safety issues)* | ▪ Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for Implementation of SWM Rules 2016 – regdg Fire Incidents at MSW Dumpsites (https://cpcb nic.in/openpdffile.php?id=UHVibGljYXRpb25GaWxlLzQyNDRfMTY1NDE2Mzk3N19tZWRpYXBob3RvNzYxMi5wZGY= ), LSGD Kerala Government GO on Fire Safety of MRF, MCFs (for the MRF on site if used for storage of wastes)and other Regulations, guidelines applicable<br>▪ Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3; and National/State regulations & WB EHS<br>▪ Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes<br>▪ Avoid conditions that can lead to spontaneous combustion such as:<br>o Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard<br>o Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.<br>▪ Design the facility for access by firefighting equipment, including clear aisles among waste heaps or work areas and access to adequate water supply.<br>▪ Ensure workers are briefed of fire hazard & its management<br>▪ No unauthorized entry shall be permitted to the site; including of workers during holidays, nighttime, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating “trespassers not allowed”<br>▪ The following activities should be implemented to prevent fires from occurring at the facility<br>o adequate fire-fighting equipment should be made available on-site and stored in an accessible manner<br>o all operating staff should be trained and able to manage fire outbreaks at any part of the facility.<br>o clear signage should be established to inform workers and the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers | Contractor, ULB | SPMU/DPMU |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | at the gatehouse and inspection of loads at the organic reception area.<br>o Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows.<br>o all fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the biomining, storage, and processing areas.<br>o all flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating stormwater.<br>▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the biomining activity in line with National State regulations, guidelines and international good practices<br>▪ Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.<br>▪ Contain all local smokes/small fires inside the dump asap. Fire brigade help shall be sought on all smokes/fires outside the dump<br>▪ Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured.<br>▪ Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers | | |
| 10 | Construction of new facilities in retrieved land | ▪ The excavated site shall be protected from any dumping during or after the biomining activity and shall be reserved for SWM activities in line with SWM Rules 2016<br>▪ Any new facility under KSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations | ULB | SPMU/DPMU |
| 11 | Pest / Vermin Control & Visual impacts (Odour, flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center<br>▪ Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups<br>▪ Biopesticides / biological control shall be followed. However, biopesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used<br>▪ Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate | Contractor, ULB | DPMU, SPMU |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | management | | |
| 12 | Odour nuisance | ▪ Waste with a strong odor to be covered immediately they are emptied from vehicles.<br>▪ Control and manage leachate treatment to minimize odor.<br>▪ Provide buffers screens to curtail odor from reaching surrounding communities especially to North side of site.<br>▪ Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor. | Contractor, ULB | DPMU, SPMU |
| 13 | Storage, Collection, Transport, Treatment & Disposal of wastes and rejects | ▪ Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste<br>▪ Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters<br>▪ Waste handling shall be inline with existing regulations & guidelines & avoid health & safety impacts<br>▪ No material is allowed to remain on site after the contract period<br>▪ Adequate fire safety arrangements & awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported<br>▪ Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/interts in designated or agreed area & are in line with schedule; using GPS.<br>▪ Given that the access road is used by the public, it is imperative to implement the required safety precautions and environmental protection measures when transporting the waste. | Contractor, ULB | DPMU, SPMU |
| 14 | Other activities | ▪ No activity other than biomining shall take place on site & any activity shall cause no adverse impacts on the environment or people<br>▪ If existing MCF shall be used for storing biomining wastes, its safety shall be ensured in terms of fire & structural safety before starting to use the facility. Further usage of the MCF after biomining works shall be after proper cleaning / washing & disposal of all rejects/inerts & tools to ensure good housekeeping & no H&S impacts<br>▪ If existing MCF shall be used by the ULB for storing dry wastes from Town, during biomining period, alternate access shall be arranged & workers shall be adequately protected against any health & safety impacts | | |
| 15 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & biomining / construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees | Contractor | ULB |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | • Waste water and Leachate to be treated & recycled/reused | | |
| **C** | **Future Site Usage (EMP shall be updated in line with EMF & used if future site usage is proposed under KSWMP). This section is not the responsibility of the Contractor for Biomining, but of the future facility operator & ULB** | | | |
| 1 | Future use of the biomined site: Green Park, MCF, MRF, RRF, Treatment plants, landfill cell or any other, preferably for SWM | • ULB to ensure that the site will not be used for future dumping.<br>• Activities at existing MCF to be upgraded to ensure that no waste (even dry wastes) gets dumped around.<br>• ULB shall plan the future use of the site shall be in consultation with the communities.<br>• Phase 1 Environmental Assessment to be carried out. EA for existing facilities & EIA for proposed development in line with EMF in case this is proposed to be developed under KSWMP<br>• All applicable clearances, permits shall be arranged in line with applicable regulations for the proposed new use of the site, and appropriate designs/plans to be prepared & implemented | Future Facility Developer/ Operator & ULB | ULB (SPMU in case it is under KSWMP) |
| 2 | Vehicle movement for new activities: MCF/MRF, RRFs, Treatment plants, landfill cell<br><br>*(Air, water environment, a nuisance to healthiersity, communities, Health impacts)* | • The movement route shall be scheduled for each vehicle.<br>• Enforce speed limits applicable and make drivers aware of this<br>• Vehicles movement shall be tracked by Health Supervisors to ensure keeping up to schedule; preferably using GPS<br>• Any adulterated fuel shall be avoided. There shall be periodic emission tests for vehicles<br>• Provision of Personal Protective Equipment such as face mask, gloves, nose masks & goggles to all workers in C&T vehicles, Maintenance yards<br>• Proper lubrication shall be provided to minimize squeaking noise due to friction<br>• Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br>• The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public<br>• Traffic will be managed at the site by providing adequate space for parking of vehicles<br>• Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design<br>• No waste or material shall be disposed in any place other than the designated area; including water bodies, coasts/forests, or sensitive areas. | Future Facility operator | ULB |
| 3 | Exhaust emissions *(Air impacts)* | • No idling of vehicles on site.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed | Future Facility operator | ULB |
| 4 | Plying of vehicles through kutcha / | • Vehicle movement shall be well planned – through topped roads. In case of necessity to move through Kutcha roads, ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Future Facility operator | ULB |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | unsurfaced roads and idling<br>*(Air pollution: SPM, CO, CO2)* | | | |
| 5 | Impact on the ambient noise quality during the operations<br>*(Noise, nuisance to sensitive receptors, health impacts)* | ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines;<br>▪ Using modern, well-maintained and regularly serviced vehicles;<br>▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>▪ Provision of earmuffs and ear protection to workers and employees in high noise areas | Future Facility operator | ULB |
| 6 | Occupational health and safety impacts of the workers:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | ▪ All OHS and CHS measures to be followed in line with applicable regulations, guidance<br>▪ Workers & communities shall be made aware of OHS, CHS risks and impacts & mitigation measures adopted<br>▪ Emergency management plan to be prepared & followed<br>▪ Workers shall be appropriately trained or OHS during construction & Operation of all future facilities | Future Facility operator | ULB |
| 7 | Pest / Vermin Control (Odour, flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted<br>▪ Biopesticides / biological control shall be followed.<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be | Future Facility operator | ULB |

| Sl. No. | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | used | | |
| 8 | Fire Safety | ▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented in line with National State regulations, guidelines and international good practices | Future Facility Operator | ULB |
| 9 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees<br>▪ Waste water to be treated & recycled/reused | Future Facility Operator | ULB |

### 6.1.1 Disposal phase of By-products from Bio-mining process:

The bio-earth and coarse fraction soil recovered from dumpsite will be used for filling low lying areas. The RDF material recovered from dumpsite will be transported to nearby cement factory and recyclable material will be handed over to the authorized recycling agency. If the by-products are not removed from the site within a three-month period, penalties will be imposed on the contractor.

## 6.2 Disaster Management and Emergency Preparedness

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care, and other necessities of life. In the case of Dumpsite remediation, Disaster Management Plan is aimed to ensure the safety of life, protection of the Environment, protection of installation, restoration of the remediation process, and salvage operations in this same order of priorities.

For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel training is to be provided through rehearsals/drills. The disaster management Plan Comprises of Onsite Emergency Plan and an offsite Site Emergency plan, which is outlined here for Emergency Preparedness.

*Table 6. 2 List of Emergency Helpline Services*

| Sl. No. | Emergency Services | Distance from the dumpsite |
|---|---|---|
| 1 | Koothattukulam police station | 1 Km |
| 2 | Koothattukulam Fire and Rescue station | 0.2 Km |
| 3 | Koothattukulam Govt. Hospital | 1 Km |

### 6.2.1 Approach to Disaster Management Plan

The objective and approach of the Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effect the rescue and medical treatment of casualties;
- Safeguard other people;
- Minimize damage to property and the environment;
- Initially contain and ultimately bring the incident under control;
- Identify any dead;
- Provide for the needs of relatives;
- Provide authoritative information to the news media;
- Secure the safe rehabilitation of the affected area;

Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency.

In effect, it is to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy. Disaster Management Plan should include Emergency Preparedness Plan, Emergency Response Team, Emergency Communication, Emergency Responsibilities, Emergency Facilities, and Emergency Actions.

#### *6.2.1.1 Identified Emergency Situations*

Major disasters which can affect the remediation process are as follows:

- Floods due to heavy rainfall
- Fire risk in summer
- Occupational and health risks during the remediation process
- Safety-related accidents during the remediation process

#### *6.2.1.2 Proposed Organizational Structure for Disaster Management Plan*

**Response team:** Setup an Emergency Organization. Emergency Organization includes the senior executive (head of EO as a Site controller), Manager Safety (Incident controller), Shift in charge, and Emergency Coordinators.

- All Incident control would be reported to the Site Controller. Each Incident Controller organizes a team responsible for controlling the incident with the personnel under his control.
- **Shift In-charge** would be the reporting officer, who would bring the incident to the notice of the Incidence Controller and Site Controller.
- **Emergency Coordinators** would be appointed who would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential and support services. For this purposes, security in-charge, personnel department, essential services personnel would be engaged. All these personnel would be designated as key personnel.
- In each shift, the electrical supervisor, in charge, and other maintenance staff would be drafted for emergency operations. In the event of power or communication system failure, some of the staff members in the office/facility would be drafted and their services would be utilized as messengers for quick passing of communications. All these personnel would be declared as essential personnel.

## 6.3 Proposed Monitoring Plan

The proposed monitoring plan is presented in table below,

*Table 6. 3 Proposed Monitoring Plan and Frequency*

| Monitoring media/parameters | Items and parameters | Frequency | Location |
|---|---|---|---|
| **Ambient Air Quality** | PM10, PM2.5, NOx, CH4, CO, Ammonia | Quarterly (1 sample) | 2 point |
| **Noise** | Leq Day and Night | Monthly | 2 point |
| **Health safety Hazards** | Medical records, documentation of injuries and accidents, Health and safety assessments | As and when accident/injury occurs | Incident reports |
| **Leachate** | • pH<br>• Biological Oxygen Demand- BOD<br>• Chemical Oxygen Demand-COD<br>• Nitrogen (Ammonia, Nitrate, Nitrite)<br>• Oxidation-Reduction Potential- ORP<br>• Electrical Conductivity-EC<br>• Total Organic Carbon (TOC) Dioxins<br>• Heavy Metals (As per the schedule II of SWM rules 2016) | Quarterly | 2 point |
| **Groundwater quality** | Parameters will be defined and sampling, preservation, and analysis of water will be carried out following those stipulated in the subsections below and Standards Methods for Testing Water and wastewater, 21st edition, published by American Public Health Association (2005). | Quarterly | 8 points |
| **Surface water quality** | | Quarterly | 6 points. 2 upstream and 4 downstream |

## 6.4 Estimated Budget for Implementation and Supervision of EMP & SMP

The estimated capital cost of [redacted] is required for budget provision for implementation and supervision of EMP & SMP. The remediation will be only during shorter time duration and hence the recurring cost won't be incurred. The estimated cost particulars for EMP & SMP is mentioned below.

*Table 6. 4 Estimated Budget For EMP*

| Particulars | Capital Cost (In Lakhs) |
|---|---|
| Dust Mitigation Measures Including site barricading, water sprinkling, Wheel Washing and leachate management | [redacted] |
| Mobile Toilet, Pest Control, Disinfectant | [redacted] |
| Medical cum First Aid facility | [redacted] |
| PPE for workers & welfare, Fire Fighting Equipment | [redacted] |
| Monitoring / testing (air, noise, water, soil, leachate) | [redacted] |
| **Total** | [redacted] |

# CHAPTER 7 INSTITUTIONAL ARRANGEMENTS

## 7.1 Proposed Institutional Arrangement for Implementation of EMP & SMP, Supervision, Monitoring

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of ToR for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation. The Support Organisation will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments. Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level. The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances. The PIU will submit the compliance reports on clearances, permits, and environmental and social safeguards to D-ESDU.

## 7.2 Capacity Building

- Sensitize and orient different stakeholders of the project with adequate communication of benchmark standards on various project components. Ensure up gradation of awareness generation at different levels. Special focus: Health Hygiene and sanitation Sub Activity
- Training program for HKS (Health & Hygiene, source level waste segregation and source level treatment, Fire and Safety)

- Training program for ULB Councilors and Ward convener (Proposed SWM project plan of KSWMP)
- Training program for Political and trade union leaders (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for Residence Association leaders (Health, Hygiene different composting methods and source level waste segregation, littering of waste, Public Health, Fire and Safety)
- Training program for workers of Municipal Sanitary workers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for school / college students (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for ULB officials (Proposed SWM project plan of KSWMP, proposed policies, existing policies etc... to improve the existing pattern into zero waste concept of the municipality)
- Training program for School children, Parents and Teachers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Massive awareness campaign on 5R (Reuse, Recycle, Repurpose, Reduce and Refuse)

**Importance of Capacity Building**

Capacity building is defined as the "process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in the fast- changing world. It is the development of knowledge, skills and attitudes in individuals and groups of people relevant in the design, development and maintenance of institutional and operational infrastructures and processes that are locally meaningful. It is generally defined 'capacity building' as the creation of an enabling environment with appropriate policy and legal frameworks, institutional development, including community participation, human resources development and strengthening of managerial systems. It is a long-term, continuing process, in which all stakeholders participate. The main aim of capacity building under solid waste management is to build a basic understanding regarding the solid waste management project at each step of value chain (waste generation, segregation & storage at source, primary collection, secondary collection, transportation, processing and disposal) and importance of their work and develop a sense of belonging towards the work.

## 7.3 Grievance Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizen can lodge complaint either directly to ULBs, toll free number or through digital platforms (website/email – grmkswmp@gmail.com / Toll free number-18004250238). The

complaint will automatically be recorded in login of ward level official of ULB and an escalation system is constituted according to the category of each complaint to close the complaint in time. The complainer can close the complaint through a feedback form according to their satisfaction.

# CHAPTER 8 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

## 8.1 Approach to Public Consultation

KSWMP have developed detailed strategy and installed various inclusive mechanism in the different stages of the remediation process considering the project affected persons, families, and commercial establishments.

As the initial step, a **Transect walk** was carried out on **06.06.2023** covering the surrounding area of the dump site. The aim of the transect walk was to assess the site and gather information about its location, potential social risks, existing infrastructure and the impact on surrounding communities. The group exercise that entails walking between two points to intentionally cross or transect a community. The group explores environmental and social resources, conditions and systems by observing, asking, listening, looking and producing a transect diagram. Information collected can be used to reveal land use practices, hazards and vulnerabilities to inform disaster mitigation and water management.

**A public consultation meeting** was conducted on 25$^{th}$ July 2023 related to the formulation of Solid Waste Management Plan engaging a wide audience who are experienced in solid waste management sectors of the ULB. Municipal council members were also participated in this meeting. Remediation of the proposed site was one of the agendas included in the discussion.

**Ward level Consultation Meetings** will be conducted before the commencement of remediation in the leadership of ward councillor by engaging the representatives from different resident's associations, commercial establishments and other institutions in the ward for explaining about the remediation process and thereby to gain public support and cooperation.

## 8.2 Information Disclosure

Warning sign boards and project information boards with full details of grievance redressal mechanism along with all related contact details will be installed at site during the remediation process at the site. Site control measures should be enforced to prevent unauthorized personnel into the work site. Work zones should be delineated around specific bore holes, excavations and other areas that may pose the risk of potential exposure to the hazards.

## ANNEXURE I: INITIAL ENVIRONMENTAL AND SOCIAL EXAMINATION

### Section II: Environmental Screening Form

**INITIAL ENVIRONMENTAL EXAMINATION**
**(To be prepared for each subproject)**

Checklist to be followed for Environmental Screening during the Initial Environmental Assessment Stage has been provided below:

**Subproject Details**

| | |
|---|---|
| **Name of Subproject:** | Koothattukulam Solid Waste Dumpsite Reclamation by Biomining |
| **Subproject Components:** | Dumpsite Remediation by Bio-mining |
| **Subproject Location (City / Town/ Village with ward numbers):** | Near Municipal Market, Ward 15, Koothattukulam Municipality |

**Stage 1: Exclusion List**

**Is the Project Excluded from Consideration due to the following:**

| *Sl No:* | *Non-permissible Activities* |
|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i) any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides |

*(This space can be used to add details on the above, reason for exclusion from the Project etc.)*

*This dumpsite remediation project involves 1. (i) no construction in demarcated Forest areas or protected areas or their buffers, (ii) no construction of landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) no treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). 2. NO activities which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas, 3. No activities with (i) any impact on or due to Dams or embankments (ii) and project will not purchase, store and use Banned Pesticides.*

*Hence, not excluded*

*Proceeding to Stage 2 Screening*

*(Do not proceed to Stage 2; if the subproject is Excluded as per Stage 1 Exclusion List)*

**Stage 2: Environmental Screening Checklist**

| Project Details | | |
|---|---|---|
| **Sl.No** | **Components** | **Details** |
| 1 | Project components | Dumpsite Remediation by Bio-mining |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste management, centralized non-biodegradable waste management facilities, centralized biodegradable waste management facilities, sanitary landfills, biomining of dumpsites, including for Linked activities / associated facilities) | Bioremediation of Koothattukulam Dumpsite: -<br>A total station survey was conducted to determine the quantity of legacy waste, revealing a total of 899 cubic meters. |
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project; including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination)<br>Site Survey No:/s (attach map) with ownership details, Geographical co-ordinates of the site location [including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | **Location:** Near Municipal Market, Ward 15, Koothattukulam Municipality<br>**Survey Number:**<br>**Ownership –** Koothattukulam Municipality<br>**Land use –** Solid Waste Management facility<br>**Geographical Coordinates:**<br>Latitude: $9^0$ 51'49.2" N<br>Longitude: 76 $^0$35'27.3" E<br>**Earthquake zone**: III<br>**Cyclone:** Moderate<br>Access road of width 4m (Nadappuram Bypass – Sreedhareeyam Hospital Road)<br>Dumpsites have existed since the year 1981. |
| **4** | Land Area proposed to be used: Location wise (in sq. km / sq. m) | Current total land area of 1214 sq. m. will be fully remediated through bio-mining. |
| **5** | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | For domestic usage 1 KLD will be met from a private supplier |
| **6** | Power Required and Source of Power | No DG set requirement for this sub-project. Electricity connection is available within the site.<br>Source: KSEB |

***Baseline Environmental Conditions***

| ***Sl. No*** | ***Environmental Aspects*** | ***Yes*** | ***No*** | ***Details (include distance in Km, info on its importance)*** |
|---|---|---|---|---|
| 1 | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers) | | | |
| *(i)* | Critically Vulnerable Coastal Areas (CVCAs), Eco-sensitive Areas (ESAs) | | ✓ | No Critically Vulnerable Coastal Areas and Eco sensitive Areas in the study area |
| *(ii)* | Cultural Heritage site, Protected monuments - listed by ASI/State | | ✓ | Koothattukulam Mahadeva temple – 1.1 Km away |
| *(iii)* | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensitive area, with any schedule 1 species? If Yes, which is the area? | | ✓ | No Eco-Sensitive Areas in the study area |

| Sl. No | Environmental Aspects | Yes | No | Details (Include distance in Km, info on its importance) |
|---|---|---|---|---|
| (iv) | Other Wetlands/ Mangrove/ Estuarine Region | | ✓ | There is no Wetlands/ Mangrove/ Estuarine Region in the study area |
| (v) | Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves | | ✓ | There is no Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves in the study area |
| (vi) | Other Sensitive Environmental Components listed in EMF | | ✓ | There is no other Sensitive Environmental Components in the study area as listed in EMF |
| (vii) | Drinking water source, upstream and downstream uses of rivers, etc | ✓ | | Nullah 20m away on the roadside in front of the proposed site |
| (viii) | Low-lying areas/areas of Tidal Influence (provide CRZ details) | | ✓ | Site is not in low-lying area and site does not falls in CRZ area |
| (ix) | Sensitive Receptors – a) Habitations / Households / Hostels, other special areas, etc. b) School c) Religious Places d) Tourist Areas | ✓ | | Nangeli Ayurveda Hospital 200m away, Devanatha Hospital 300m away, Around 25-30 houses (with 1 house at 25m distance) and commercial Establishment within 200 m from dumpsite. |
| 2 | Is the site in Critical / Over Exploited Ground Water Block. Provide the level of the groundwater table | ✓ | | Water level ranges from less than a metre to 12 metres |
| 3 | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other (specify) | | ✓ | The site is not vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, etc. |
| 4 | Describe the type of soil and vegetation on site | | | Clayey soil is the most predominant soil type, presence of vegetation ( shrubs ) |
| 5 | Is the site present in the flood plains as recorded in the last 100 years? Provide the HFL level of the site/region | | ✓ | Site is not located in a flood prone area. |
| 6 | Existing pollution/contamination or degradation on site | ✓ | | Dumpsites have existed since the year 1981. |
| 7 | Any other remark on baseline condition | | ✓ | In the baseline environmental analysis, the results have been determined to fall within permissible limits. |

***Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology, and Soils***

| Sl. No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 8 | Total extend of land to be covered/built | | | Total Land: Approx. 0.30 acres<br>Quantity of legacy waste: 2061.41 cum. |
| 9 | Total extend of land where the waste will be dumped openly / or expected to get contaminated by waste or leachate/material storage | | | |
| 10 | Extend of Land to be remediated | | | |
| 11 | Extend of land expected to be under green belt | | | Green belt of 20m should |

| Sl. No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| | | | | be provided |
| 12 | Will the proposed project cause the following on Land / Soil: | | | After bio-mining the land will be remediated and will have a positive impact to the land and soil. |
| (i) | Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains | | ✓ | No Impact on Surrounding Environmental Conditions |
| (ii) | Substantial removal of Top Soil (mention area in sqm) | | ✓ | Presence of solid waste beneath the ground level combined with soil is to be excavated for bio-mining process.<br>Total Area – 30 cents |
| (iii) | Any degradation of land / eco-systems expected due to the project? | | ✓ | No land use change or ecosystem change due to implementation of this project since the land will be reclaimed. |
| (iv) | Loss or impacts on Cultural/heritage areas/properties | | ✓ | No impacts or loss of cultural/ heritage areas/properties due the implementation of the project since the existing one is at a distance of 4.5 Km from the dumpsite. |
| (v) | Does the project activity involve cutting and filling/ blasting etc? | | ✓ | It is bio-mining of existing solid waste only |
| (vi) | Will the project cause physical changes in the project area (e.g., changes to the topography) due to excavation, earthwork, or any other activity? | ✓ | | Waste heap is about 1.5 m in depth from Ground Level which is to be excavated. |
| (vii) | Will the project involve any quarrying/ mining etc? | | ✓ | The project does not involve quarrying/ mining |
| (viii) | Will the project / any of its component contaminate or pollute the Land? | | ✓ | The land remains unaffected by the process of bio-mining, as evidenced by the absence of any discernible impacts observed during our assessment |
| (ix) | Will the project contribute to any long term significant adverse (negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | ✓ | Positive impact to the environment. |
| (x) | Will the Project or related activities cause negative impacts on the land in combination with other anticipated / existing projects in the region? | | ✓ | Bio-mining will be conducted following the necessary mitigation measures. Hence, no impacts |

| Sl. No | Impacts on Air and Noise Environment | Yes | No | Details/Remarks |
|---|---|---|---|---|
| 13 | Will the project cause or increase air pollution due to dust and / or vehicle emissions? | ✓ | | The process of bioremediation may cause dust emission from process and vehicle movement which shall be managed using effective mitigation measures |
| 14 | Will the project cause or increase pollution due to GHG emissions? | ✓ | | Chances of GHG emissions due to unstabilized waste |
| 15 | Will the project cause or increase odor nuisance? | ✓ | | The process of bioremediation may cause odour which shall be managed using effective mitigative measures |
| 16 | Is there a potential for release of toxic gases or accident risks (eg. potential fire outbreaks) | ✓ | | Chances of GHG emissions due to un-stabilized waste |
| 17 | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | ✓ | | Project activity stage (during the process of bio remediation) due to vehicular movements& working of machineries). |

| Sl. No | Impacts on Water Environment | Yes | No | Details/Remarks |
|---|---|---|---|---|
| 18 | Will the activities proposed at the site(s) impact water quality (surface or ground) – leachate, runoff, wastes deposition, erosion? | ✓ | | Nullah 20m away on the roadside in front of the proposed site. Hence, Proper leachate treatment and waste disposal is necessary |
| 19 | Will the activities proposed at the site(s) impact water resource availability and use - leachate, runoff, wastes deposition, erosion? | | | |
| 20 | Chances of Pollution of Water bodies/groundwater wells, nearby or downstream | | | Nullah is around 20m away from the dumpsite. Hence, proper leachate treatment and waste disposal is necessary |
| 21 | Will the activities proposed at the site(s) hinder natural drainage | | ✓ | The hindrance to natural drainage caused by the deposited waste at the site will be resolved through the implementation of the bio-mining process. |
| 22 | Will the activities proposed at the site(s) decrease permeability/rainwater percolation | | ✓ | No impacts to the permeability/rainwater percolation of site |

| Sl. No | Impacts on Biodiversity and Host Communities | Yes | No | Details/Remarks |
|---|---|---|---|---|
| 23 | Will the project necessitates cutting of Trees / Loss of Vegetation | | ✓ | Cutting of trees are not required. |
| 24 | Will the project necessitate substantial removal of Top Soil (maintain area in sqm) | | | Presence of solid waste, no topsoil. Excavation of legacy waste – 2061.41 cum |
| 25 | Any degradation of land / eco-system expected due to the project? | | ✓ | The process of bio-mining ensures that there will be no degradation of the land. |
| 26 | Will the project result in Health & Safety Risks in the neighbourhood including the release of toxic gases, leachate, accident risks | | | 25-30 households are within 200 m to the dumpsite. Hence bioremediation should be conducted considering proper mitigation measures |

| *Sl. No* | *Impacts on Biodiversity and Host Communities* | *Yes* | *No* | *Details/Remarks* |
|---|---|---|---|---|
| *28* | Potential Noise, Light Pollution/movements causing disturbance to nearby habitats/communities | ✓ | | 25-30 households are within 200 m to the dumpsite. Hence, bioremediation should be conducted considering proper mitigation measures. |
| *29* | Potential disruption to common property, accessibility, traffic disruptions, conflicts, or disruption to the local community within the subproject area? | ✓ | | Only merge noise pollution due to machinery operation and line source.<br>Enclose noisy equipment or use barriers to minimize sound propagation. This could involve using soundproof enclosures or acoustic panels. |

### *Project Categorisation and Need for Safeguards Instruments, Oversight*

| | |
|---|---|
| **Project Category** | □ **E1** □ **✓ E2** □ **E3** |
| **Key Reasons (for categorisation)** | During screening, it has found that the proposed subproject is moderately causing impact to the base line environment, land/ soil / water /noise environment, biodiversity or to the community. Site is not close to any Environmental Sensitive Receptor. Moreover, Project results positive impacts on Environment. The Environmental Baseline analysis reveals that dumpsite not having any Heavy metal contamination. Hence it is categorized as E2. |
| **Safeguards Instruments Required** | ~~a) E1: Project-specific EIA (impact assessment considering the project details & location) by Independent Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)~~<br>b) E2: Project-specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>~~c) E3: signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities~~ |
| **Additional Responsibilities Expected** (such as i) Specialists to be hired for Physical/Cultural resources, Natural Habitats/others, etc for EIA preparation, and/or supervision), ii) Consultations, iii) any other aspect | |

| ***Status*** | ***Agency / Official*** | ***Name, Signature with Date and Seal*** |
|---|---|---|
| **Prepared by** | PIU or ULB (project in-charge) | |
| | Environmental Engineer | |
| **Checked, Categorised as ___ (E1, E2, E3) & ToR issued by:** | DESDU / SESDU | |
| | Environmental Specialist | |

Enclosures:

| Access road | Site entrance |
| --- | --- |
|  |  |
| **General view of waste deposit** | **Constructions** |
|  |  |

| Map (from google) |
| --- |
|   |

# ANNEXURE II: FIRE RISK ASSESSMENT

**Objectives:** The important elements of fire risk Management planning can be classified as:

- Identifying the disaster potential scenarios and advance planning to combat and minimize the damage.
- Vulnerable zone delineation.
- Assessment of loss probability and its severity.
- To deal with such emergencies expeditiously.
- Warning, protective actions like evacuation of personnel.
- To contain the disaster by isolating the area, firefighting etc.
- To make efforts to return to normal condition when the situation is controlled.

*Causes of fire and Risk:*

| Ignition (heat) sources | Fuel Sources | Oxygen Sources |
|---|---|---|
| Lit cigarettes/ butts, matches, lighters<br>Improperly stored batteries<br>Bushfire<br>Self-heating piles<br>Hot loads/contaminated waste<br>Hot work operations<br>Arson<br>Lightning<br>Fires from neighbouring activities<br>Faulty electrical wires | Flammable liquids, gases and solids<br>Combustible goods and waste (e.g. CRWM[2])<br>Contamination in CRWM storage<br>Dry and unmanaged vegetation | Oxidising chemicals such as oxy-acetylene sets, bleach, hydrogen peroxide, nitrates<br>Physical introduction of oxygen through unbaling or turning of loose piles |

**Fire Prevention & Management Plan**

It is a strategy well evolved, organized and rehearsed to contain the adverse effects of a possible disaster. It aims to mobilize the internal resources and use these with minimal dependence on external agencies for the following purposes:

- To control and contain incidents.
- To safeguard employees and people in the vicinity.
- To inform employees, the general public and the authorities about the hazards/risks assessed, safeguards provided, residual risk, if any, and the role to be played by them in the event of disaster.
- To effect rescue and treatment of casualties.
- To prevent recurrence of such a disaster.

- To establish machinery for review, rectification/modification of the emergency
- To ensure safety of works before personnel re-enter and resume work.
- To work out a plan with all provisions to handle and to provide for emergency preparedness and the periodic rehearsal of the plan.

**Pre-Disaster Stage**

The prevention of disaster is of vital importance and is the moral responsibility of each and every individual employed in the dumpsite site. It can be prevented by observance of precautionary and preventive measures. During pre-disaster stage following points will be followed to avert the occurrence of disaster:

The emergency operation procedures of the dumpsite site will be written down, so that no confusion is caused in the event of emergency taking place.

- To reduce the probabilities of accidental leakage of methane.
- Smoking will be prohibited in the areas where handling of dumpsite will be done. "NO SMOKING" boards will be prominently displayed in Local Language i.e., Malayalam and English languages.
- All electrical wiring, fittings, cables, equipment will be checked periodically. Temporary wiring will not be permitted to be installed inside the dumpsite area. No inflammable material including papers, Oils, wooden racks will be stored within 1 meter of any electrical fittings. No un authorized person will be allowed to tamper with electrical fittings.
- Welding, Burning, cutting, Chipping, soldering work, etc. will only be carried out by authorized person.
- Necessary compliance with various Statutory Guidelines and other relevant instructions as issued from time to time will be done by the contractor.
- Safety Department will arrange to educate all concerned regarding operational hazards of non-compliance of the safety guidelines. They will also provide necessary guidance and support in proper implementation of the program. They will also arrange mock exercises periodically.
- Safety Department will display at prominent places important telephone numbers and instructions, in Mizo & English languages. The Security Control Room located at the dumpsite site will be equipped with the following:
- Sufficient number of copies of On-Site Disaster/Emergency Management Plan.
- Master plan of the dumpsite site indicating vital locations and possible sources of disaster.
- Important Telephone numbers
- Emergency lights (portable) and Wireless sets if required and possible).
- First Aid boxes

**Disaster Stage**

The most probable disaster which may occur at dumpsite site is because of accidental leakage and fire. To control leakage and fire the following measures/precautions will be taken at the dumpsite site:

The guidelines as given below for the protection of fire will be followed:

- The dumpsite's fire protection will consist of structural solutions, fire extinguishing systems and fire alarm systems. The fire extinguishing system will consist of the fire system with fire pumps, distribution pipelines, hydrants and fire hoses and the portable extinguishers.
- The fire alarm system will be a part of the primary systems and take care of the places which are unmanned or will not have any fixed fire extinguishing system.
- The major operation areas shall be equipped with fixed smoke detectors, $CO_2$ extinguisher near the door in the control room.
- All the rooms in the office shall be equipped with fixed smoke detectors.
- The ventilation rooms shall be equipped with fixed smoke detectors. One $CO_2$ extinguisher will be located near the door to ventilation room.
- The fire alarm and detection system shall be designed, installed, maintained and tested according to relevant standards.
- The water for firefighting shall be stored in the fire water tank (water reservoir).
- $CO_2$ fire extinguishers contain extinguishing carbon dioxide which either by it or under expected conditions of use gives off $CO_2$ to prevent fire.
- Dry fire extinguishers contain extinguishing medium which either by itself or under expected conditions of use will give fine powder to prevent fire to get oxygen.
- As soon as a fire takes place inside the premises of dumpsite, action to be taken by various persons/officials.

**Post Disaster Stage**

After the incident, an incident report will be prepared regarding occurrence of event/losses incurred and recommendations thereof for restoration of normalcy.

**Reporting of Accidents**

Situation in totality will be studied thoroughly, investigated with respect to the cause of the incident, extent of loss of life and property and a detailed report prepared by the individual/team nominated by dumpsite site authorities for this purpose. Based on the investigation report, rescue team would finalize time bound programmes for implementation of corrective measures proposed and regularly monitor the progress thereafter. Rescue, medical and welfare operations would be continued by the concerned agencies.

# ANNEXURE III: BASELINE MONITORING LOCATION




**GOOGLE IMAGE DEPICTING THE AAQ AND NOISE MONITORING LOCATIONS AT KOOTHATTUKULAM DUMP SITE**




**GOOGLE IMAGE DEPICTING THE SURFACE WATER, GROUND WATER AND LEACHATE MONITORING LOCATIONS AT KOOTHATTUKULAM DUMP SITE**

KSWMP

FEASIBILITY REPORT

# DUMPSITE BIOMINING AND BIOREMEDIATION, KOOTHATTUKULAM MUNICIPALITY




November 2023

KSWMP | LSGD | LSGD

State Project Management Unit
Kerala Solid Waste Management Project (KSWMP)

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## Executive Summary

Koothattukulam in the midland directly to the eastern part of Ernakulam district. Even though the ULB has an excellent practice of waste management, the primary environmental issue currently faced by municipal authorities revolves around a longstanding existing legacy waste dumpsite. Despite discontinuing the dumping activities, these dumpsites remain as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Consequently, these sites pose significant environmental, social, and economic challenges for the communities and ecosystems surrounding them. The SWM Rules 2016 directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the project for the remediation of legacy waste dumpsites in all the ULBs of Kerala. As part of the project, in phase1 the existing dumpsite at Koothattukulam ward 15, Town ward was proposed for remediation.

The Koothattukulam Municipality has an area of 23.18 sq.km with 25 wards. The municipality, with the financial and technical support of KSWMP, has taken up steps to remediate the existing legacy waste dumpsite located in around 1203.97 Sqm (29.757 cents) of land in ward 15, Town ward and to recover optimum land for future developmental activities. The Koothattukulam dumpsite was used for dumping municipal solid waste from the year 1985. The dumping of solid waste (biodegradable waste) was stopped once the ULB level OWC was set up. Considering the impending threat of fire hazards and leachate issues, the Municipal Council has taken up the remediation of legacy dumpsite as a priority and to utilize the remediated land for setting up other solid waste management facilities. Since the cessation of dumping activities in 2018, only sweeping waste from towns and streets were dumped at the facility daily and has now been discontinued.

The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes. To assess the quantity & composition of legacy waste & also evaluate the environmental baseline of the dumpsite, samples from representative locations were collected and analysed for various parameters viz., physical, and chemical analysis of Legacy waste, Soil, Air, Noise, leachate, Groundwater, and Surface Water. As part of the study, detailed site investigations were carried out for; – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical and Environmental Analysis by M/s Poluchem laboratories.

From the results of the investigations, the total estimated quantity of legacy waste is around **2073.18 Cum**. (Above GL 899.55 Cum and Below GL 1173.63 Cum)

As per the SWM Rules 2016, selection of an applicable method/type or technique for dumpsite remediation needs to be arrived from the Feasibility study carried out, and based on the results, remediation can be done by a) Capping without land recovery, b) Bio-mining – reclamation/recovery of land) capping with partial land recovery. The selection of technology shall also depend on the available resources viz., manpower, machineries, money, and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for land recovery and forward linkages/utilization of processed aggregates/byproducts. Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste

dumpsite. Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by-products as per the requirements of the utilization/forward linkage. Based on the detailed assessment of the selection parameters, stationary trommel screening machineries shall be optimum for processing the legacy waste within the stipulated timeline of 31st March 2024.

Environmental & Social safeguards: The project attracts E2 Environmental category based on the project activities and status of the environment baseline. The project attracts moderate social risks based on the social mapping, transect walk and consultation with the people living around the proposed project site to assess the problems associated with the legacy waste dumpsite and the impact during the execution of the project.

The activities of bio-mining will commence from Nov 2023 and are expected to end by March 2024. An area **of 29.757 Cent** will be reclaimed and will be utilized for setting up other solid waste management facilities. Total cost of the project is Rs**.** [redacted]

## 1.0 Introduction

In view of the environmental and social issues connected with dumpsites, the SWM Rules 2016, directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the remediation projects of legacy waste dumpsites in all the ULBs. As part of the project, in phase -1, the existing dumpsite of Koothattukulam ULB was proposed for remediation.

For arriving at a methodology for remediating the legacy waste in the dumpsites, as per the Project Implementation Manual, a feasibility study outlining the technical, economic, and socio- environmental factors has been carried out. As a result of the feasibility study that involved detailed field investigations and assessment, and market sounding, the method proposed for remediation of legacy waste dumpsite is biomining, which will ensure long-term sustainability and environmentally sound treatment, which is found technically feasible, economically viable, and socially acceptable. The details of various steps involved in the feasibility study are described in the following sections.

## 2.0 General Description about the Project

Koothattukulam is experiencing the issues of treatment and disposal of MSW. The KSWMP project aims to improve the overall SWM system in all the 93 ULBs and covers the waste collection, transportation, processing, and disposal of rejects in a scientific landfill.

The existing waste dumpsite at Koothattukulam needs to be remediated scientifically and the land reclaimed for productive use. This feasibility report outlines the current status including the environmental and social aspects, examines various remediation options and suggests the most feasible option for the given context is being prepared for the purpose of availing for execution of closure of by Koothattukulam ULB.

## 3.0 Profile of ULB- Koothattukulam Municipality

### 3.1 Location

Koothattukulam Municipality is located at latitude 9.8621862 "N and longitude 76.5980931” E in the Ernakulam district as shown in **Figure 3.1**. Koothattukulam is a town and Municipality situated in Muvattupuzha Taluk, towards the southeast corner of Ernakulam district in Kerala. The total geographical area of Koothattukulam municipality is 23.18 sq km. The Municipality is divided into 25 administrative wards. The Dumpsite is in ward 15 next to the Koothattukulam New Market and KSRTC Bus stand.

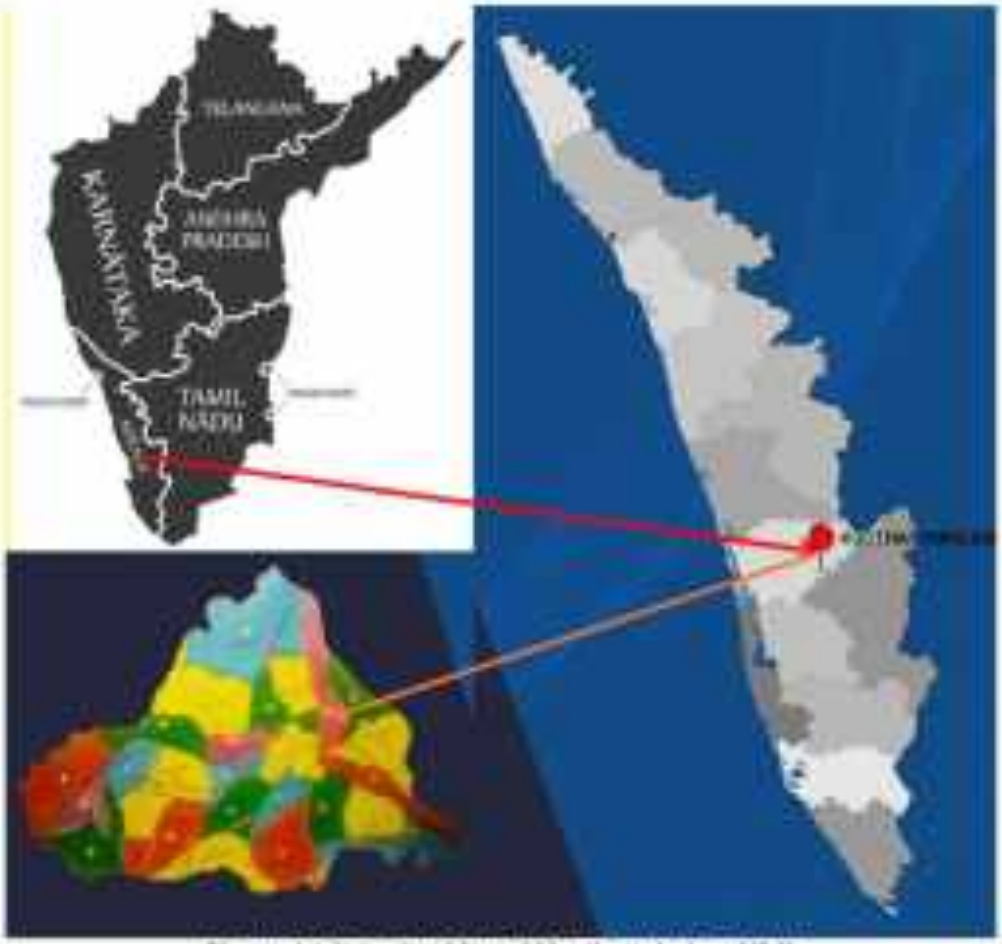



**Figure 3.1 Location Map of Koothattukulam ULB**

## 3.2 Demographic & Socio-Economic Status

The municipality has a total population of 17,253 of which 8,384 are males while 8,869 are females as per report released by Census of India 2011 indicating a sex ratio is of 1.058 against state average of 1.084. The overall literacy rate of Koothattukulam town is 96.38 %, which is higher than the state average of 94.00 %. The estimated population in 2023 is 17,529 with a decadal growth rate of 2.43 %.

In Koothattukulam, out of total population, 7074 were engaged in work activities. 81.81 % of workers describe their work as Main Work (Employment or Earning more than 6 Months) while 18.19 % were involved in marginal activity providing livelihood for less than 6 months. Of 7074 workers engaged in Main Work, 742 were cultivators (owner or co-owner) while 407 were Agricultural labourers.

**Table 3.1 Workforce Participation Details, Koothattukulam**

| Category | No of Person | Percentage |
|---|---|---|
| Main Workers | | |
| Cultivators | 742 | 4.3% |
| Agriculture Labourer | 407 | 2.35% |
| Household Industries | 7074 | 41.00% |
| Total Workers | **8223** | 47.66% |
| Non-Workers | **9030** | 52.33% |
| Grand total Population | **17253** | 100% |

*Source: Census of India 2011*

### 3.3 Connectivity

Koothattukulam town is well connected to neighbouring local bodies and towns through National Highways, State Highways, and other Major and minor road networks. National Highway 966A passes through the municipality. Kochi – Salem Highway also passes through the town. The Main Central Road also passes through the municipality.

The nearest railway station, Piravom Road railway station is located 22 kms from the town center. Koothattukulam's nearest airport is Cochin International Airport situated at 49.5 km distance.

### 3.4 Climatic Condition

All parts of Ernakulam district including Koothattukulam have a wet monsoon type of climate. Entire district experiences heavy rainfall during the southwest monsoon season followed by northeast monsoon. During the other months the rainfall is considerably less. March, April, and May are the hottest months. December to February are the coldest months. The overall meteorological condition of Ernakulam District is presented in Table 3.2

**Table 3.2 Meteorological Condition of Ernakulam District**

| Meteorological Parameter | Details |
|---|---|
| Temperature | The mean monthly maximum temperature ranges from 28.1 to 31.4°C and the minimum ranges from 23.2 to 26 °C. The maximum temperature occurs during March and April months and the minimum temperature occurs during December and January months. |
| Relative Humidity | The humidity ranges from 68 to 89% during morning hours and 64 to 87% during evening hours. The maximum humidity is observed during May to October months. |

| | |
|---|---|
| Evaporation | Evaporation is more during summer months of January to April and it is low during the rainy months May to August. The maximum rate of 4.8 mm per day is recorded in March and the lowest rate of 2.6 mm is recorded during July |
| Wind | The wind speed ranges from 6.7 to 10.9 km/hour with mean speed of 9.1 km/hour. The wind speed is high during the period from March to September |

Source: Groundwater Information Booklet of Ernakulam District published by Central Ground Water Board

### 3.5 Ground Water Level

From monitoring wells dispersed across the state, the depth to water level is observed in the months of April, August, November, and January. According to information published by the CGWB, the Government of India, the water level in Koothattukulam fluctuates from 2 to 15 MBGL.

### 3.6 Land use

The vicinity of the project area has a few households within a radius of 200 m. The land use survey of 2007 revealed that the predominant land use of Koothattukulam Municipality is dry cultivation The landuse map of Koothattukulam Municipality is presented in following Figure 3.2



**Figure 3.2 Existing Land Use Map of Koothattukulam Municipality in 2007 Published by Department of Town and Country Planning Ernakulam**

## 4.0 Detailed Description of the Dumpsite

Koothattukulam dumpsite is located approximately 1.0 Km from the centre of Koothattukulam town on the western side and encompasses an area of approximately 29 cents of land. The dumps site is not very far from human settlement. The coordinates of the dumpsite are Latitude 9.863771° N and Longitude 76.909936° E. It is in ward No. 15 of the municipality. Koothattukulam municipality holds the ownership of the dumpsite land. A small canal flows adjacent to the dumpsite. Also, market area and KSRTC bus stand are located adjacent to the dumpsite.

The exact date for start of the dumpsite was not available with the municipality; however approximately it had started in the year of 1990, the information has been gathered during field visit.

## 4.1 Physical Feature of the Site

The salient features of the dumpsite existing within Koothattukulam municipality is present in table below. There is a high chance of water being contaminated in this area due to the irregular dumping and air pollution because of odour problems to the nearby residents.



**Figure 4.1 Photograph of Koothattukulam Dumpsite**

**Table 4.1 Salient Features of Koothattukulam Dump Site during Site Visit**

| Particulars | Details |
|---|---|
| Name of Dumpsite | Koothattukulam dumpsite |
| Location of Dumpsite | Ward No. 15 of the municipality |
| Co-ordinates of Dumpsite | Latitude: - 9.863771° N<br>Longitude: - 76.909936° E |
| Distance from the central part of the town | 1.0 km |
| Area of dumpsite | 29.737 cents |
| Average height of dumpsite | 0.8 m (Above GL) |
| Ownership of dumpsite land | Municipality |

| Particulars | Details |
|---|---|
| Distance from nearby features- residential, school, offices, temples, institutions, industry etc.) | There is Residential and other structures within 20 metres from the site |
| Start date of dumpsite | 1990 |
| Quantity of waste dumped per day | None |
| Utilities on site | Electricity connection is available |
| Details of manpower available in dumpsite | 18 persons |
| Site demarcated | Site is currently demarcated with boundary wall. |
| Details of weighbridge available at dumpsite | No weighbridge at site |
| Plant adjacent to dumpsite details | Nil |
| Availability of electrical power | 440 LV grid available at 100m from site |
| Availability of water for process | Water is not available at dumpsite, water to be supplied by tanker |
| Road Width (for vehicle access) | 3.5 m |

### 4.2 Surrounding Features of the Dumpsite

The dumpsite is located adjacent to the KSRTC Bus Stand. It is located on the back side of the market, besides the fire station. A canal runs nearby to the dumpsite. Within 500 metres of the dumpsite house and shops are present.

### 4.3 Relevance in local or regional SWM plans

The ULB is planning to utilise the reclaimed dumpsite land for the construction of a state of art Material Recovery Facility. The non-biodegradable waste from the ULB shall be brought to this facility and materials collection facilities and processed for further use. The project is being funded under the KSWMP project.

### 4.4 Litigation status of the Site

There is no litigation for the dumpsite in the Koothattukulam Municipality.

## 5.0 Scope of Work

Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at Koothattukulam includes the following steps.

- Conducting detailed field investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical, and Environmental Baseline Analysis by M/s Pollachem Laboratories.
- Assessment & Analysis of detailed investigation report submitted by the Laboratories.

- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.
- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the By-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation (land recovery – Biomining, Capping partially Biomining & Capping), Methods/Technologies (Stationary & Mobile- compact), Implementation mode, Forward linkages (Utilization/Management of By-products) and Environmental & Social categorization as per the ESMF developed for projects envisaged under KSWMP.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Delineation of baseline assessment, impact & risk assessment, mitigations measures, Environmental Management & monitoring plan, budget for EMP, EMOP, institutional responsibilities for implementing monitoring and reporting
- Social Safeguards - Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.
- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport,
- Environmental and social monitoring costs, Revenue from the project, Funding for project
- Project Implementation plan –contractual models and timelines.

## 5.1 Objectives:

- To remediate the dumpsite by 31st March 2024.
- To reclaim area and by eliminating the chances of dumpsite fires, leachate generation, and foul odour.
- To reduce greenhouse gas emissions, soil pollution, and groundwater contamination.
- To increase nearby real estate/social value and benefit the citizens.

# 6 Detailed Investigation Strategy

## 6.1 Investigation Strategy

To understand the nature and composition of the legacy waste and the existing baseline environmental conditions, samples from waste, surface and groundwater, leachate, soil, air, and noise were collected as per the requirements given in the Project Implementation Manual, considering the state and national guidelines. Samples were collected as mentioned below;

- Bore hole upto a depth of 10 m and collection of 3 (nos) samples from the soil at interval of 1.5 m.
- Waste analysis viz., leachate sample from 3 (nos) locations and physical analysis from 2 (nos) locations, and chemical analysis from 1 (nos) location.
- Environmental baseline analysis surface water 1 (nos) location and ground water samples from 3 (nos) locations (Well Water Samples -1 up gradient, 2 down gradient) and Air sampling from 2 (nos) locations and noise sampling from 1 (nos) location

## 6.2 Investigation Plan

The detailed investigations carried out for the legacy waste dumpsite is given in the table below:

| S.No | Parameters | Sampling Nos |
|---|---|---|
| 1 | **Geotechnical Investigation** | |
| A | Bore Holes up to 10m depth(1No./2Hectare) (as per CPHEEO) | 1 |
| B | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, Strength compressibility (vertically-3 samples per borehole). | 1 |
| 2 | **Waste & Environmental Analysis** | |
| A | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016). Suspended solids, Dissolved solids(inorganic), pH, Ammoniacal nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | 3 |
| B | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | 2 |
| C | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium(N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor. | 1 |
| D | Ground water (well water samples-1 up gradient, 2 down gradient)-(shallow and deep wells) Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, CL NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total coliform (IS 10500-2012). | 3 |

| S.No | Parameters | Sampling Nos |
|---|---|---|
| E | Surface water (pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, Ecoli and Total coliforms (IS 10500-2012). | 1 |
| F | Ambient Air Quality (Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | 2 |
| G | Ambient Noise level [E(P)] for 24 hours. | 1 |

## 6.3 Sampling Methodology

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat/Long) were considered. The following table shows the strategic location details of samples selected for the detailed investigation.

**Table 6.1 Detailed Investigation Plan Executed for Waste Dumpsite at Koothattukulam**

| S.No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | Within the Dumpsite<br>Dumpsite boundary | The AAQ locations were chosen based on the Windrose data |
| 2 | Noise (1 Location) | Ambient Noise level [E(P)] for 24 hours | Entrance of the dumpsite | Most vulnerable point in the site in regards of Noise quality is due to entry and exit of the waste loading and unloading vehicle. |
| 3 | Surface water (2 Locations) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, Ecoli and Total coliforms (IS 10500-2012). | Surface water near to the dumpsite [stream] | It is important to identify area nearest to the dumpsite to assess any contamination due to the project thus location was selected |
| 4 | Ground water (2 Locations) | Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total coliform (IS 10500-2012). | 2 wells identified near the dumpsite area | It is important to identify area nearest to the dumpsite to assess any contamination due to the project thus location was selected |

| S.No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 5 | Bore Hole (1 location) | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coeff of permeability, Strength compressibility (vertically-3 samples per borehole). | Within the dumpsite area | As per requirement on the waste dump based on the objective of the sampling and preferably at the centre of the dumpsite |
| 6 | Waste & Environmental Analysis | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammoniacal nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | Within the dumpsite area | |
| | | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents | Within the dumpsite area | |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium(N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor | Within the dumpsite area | |

For the borehole investigation the sample were collected by rotary drilling a 150mm bore hole using a fast rig attached to a drag bit. The soil drillings are removed by a circulating bentonite slurry which also aids in keeping the side walls stable. An SPT sampler was driven in to collect the representative samples, which is carefully packed in double walled polythene bags, sealed, and sent to laboratory for testing. Standard penetration tests were conducted on soil at every 1.5m depth and the number of blows to achieve 300mm penetration were noted. Fractions recovered from the mining of legacy waste should be tested, especially for the presence of toxic metals and organic contaminants.

The total quantity of waste present in the waste dump is calculated based on the topographic study executed by ULB (towards calculating quantum of waste above ground level) and the results of borehole investigation (towards calculating the quantum of waste below ground level).

## 6.4 Analysis and Interpretation of Exploratory Data

The baseline condition of the waste dumpsite at Koothattukulam, has been assessed through the geotechnical investigation and Waste & Environmental baseline assessment executed through M/s. Matter Material Testing & Research Laboratory (P) Ltd and M/s Poluchem Laboratories (P) Ltd respectively. The results of the Topographical survey conducted in the year 2022 are also considered for the analysis. The signed reports of all analysis are enclosed as Annexures as detailed below;

Annexure 1 – Topographical survey report

Annexure 2 –Geotechnical Survey report

Annexure 3- Waste Characterization study report

Annexure 4 - Waste & Environmental baseline assessment reports

The initial site visit was carried out by M/s. Matter Material Testing & Research Laboratory (P) Ltd on 23rd May 2023 along with the experts of TSC and PIUs. Field Geotechnical investigation to collect the soil samples after drilling through the legacy waste was started on 6th June 2023 and was completed on 8th June 2023. Positioning of Air samplers & Noise monitoring equipment, sampling of surface/groundwater, leachate, and legacy waste were done on 3rd June 2023 by M/s Poluchem Laboratories (P) Ltd.

### 6.4.1 Topographic Survey Results

Topographic survey was conducted by ULB itself in the year 2023 towards assessing the quantum of the waste present in the dumpsite above the ground level. The Topographical survey report is presented in **Annexure 1**. The inference of the Topographical survey is as follows:

- Topographical Survey Map shows approximate 29.757 cents of land used for waste dumping.
- Maximum height of waste dump above soil is 0.8 m (above GL)
- Estimated waste volume above ground level is 899.55 cum which will constitute 944 T of waste (density of waste is 1.05 T/cum as per the characterization study results presented in subsequent sections)

### 6.4.2 Geotechnical Exploratory Details

The geotechnical investigation at the dumpsite at Koothattukulam, Ernakulam district was carried out by M/s. Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was drilled through the waste into the ground using a rotary drilling method. The maximum depth of investigation was 7m (3 m in waste and 4 m in the ground). SPT and collection of undisturbed soil samples were carried out at regular intervals within the ground. Various laboratory tests were carried out on the SPT and undisturbed soil samples. The full geotechnical

report is appended as **Annexure 2**. The major inference of the geotechnical investigations are as follows;

- In the borehole investigation it was asserted that the depth of the waste column is 3 m.

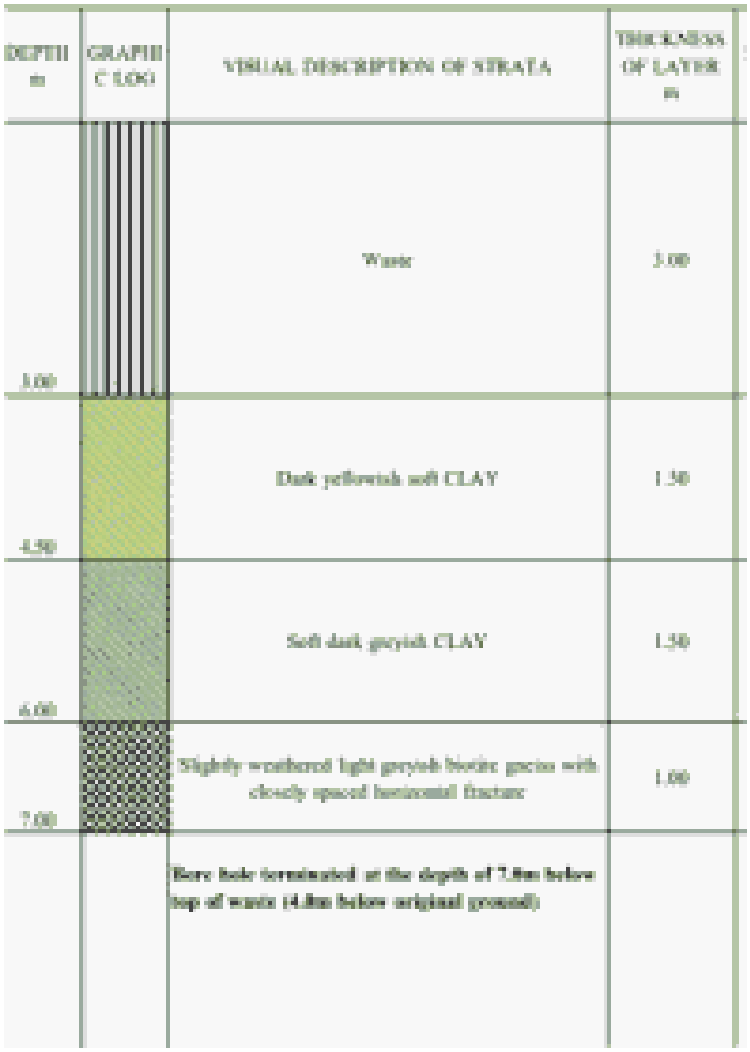



**Figure 6.1 Borehole Strata Obtained for Koothattukulam Dumpsite**

- The soil exhibited a plasticity index of 33. The base soil has a plasticity index greater than 10 and the clay and silt fractions account to more than 30%, which makes it a good soil for the subbase.
- The clay fraction is 60 %.
- The pre-consolidation pressure is b 145 KPa.
- The permeability value is 1.44 E-05.
- The Cation Exchange Capacity (CEC) of the soil is 11.91 meq/100gm

### 6.4.3 Estimated Total Quantity of Waste

The total quantity of waste is estimated based on the contour/ topography survey of the waste over the ground level and exploratory data of the bore log (Geotechnical investigations). As detailed under section 6.4.1, the estimated quantity of the waste above the ground level is **899.55 Cum**.

Quantity of waste below the ground level is estimated as **1203.97 Cum**. The quantity of waste below ground level may vary as per actual site conditions. We recommend taking 4 more bore holes for estimating exact quantity or the assessment of quantity below ground level may be included in the contractor's scope.

Thus, the total legacy waste present in the Koothattukulam dumpsite is calculated as below:

**Table 6.2 Total Waste Quantification for Koothattukulam Dumpsite**

| Sl No | Name of Dumpsite | Quantity of Waste present above the Ground level | Quantity of Waste present below the Ground level | Total quantity of legacy waste to be managed |
|---|---|---|---|---|
| 1 | Koothattukulam | 899.56 Cum | 1203.97 Cum | 2103.52 Cum |
| | | 944 T | 1264.16 T | 2208.70 T |

### 6.4.4 Legacy Waste Characterization

The characteristics of the legacy waste were assessed by collecting a 15kg sample. The legacy waste samples were collected on 3rd June 2023 by M/s Matters lab (P) Ltd. The assessment of waste characteristics. was done based on the results of the analysis. The details of the physical characteristics are provided in the tables below: The detailed legacy waste characterisation reports are enclosed as **Annexure 3**

**Table 6.3 Grain Size Analysis of Legacy Waste**

| Sieve Size (mm) | Percentage Retained |
|---|---|
| 80 | 13.3 |
| 37.5 | 13.8 |
| 10 | 47.3 |
| 4 | 20.5 |
| Pan | 5.1 |

**Table 6.4 Characterisation of Waste Material Retained in Each Sieve**

| Test/ Parameters | Waste Material Retained on each sieve in % | | | |
|---|---|---|---|---|
| | 80mm | 37.5 mm | 10mm | 4mm |
| Plastic Waste | 42.7 | 6.9 | 1.6 | 0 |
| Cloth | 2.1 | 0 | 0 | 0 |

| Test/ Parameters | Waste Material Retained on each sieve in % | | | |
|---|---|---|---|---|
| | 80mm | 37.5 mm | 10mm | 4mm |
| Glass | 0 | 0 | 0.2 | 0 |
| Wood | 0.7 | 3.4 | 0.9 | 0 |
| C&D | 0 | 0 | 0 | 0 |
| Bio Fraction | 0 | 0 | 0 | 0 |
| Gravel | 47 | 89.7 | 95.7 | 100 |
| Rubber | 7.5 | 0 | 0 | 0 |
| Metal | 0 | 0 | 1.6 | 0 |

**Table 6.5 By Product Composition**

| Particular | Percentage of Composition (%) |
|---|---|
| RDF | 9.38 |
| Recyclable | 0.76 |
| Inert | 82.94 |
| Compost Soil Enricher | 5.10 |

**Table 6.6 Physical Characteristics of Waste**

| Sl No | Parameter | Test Method | Unit | Value |
|---|---|---|---|---|
| 1 | Moisture@105°C | ASTM D 2216 | % | 28.01 |
| 2 | Bulk Density | USEPA | kg/m3 | 1098 |
| 3 | Density | USEPA | g/cm3 | 1.0555 |
| 4 | Calorific Value | ASTM D 5865 | K cal /kg | 124 |

**Table 6.7 Chemical Analysis**

| Sl No | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 7.3 |
| 02 | Biodegradable Factor | USEPA | % | 3.4 |
| 03 | Total carbon | USEPA 9060A | % | 5.3 |
| 04 | Phosphorus(P) | USEPA | % | 0.064 |
| 05 | Nitrogen(N) | USEPA | % | .32 |
| 07 | Potassium(K) | USEPA | % | 0.047 |
| 08 | C/N Ratio | USEPA | .. | 16.5:1 |

*Note: The average Nitrogen, Phosphorus and Potassium (NPK) content in the legacy waste samples picked from the site is 0.32, 0.047, 0.064, respectively by weight. This is far lower than 0.8, 0.4 and 0.8 as specified by the Fertilizer Control Order (FCO) 1985 for city compost and hence cannot be used as compost. The carbon: nitrogen ratio is 16.5 which is much lesser than the specified standard. This could be due to the materials being exposed to sun and air over the years or that the carbon content may have leached into the ground through leachate during the rainy season. Another possible contributor to the reduced carbon levels could be multiple fire incidents at the site. Although the material has very less carbon content, the NPK value can be enriched by adding additives like poultry litter. The enriched material can be given to farmers or used for horticulture purposes.*

### 6.4.5. Soil Conditions of the Dumpsite

As it is an unlined dumpsite, there is a probability of finding traces of contaminant from waste and leachate in the underlying soil. Since it is an uncontrolled disposal site, the mixed waste contains different types of pollutants which may eventually have an impact on the soil. Results of soil analysis of the samples taken from the borehole in the Koothattukulam dumpsite is as shown below:

**Table 6.8: Chemical analysis of soil extracted from borehole at Koothattukulam dumpsite**

| Sl. No | Parameter | Result | US (NY State-Codes, rules and regulations) Industrial Use |
|---|---|---|---|
| 1 | Cadmium (Cd) mg/Kg | <5.0 | 60 |
| 2 | Chromium (Cr) mg/Kg | 172.4 | 800 (Hexavalent) 6800 (Trivalent) |
| 3 | Copper (Cu) mg/Kg | 62.9 | 10000 |
| 4 | Nickel (Ni) mg/Kg | 68.8 | 10000 |
| 5 | Lead (Pb) mg/Kg | 39.9 | 3900 |
| 6 | Zinc (Zn) mg/Kg | 601.0 | 10000 |
| 7 | Mercury (Hg) mg/Kg | <0.1 | 5.7 |
| 8 | Arsenic (As) mg/Kg | 2.0 | 16 |

On comparing results of the report with the US Industrial Use benchmark, it is observed that the values are significantly low and within the benchmark values. Bioremediation may be carried out to reduce traces of heavy metals in soil and for site clearance. The location may be used for Industrial landuse as a site for the SWM facilities like Material Collection and Resource Recovery Facility. However, the solution may be considered after proper soil and groundwater investigation post dump-clearing stage.

### 6.4.6 Leachate Characterization and Quantification

There is no leachate collection/management system in the dumpsite. To address the concern of contamination of the groundwater and soil due to uncontrolled dumping, leachate samples are picked for analysis. The data is presented in **Annexure 4**. The data indicates that the TDS is

about 367 mg/l while the suspended solids is about 142 mg/l. The chlorides are high at 52.1 mg/l, while the COD, BOD are 110 mg/l and 480 mg/l respectively.

**Table 6.9 Leachate characteristics at Koothattukulam Dumpsite**

| Parameters tested | Test method | Results |
|---|---|---|
| Sampling Location | N-9°59'23.582'' E -76°33'51.031 | |
| pH | IS 3025 (P) 11 –1983RA2017 | 7.48 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 367 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 142 mg/l |
| Chloride as Cl- | IS 3025 (P) 32 – 1988RA2014 | 52.1 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 480 mg/l |
| B O D (3 days at 27 C) | IS 3025 (P) 44 – 1993 RA 2014 | 110 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 24.3 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 19.07 mg/l |
| Phenolic Compound as C6H5OH | IS 3025 (P) 43-1992 RA2014 | 1.3 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 1.2 mg/l |
| Cyanide as CN- | IS 3025(P) 27-1986RA2014 | BDL (MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL (MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL (MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL (MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 2.3 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL (MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 3.5 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL (MDL- 0.01 mg/l) |

*BDL- Below Detection Level, MDL- Minimum Detection Level*

The heavy metals are found to be low, hence the soil is unlikely to be contaminated by heavy metals from waste.

### 6.4.7 Environmental Baseline

The environmental baseline was assessed from the analytical results of air, surface & groundwater, noise and leachate. The samples were collected by M/s Pohchem Laboratories (P) Ltd. The Environmental baseline was analyzed with reference to the lab analysis reports. The details of analysis & inferences are provided in the ESIA Section in **Annexure 5**

### 6.4.8 Risk Assessment

**Surface Water:** Dumpsites can release pollutants into nearby surface water bodies through leachate, which is generated when rainwater or other liquids come into contact with the waste. Leachate can contain various contaminants such as heavy metals, organic compounds, and pathogens. Proper containment and management of leachate are essential to prevent water pollution.

The analysis of surface water reveals that all the parameters are within the acceptable limit, except it is slightly acidic and the dissolved oxygen content is less than prescribed limit, so also the BoD is greater than the allowable limit, indicating that the water contains organic load.

**Table 6.10 Risk Assessment- surface water**

| Risk Assessment | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite - BOD Higher than the acceptable limits |
| **Pathway** | Water/Run off |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | High BOD indicates the water is highly polluted and it is harmful to the ecosystem as fish and other aquatic life may suffocate in oxygen-depleted waters. Also, it will contain more Pathogen and make the water unfit for human and animal |

**Ground Water**: Pollutants from dumpsite can infiltrate into underlying groundwater, particularly if the dumpsite is not adequately lined or if waste disposal practices have caused contamination of the soil. Once pollutants enter the groundwater, they can spread over a wide area, affecting drinking water sources. Remediation techniques often focus on preventing or minimizing further groundwater contamination.

The analysis of ground water samples taken at one location reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The pH of the sample analysis is 5.61, which is in a slightly acidic range which can make the water not fit for any industrial purpose as it is more corrosive.

**Table 6.11 Risk Assessment - Ground water**

| Risk Assessment | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite - pH is acidic in nature |
| **Pathway** | Water, soil |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | Possible risk to human health are;<br>• Diarrhea<br>• Nausea and Vomiting<br>• Abdominal Pain<br>• Weakness<br>Possible risk to flora |

| | |
|---|---|
| | It can decrease the availability of plant nutrients, such as phosphorus and molybdenum, and increases the availability of some elements to toxic levels, particularly aluminium and manganese. |

**Air**: Dumpsites may emit pollutants into the air through processes such as open burning of waste or the release of gases from decomposing organic materials. Airborne pollutants can include particulate matter, volatile organic compounds (VOCs), dioxins, and other hazardous substances. These pollutants can have adverse effects on air quality and human health. Measures to control and mitigate air pollution during dumpsite remediation include covering waste, implementing proper waste management practices viz., dust containment screens, etc. to be ensured.

**Table 6.12 Risk Assessment - Air**

| **Risk Assessment** | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Within the limits |
| **Pathway** | Air |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | No Anticipated risk |

**Soil**: Dumpsites can contaminate the surrounding soil with a wide range of pollutants. Hazardous chemicals, heavy metals, and organic compounds can leach from the waste and accumulate in the soil, potentially posing risks to plants, animals, and humans.

**Table 6.13 Risk Assessment - Soil**

| **Risk Assessment** | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Heavy metals |
| **Pathway** | soil |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | Possible risk to human health: Soil that contain substance such as heavy metals which may be toxic to human can pass those substances on to human through crop uptake leading to unsafe foods.<br>Possible risks to animals: when farm animals consume the plant grown from contaminated soil it affected the health of animal<br>Possible risk to flora: Soil pollution may affer plant metabolism and reduce crop yield, also the trees and plants that absorb the soil contaminants enter into the food chain |

**Bioaccumulation in Biota**: Pollutants from dumpsites can enter the food chain and bioaccumulate in plants and animals. As pollutants move up the food chain, their

concentrations can increase, leading to potential health risks for humans and wildlife. Remediation efforts include restoring the land and minimizing the exposure of organisms to contaminated environments

**Table 6.14 Risk Assessment - Bioaccumulation in Biota**

| **Risk Assessment** | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate and heavy metals |
| **Pathway** | Air, water and soil |
| **Receptor** | Human, Animals, flora and fauna |
| **Risk** | Possible risks to human health, animal flora and fauna<br>Accumulated of contaminants in plants and animals indirectly through food chain affects human health |

## 7.0 Evaluation of Remediation Techniques

The remediation of existing unmanaged municipal waste dumpsites has emerged as a crucial necessity for Urban Local Bodies (ULBs) in India. The adoption of unscientific and unplanned waste disposal methods in non-engineered landfills has given rise to significant environmental challenges. These issues encompass soil and groundwater contamination, unregulated emissions of landfill gases into the atmosphere, and the heightened risk of exposure to disease vectors and scavengers. As a result, addressing and reclaiming such dumpsites has become a priority to mitigate these adverse environmental impacts.The Hon'ble NGT seized with these problems across the country has ordered that the respective authorities to remedy this at the earliest.

The dumpsites have emerged as pollution hubs, especially those situated in human settlements, as cities have grown over the decades. It has, therefore, become a necessity for the city authorities to remediate the existing dumpsites in an environmentally sound and economically visible manner.

Remediation of waste dumpsite is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

- Environment Enhancement - reduction in greenhouse gas emissions, soil pollution, ground water contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.

- Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in nearby real state value and rental values.
- Land - Dumpsite land becomes available for utilizing same for the establishment of other Waste Management Facilities.
- Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels

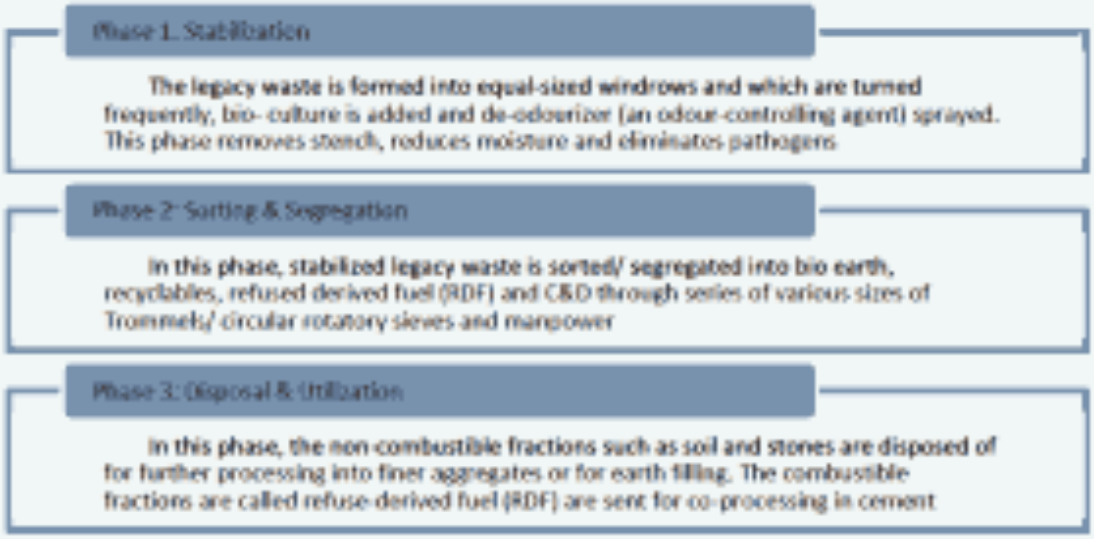
For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- A total station survey for assessment of volumetric quantity of legacy waste above the ground level.
- Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- History of the site, Physical features of site, as –is/current situation and compositional analysis of waste.
- Baseline study of heavy metals; subsurface soils and water; rainfall; soil type; surface hydrology; topography; wind direction etc. Shall be studied prior to bioremediation.
- Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area.

The details of the remediation techniques for the remediation of the legacy waste dumpsite remediation are as follows:

## 7.1 Bio-Mining – Reclamation/Recovery of Land

Bio- mining is the scientific technique to extract materials of economic interest from legacy waste through bioremediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) and followed by sustainable management through recycling, co-processing, road construction etc.




| | |
|---|---|
| Salient Features | • Maximum land recovery, increase in value of land and available for public use/habitation with immediate effect.<br>• Ensures long-term sustainability and environmentally sound treatment of legacy waste and also present lucrative revenue-generating opportunities.<br>• Bio products/aggregates generated from the process can be used as alternative construction material, fuel and recyclables.<br>• Compliance to SWM Rules and NGT orders.<br>• Improvement in aesthetics and quality of life & health. |
| Applicability | • The ownership is well defined.<br>• Working space is available in the dumpsite.<br>• Linkage for utilization by-products is available |

## 7.2 Capping Without Land Recovery

Capping is a scientific process of profiling legacy waste and covering with barrier layers consisting of soil, high density polyethylene (HDPE) liner, gas collection system surface drainage system, and a vegetative cover to minimize the percolation of rainwater into the legacy waste.

| | |
|---|---|
| Salient Features | • The capped area becomes a green space and can be developed into parks/recreational areas.<br>• Capped area will be equipped with environmental monitoring systems for post-closure maintenance to monitor pollution levels in groundwater and surface-water sources and air (especially methane emissions) at least 15 years |

| | |
|---|---|
| | • Capped area needs to be inspected periodically for settlement due to physical, chemical and biological transformation, leachate generation, erosion and naturally occurring invasion by deep- rooted vegetation.<br>• SWM rules 2016 do not permit habitation over it for at least 15 years because of the danger posed by toxic gases release by the waste. |
| Applicability | • Simple & robust, least expensive method among various available technologies |

### 7.3 Capping with Partial Land Recovery

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bioremediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can be linked to relevant buyers and the inert material will be capped over lower footprints, with well-designed slopes to prevent further degradation of the environment.

The top layer of capped material may also be provided with gas collection wells and pipes to trap the methane and the collected gasses are typically passed through an oxidation layer of passive venting or flared. If the gas quantity is substantial then, power generation may be a possibility. The capped area should have drains to collect the surface water flow as well as any leachate that may be generated. Such leachate are collected and treated in leachate treatment plants.

The reclaimed land may be covered with loamy soil that has plants with high transpiration rates. The plants do not permit the ingress of water into the soil thereby reducing the possibility of leachate generation. The plants and soil microbes also behave as oxidation layer. The soil is compacted and maintained with gentle slopes with 1 to 3. Contour drains may be provided to divert the water away from the soil thereby preventing ponding of water. The reclaimed land may be covered with solar panels to generate renewable energy during the period of observation following the post closure.

| | |
|---|---|
| Salient Features | • The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.<br>• Ensures short -term sustainability and environmentally sound treatment of legacy waste.<br>• Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area |

| | |
|---|---|
| Applicability | ● Legacy waste dumpsite area partial of steep terrain, inaccessible ravines and narrow valleys.<br>● Lack of linkage for disposal of inert<br>● Recovery land for public use is not a priority |

## 7.4 Selection of Remediation Option

Selection of the applicable method/type or technique is based on the factors like., salient aspects & applicability of remediation types viz., Capping without land recovery, Bio-mining – reclamation/recovery of land & capping with partial land recovery and also available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for maximum land recovery and forward linkages/utilization of processed aggregates/by-products.

Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. Moreover, as per Solid Waste Management Rules, 2016 and several National Green Tribunal (NGT) directives have mandated that urban local bodies opt for bio-mining over capping

However, after the bioremediation municipality wants to use the land for setting up of Material Collection Facility and Resource Recovery Facility. Hence backfilling of the site with boulders and inert are planned.

For the execution of dumpsite bio-mining two strategies can be adopted.

- *Insitu biomining*: Here the biomining is carried out within the premises of the dumpsite after clearing the waste and reaching the original ground level or in a land adjoining the dumpsite. The advantage is that only the finished products are moved out of the premises, inerts may be used for gradation and filling up low lying areas within the site, or in a newly developed sanitary landfill. This is quite economical when legacy waste quantities are significant. The possibility of gaseous emissions, noise and odour and formation of leachate exist as the processing takes place at the site. The location would remain affected for the time till all waste is processed.
- *Ex Situ biomining:* In small dumpsites, or where the area is a constraint, the entire waste is excavated and taken away to an alternate location for processing. The work in the dumpsite can be completed quickly and the disturbance due to the excavation can be minimized. The cost of transportation of the whole waste adds to the cost of bio mining. But since the process plant can serve multiple locations, economies of scale may be achieved and may also compensate for the added transport cost.

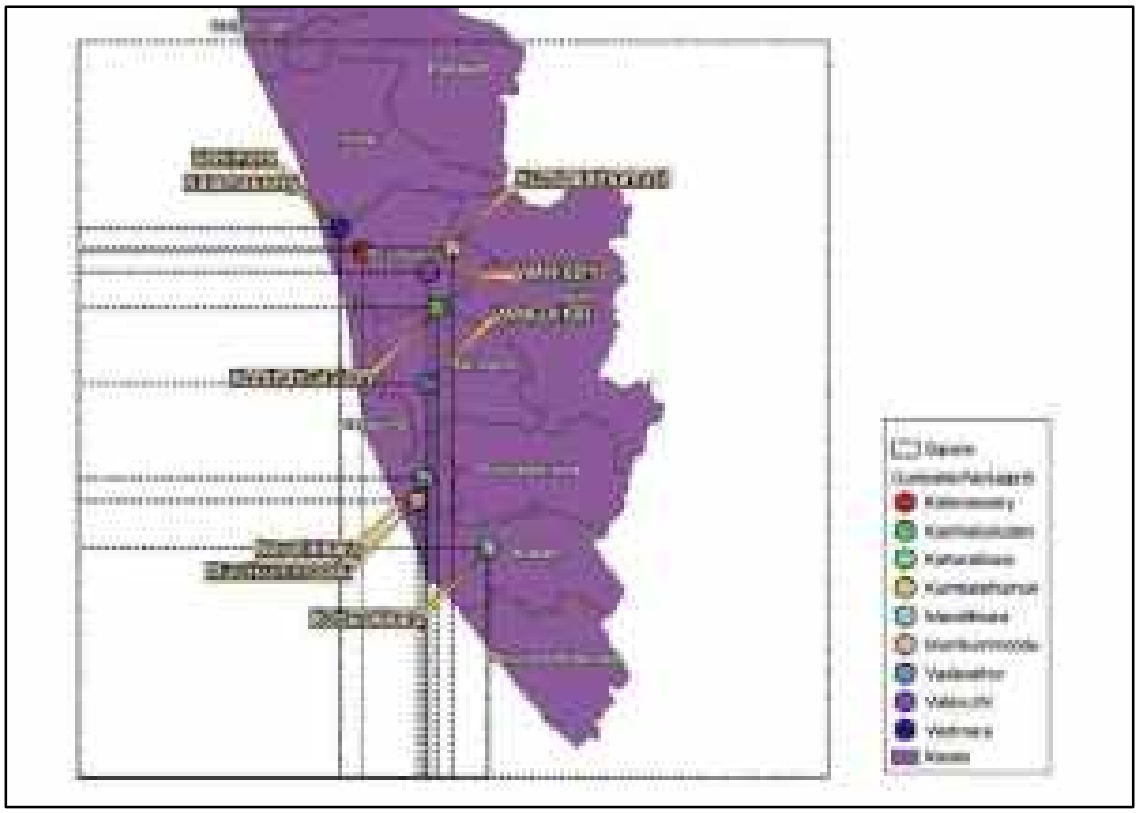


**Figure 7.1 Location of Other Dumpsites nearby**

## 8.0 Technical Description of the Selected Option

### 8.1 Methodology

The legacy waste dumpsite reclamation through bio-mining with recovery of land.

Phase 1: stabilization

Phase 2: sorting & segregation

Phase 3: disposal & utilization

Phase 4: Back filling of inerts/ soil enricher

## 8.2 Selection of Machineries

The type of machinery, capacity and type of screens to stabilize of the legacy waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) will depend on the physical site conditions including quantity & characteristics of legacy waste and utilization of the aggregates/by-products/recovered material.

The type machinery available for the bio mining are as follows:

- Stationary screening machinery and
- Mobile/compact machinery

### 8.2.1 Stationary Screening Machinery

A Stationary trommel is a specialized piece of equipment used in legacy waste bioremediation processes to separate and classify solid waste materials. It is designed to efficiently screen, and sort different components of the waste based on size and other characteristics. Technical description of a Stationary Trommel used in legacy waste bioremediation are as follows:

- Structure: The Stationary trommel consists of a frame made of steel or other durable materials. It is designed to withstand the harsh conditions of waste treatment facilities. The frame supports a cylindrical drum that is inclined at an angle for optimal material flow.
- Drum: The drum is the main component of the Stationary Trommel and is typically made of perforated metal or mesh. It is cylindrical in shape and rotates on its axis using a motorized drive system. The drum's 3- 5 mtr diameter and 10 mtr length can vary depending on the specific requirements of the waste treatment process.
- Motor and Drive System: The Stationary Trommel is equipped with a motor and drive system that powers the rotation of the drum. The motor is typically electrically powered and is connected to the drum through a gearbox or direct drive mechanism. The rotational speed of the drum can be adjusted to optimize the screening process
- Inlet and Outlet: The Stationary Trommel has an inlet where the legacy waste is fed into the drum for processing. The waste material enters the drum at one end, typically assisted by a conveyor or loader. The screened waste material is discharged from the opposite end of the drum through an outlet.
- Screening Mechanism: As the drum rotates, the legacy waste inside it is subjected to a combination of tumbling and rolling actions. The perforated drum allows smaller-sized particles and materials to pass through, while larger items such as bulky waste, debris, and contaminants are retained inside the drum. The drum's perforation size can be customized to achieve the desired separation efficiency.
- Waste Sorting: The Stationary Trommel facilitates the separation of different components within the legacy waste. It effectively segregates organic waste, inert materials, recyclables, and other categories based on their size and physical properties. This sorting process prepares the waste for further treatment or disposal.

### 8.2.2 Mobile/Compact Screening Machinery

The Mobile Trommel is a technical apparatus utilized in legacy waste bioremediation processes. Its primary function is to separate and sort various types of waste materials, such as solid waste and organic matter, for effective bioremediation

***Structure***: The trommel consists of a cylindrical drum, typically made of heavy-duty metal, which is inclined at a slight angle. The drum is supported by a framework and set in motion by a motor or engine, causing it to rotate slowly. The rotation of the drum allows the waste materials to be fed into the trommel at one end, while simultaneously moving the materials along its length. Large screening area (9.5 sq m). Helps in good quality segregation & high productivity

***Screening Mechanism***: The Mobile Trommel incorporates various mechanical features to facilitate waste separation. As the waste enters the drum, it encounters a series of screens or perforations arranged along the length of the drum. These screens have different mesh sizes, which allow for the separation of different-sized particles. The smaller particles, such as sand or fine soil, pass through the screens and fall through openings at the bottom of the trommel, while larger materials, such as plastics or larger debris, are retained and carried along by the rotation of the drum.

***Separation System***: Additionally, the Mobile Trommel may be equipped with paddles or lifters mounted inside the drum. These paddles help to agitate and tumble the waste materials, assisting in the separation process by ensuring proper contact between the waste and the screens. They also help to break up clumps or aggregates, aiding in the release of trapped organic matter. Four different screen inclination angles for operations between 20°-35° are available for selection provides flexibility.

***Treatment Process***: In the context of legacy waste bioremediation, the Mobile Trommel plays a crucial role in preparing the waste for subsequent treatment steps. By separating the waste into different fractions based on particle size, it allows for targeted bioremediation processes. For example, the fine fraction may be subjected to aerobic or anaerobic composting, while the larger fraction can undergo mechanical or physical treatments.

***Transport***: Quick and easy folding of conveyor helps in quick setup time.

***Discharge height***: Wider conveyor and higher discharge heights help in making bigger stockpile and eliminates the frequent loader usages

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by- products as per the requirements of the utilization/forward linkage.

Based on the detailed assessment of the selection parameters listed above, the site conditions, legacy waste characteristics, statutory requirements etc, stationary trammel machine shall be the optimum screening machinery.

## 8.3 System Requirements

The following are the infrastructural facilities required for setting up of machineries and equipment in biomining of a dumpsite: These are required irrespective of the option of in-situ or ex-situ processing.

- Fencing and secure entrance gate
- Security and reception office
- Weighing bridge
- Records room
- Laboratory
- Medical room
- Workers' area
- Parking for vehicles (heavy earth equipment, trucks, etc.) with tire washing facility.
- Administrative building
- Fire control unit
- Toilet–bath complex, with personnel protection equipment (PPE) storage room)
- Overhead water tank
- Leachate collection and treatment unit
- Environmental monitoring unit
- Segregation and processing area
- Temporary storage area for rejects, domestic hazardous waste and sanitary waste
- Material storage area
- Waste drying and windrow area.
- DG set

The total area required is about 900 sqm in an in situ biomining activity. Temporary construction power at 440V needs to be obtained from KSEB. This can be easily availed as there is an existing electrical infrastructure passing through the site. A 440V, 125KVA needs to be established for the project. Water storage tanks needs to be provided for the duration of the project. The water may be supplied by tankers. Labour will reside in Koothatukulam and commute daily to the site, hence no labour sheds are envisaged during this project. The requirements are only indicative, and the contractor is required to propose own design and capacity to complete the works in the stipulated time and standards.

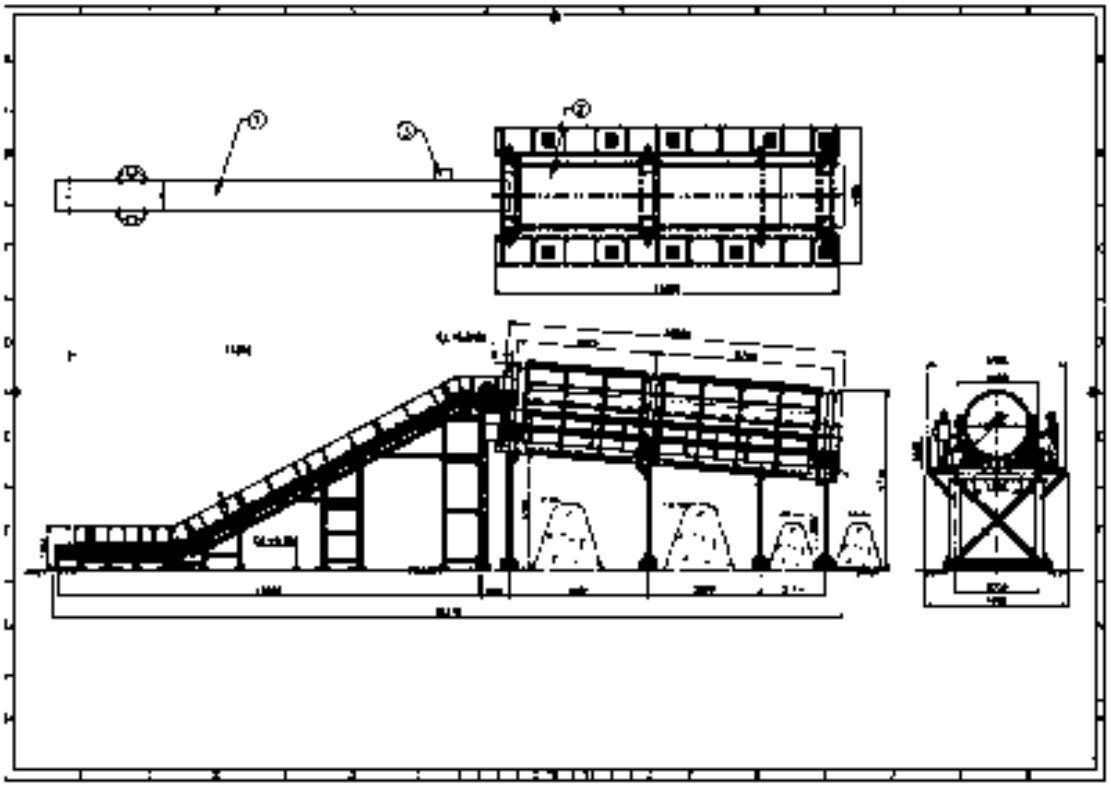


**Figure 8.1 Schematic of the Segregation System**

## 8.4 Site Reclamation Requirement

As detailed under section 6 the Koothattukulam Dumpsite has a waste spread of Approx 29.757cents of land with a max of waste dump height 0.8 m above the ground level. Estimated volume of waste above the ground level is: 899.56 Cum which will be around 944.52 MT. *(source: Topographical survey result for the Koothattukulam Dumpsite conducted in the year 2023)*

In the borehole investigation it was asserted that the depth of the waste column below ground level is 3 m and the quantity of waste below ground level is estimated at 1173.63 Cum as detailed under section 6. *(source: Borehole investigation survey conducted by KSWMP through Matter Labs for the Koothattukulam Dumpsite on June 2023)*

Since the ULB intends to use the land recovered after bioremediation, backfilling of the soil enricher and inert material obtained after the biomining is proposed.

# 9 Scope of Disposal Including Location of Disposal for RDF, Bio Soils, Inert

## 9.1 Utilization of By Products

The details of the utilization of aggregates/by–products screened out by processing of the stabilized legacy waste are provided in the table below:

**Table 9.1 By Product Composition**

| By-products | Percentage Composition (%) | Quantity Cum | Utilization/Linkage/Usage |
|---|---|---|---|
| RDF | 9.38 | 194.51 | RDF will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel. |
| Recyclable | 0.76 | 15.49 | Recyclables will be sold to authorized recyclers |
| Inert | 82.94 | 1719.39 | Can be utilized for filling at the site itself |
| Compost Soil Enricher | 6.92 | 143.73 | Can be used as a soil enricher and given to farmers. The same cannot be sold as fertilizer unless it is enriched with carbon content to meet the standards suggested by FCO for city compost |
| Total | 100 | 2073.12 | |

RDF / SCF consists largely of combustible components which are shredded into a uniform size, in order to produce a homogenous material which can be used as substitute for fossil fuels in e.g. cement plants, lime plants, coal fired power plants or as reduction agent in steel furnaces. The calorific value of the RDF should be higher than 1500 kcal/kg for use in cement plants.

The RDF once dried and shredded, can be compacted and carried for disposal to RDF power plants or cement factories which can use this material in their kiln for co-processing. The cement industries/RDF plants will consider accepting this material if the calorific value confirms to the specifications for SCF/RDF. However, there may not be any financial value to the supplier or to the ULB as this is more for the disposal of RDF rather than a revenue-making stream.

The nearest cement industry that can accept the RDF from Koothattukulam City is located near Trichy, Tamil Nadu at a distance approx. 360 kms from the Dumpsite site. The other sites are at Karnataka, Tamil Nadu are between 300 km to 1074kms, while cements plants at Andhra are at 740 km to 900 kms.

**Table 9.2 Distance to potential RDF / SCF users**

| Name of the cement plant | Location | State | Distance from Kochi (KM) |
|---|---|---|---|
| Dalmia Bharath | Ariyalur | Tamilnadu | 458 |
| Dalmia Bharath | Dalmiapuram | Tamilnadu | 424 |
| ACC | Wadi | Karnataka | 1,075 |
| Chettinad | Karikazhi | Tamilnadu | 315 |
| Chettinad | Kallur | Tamilnadu | 386 |
| Dalmia Bharath | Belagavi | Karnataka | 956 |
| JK | Muddapur | Karnataka | 965 |
| Dalmia Bharath | Kadapa | Karnataka | 739 |
| Bharathi VICAT | Kalburgi | Karnataka | 1,074 |

| | | | |
|---|---|---|---|
| JSW | Kurnool | Andhra Pradesh | 901 |
| Bharathi VICAT | Kadapa | Andhra Pradesh | 739 |
| Ultratech | Tadipatri | Andhra Pradesh | 815 |
| Zuari | Yerraguntla | Andhra Pradesh | 877 |

Based on the chemical analysis the waste material has less than as suggested by the Fertiliser Control Order (FCO). The screened compost materials having size less than 4 mm shall be heaped to form windrows, the leachate (if any) from excavation shall be dried by solar exposure. The materials shall be tested for carbon content and NPK values during execution of works, the materials may be sold to farmers depending on the test outcomes. If the compost materials are not meeting with the standards, the same shall be used as soil enricher for refilling within the site itself along with inert.

Inert is a course fraction received from the landfill mining of MSW. It consists of stones, construction debris, ceramics etc. This is helpful in backfilling in the site or can be used as a subgrade material for highways, low land filling.

## 10. Estimated Project Cost

The details of the estimated cost for bio-mining - recovery of land by remediating legacy waste dumpsite is provided in the table below:

**Table 10.1 Details of Estimated Project Cost**

| Sl. No. | Activity | Rate/ m3 | Quantity (m3) | Amount (INR) |
|---|---|---|---|---|
| 1 | **Bio-mining Operations** | | | |
| a | Processing the Waste | [redacted] | [redacted] | [redacted] |
| 2 | **Disposal Cost** | | | |
| a | Disposal of RDF | [redacted] | [redacted] | [redacted] |
| b | Disposal of Compost/ Soil enricher | [redacted] | [redacted] | [redacted] |
| c | Sale of recyclables | [redacted] | [redacted] | [redacted] |
| d | Disposal of Inert | [redacted] | [redacted] | [redacted] |
| | Total (1+2) | | | [redacted] |
| | E & S Safeguards from ESIA | | | [redacted] |
| | Contractors Profit and Overheads at 15% | | | [redacted] |
| | Net Cost | | | [redacted] |
| | Average Cost Index for Kerala based on DSR 2018 is –1.35 at present. Considering the same, the Grand Total | | | [redacted] |
| | Cost per m3 | | | [redacted] |

### 10.1 Revenue from the Project

The anticipated sources of revenue from the processing of the legacy waste dumpsite viz., by sale Bio earth waste, organic compost, RDF and recyclables etc. But due to the following reasons mentioned below no revenue from the project is considered:

- RDF is utilized as fuel (co – processing) in the cement industries, presently most cement industries are only accepting the RDF at free cost and transportation cost also not borne by the cement industries.
- The uncertainty of quantity and quality of the recyclables from legacy dumpsite due to burnt or crushed or disintegrated, rusted and additional money is required for cleaning of the recyclables for saleable.

### 10.2 Funding for Project

The estimated cost of INR [redacted] for the project Dumpsite Remediation. The sources and funding pattern is given below:

**Table 10.2 Sources of funds in Crores**

| Sl No | Item wise funding pattern | | | |
|---|---|---|---|---|
| | Item | External (70%) (INR) | State Govt. (30%) (INR) | Total Cost (INR) |
| 1 | Dumpsite remediation for the Koothattukulam | [redacted] | [redacted] | [redacted] |

### 11.0 Project Implementation Plan

Koothattukulam Municipality intends to complete this project as early as possible. However, considering the time required for mobilisation, installation, sieving and handling recoverable etc, a time frame of about 05 - 06 months is considered.

### 11.1 Timeline

The broad timeline for the execution of this project is given below. Considering that there could be halts in the project due to various factors like rain and fire incidents, among others, a one-month buffer period is provided.

**Table 11.1 Project Timeline**

| TIMELINE CHART FOR EXECUTION | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Task Name** | **M 1** | **M 2** | **M 3** | **M 4** | **M 5** | **M 6** |
| 1 | Planning & Mobilization | ■ | | | | | |
| 2 | Foundation & Civil Works (Cover Shed installation) for machineries, Hiring & Installation of Machineries, Electrical Works | ■ | ■ | ■ | ■ | ■ | ■ |
| 3 | Excavation of Legacy Waste | | ■ | ■ | | | |
| 4 | Site Development for Windrows & Leachate Collection | | | ■ | ■ | | |
| 5 | Windrow Formation & Spraying of Bio culture | | | | ■ | ■ | |
| 6 | Sieving Operations | | | | | ■ | ■ |
| 7 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | | | | ■ | ■ |
| 8 | Project Closure Activities:<br>Levelling of Reclaimed Land using Bio-soil<br>Handover the site to the ULB<br>Closure Report Submission to ULB, | | | | | | ■ |

## 11.2 Contract Model

Execution Method:

Design, Own, Operate and disposal/Management of by-products/aggregates with -zero residues and optimum land recovery. The work shall be carried out in compliance with SWM Rules 2016 and CPCB Guidelines for the disposal of legacy waste 2019.

Working Model

- 100% work to outsourced to selected private contractor
- TSC will assess the quantity of waste and the ULB will hand over the land for to the Contractor for biomining.
- Cost of Electricity connection to be provided by ULB for the plant.
- Electricity charges for the usage of the plant to be paid by contractor
- ULB shall facilitate the disposal/Utilization of By-products and contractor is responsibility for disposal of RDF, recyclables and aggregates

# 12 Benefits of the Project

The project benefits of dumpsite remediation at Koothattukulam are;

- Reclamation of Land: An area of 29 cents will be reclaimed which can be used for resetting SWM facilities of ULB
- Environmental Protection: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By cleaning up contaminated sites, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity
- Health Improvement: Remediation projects reduce these risks, leading to improved public health outcomes and a reduction in waterborne and airborne diseases.
- Enhanced Water Quality: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to safe drinking water.
- Aesthetic and Social Benefits: Remediation of legacy waste dumpsite can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents. Uncontrolled waste dumping will be stopped.
- Operational & Life cycle Aspects - Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through a bio-mining process.

## 13. Conclusion

- The activities of the bio-mining will be commenced from Nov 2023 to Mar 2024. An area of **29.75 cents** will be reclaimed and will be used for setting up other solid waste management facilities in future.
- Optimum land will be reclaimed and recovered through the biomining process, and this will by ensuring environmental safeguards.
- For the optimum screening of the **2073.18 m3** of legacy waste, mobile / compact screening machinery shall be used.
- Favourable site conditions for bio-mining:
  - Optimum width (3.5 m) of the road is available for movement of the vehicles.
  - Electrical power infrastructure viz., power lines & electrical transformer is available adjacent to the boundary of the dumpsite.
  - water supply via tankers is available at the dumpsite.
- The project activity requires "Site Authorization, Consent to Establish and Consent to Operate" from KSPCB
- The implementation/execution of the project activities shall be conforming to SWM Rules 2016, NGT orders, KSPCB norms, World Bank guidelines and KSWMP ESMF and other regulatory rules & norms Environmental & Social safeguards:
  - The project attracts E2 Environmental category based on the project activities and status of the environment baseline.
  - Site specific Environmental Assessment and Environmental Management Plan has been developed.
  - The project attracts moderate risk social category based on the social mapping & transect walk to understand the settlements/habitations/establishments etc., and consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.
- Total cost of the project is Rs [redacted]

# Annexures

| | |
|---|---|
| Annexure 1 | Topographical Survey Report |
| Annexure 2 | Geotechnical Survey Report |
| Annexure 3 | Waste Characterization Report |
| Annexure 4 | Waste & Environmental baseline assessment reports |
| Annexure 5 | Site Plan |
| Annexure 6 | Operation Plan |
| Annexure 7 | ESIA Report |



N 1080
N 1070
N 1060
N 1050
N 1040
N 1030
N 1020
N 1010
N 1000
E 1000
E 1010
E 1020
E 1030
E 1040
E 1050
E 1060
E 1070
E 1080
E 1090
E 1100
CANAL
ADJACENT BOUNDARY
CONCRETE PRIVATE ROAD
DUMPING YARD
WALL
38.97
17.24
13.74
7.60
10.39
6.36
13.15
99.71
100.19
GROUND LEVEL
99.98
WATER TANK
100.29
TANK
TILE AREA
BUILDING
FLOOR LEVEL
100.45
100.29
99.94
99.92
99.99
BRIDGE
100.38
100.04
100.33
99.73
100.41
3.65
4.90
16.48
3.59
13.48
SREEDHAREEYAM HOSPITAL ROAD
100.14
100.06
100.03
100.18
100.18
100.14
100.11
100.13
100.05
100.02
100.01
100.0
100.02
3.05
3.47
GATE
6.39
5.73
2.14
4.14
TBM 100 TAKEN FROM THE ROAD

SCALE : 1:100
PRINT SCALE :

| | |
|---|---|
| DATE | 14/01/2023 |
| DRAWN | SINSHA |
| CHECKED | PRAKASH |

LEGENDS

ELECTRIC POST
SPOT LEVELS
BOUNDARY
ROAD
BUILDING
WALL
RUBBLE
CANAL

AREA

CONTOUR INTERVAL - 1 METRE
GRID INTERVAL - 5X5 M

**AREA - 40.347 CENTS**

ALL DIMENSIONS ARE IN METRE

CLIENT

KSWMP
KAKKANAD

ARCHITECTS

SURVEYED BY

SOEL
NANDHU
KIRAN

TITLE

CONTOUR & TOPO SURVEY

DRAWING CODE

D.N. : 11642

SITE AT

KOOTHATUKULAM
(9.663843° North , 76.5910123° East)
( N0.663843 , E76.5910123 )


SURVEYED BY

Spreads SURVEY

G-171, NR.SHOPPING COMPLEX
PANAMPILLY NAGAR
COCHIN - 682 036
Ph:0484 2323446
Mobi: 98954 48367/8893448368

ROOM NO : 40,30 , VYAPARABHAVAN,
BANK ROAD
CALICUT-1 PH:0495-4020204
Mobi: 98954 48369

spreadsurvey@gmail.com

# Volume Report

| Sl. No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 1090770.000 | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 1090775.000 | 1090770.000 | 5.000 | 11.166 | 15.641 | 0.000 | 7.821 | 39.103 |
| 3 | 1090780.000 | 1090775.000 | 5.000 | 23.166 | 23.446 | 15.641 | 19.544 | 97.718 |
| 4 | 1090785.000 | 1090780.000 | 5.000 | 40.737 | 29.343 | 23.446 | 26.395 | 131.973 |
| 5 | 1090790.000 | 1090785.000 | 5.000 | 41.126 | 30.888 | 29.343 | 30.116 | 150.578 |
| 6 | 1090795.000 | 1090790.000 | 5.000 | 40.653 | 21.100 | 30.888 | 25.994 | 129.970 |
| 7 | 1090800.000 | 1090795.000 | 5.000 | 40.508 | 31.202 | 21.100 | 26.151 | 130.755 |
| 8 | 1090805.000 | 1090800.000 | 5.000 | 32.995 | 22.611 | 31.202 | 26.907 | 134.533 |
| 9 | 1090810.000 | 1090805.000 | 5.000 | 11.500 | 7.433 | 22.611 | 15.022 | 75.110 |
| 10 | 1090812.641 | 1090810.000 | 2.641 | 0.024 | 0.000 | 7.433 | 3.717 | 9.815 |
| | | | | | Total | | | 899.555 |

MatterLab
Where Quality Matters

Report Number: **ML/GT/2860/232/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE B OF KSWMP AT TOWN WARD-15, KOOTHATTUKULAM, ERNAKULAM DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | IPE Global Ltd. |
| Address | : | 2nd Floor, 16/3878-3879, Kavanatt Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact Person | : | Mr. Ranbir Dey |
| Project No | : | GT-224 |
| Project Name | : | Geotechnical examination of dumpsite under package B of KSWMP at Town ward-15, Koothattukulam, Ernakulam District. |
| Owner | : | KSWMP |
| Project Location | : | Town ward-15, Koothattukulam, Ernakulam District |
| Tel / Fax No | : | - |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 03-07-2023 | 1st Submission | Dr. Gautham Adapa | |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Dr. Jimmy Thomas | Geotechnical Expert, Consultant, MatterLab | |
| Approved by: | Freddy Suman | General Manager, MatterLab | |

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## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results

# 1 INTRODUCTION

Matter Material Testing and Research Laboratory Pvt. Ltd has been set-up as a result of increased demand locally from various industries for a multidisciplinary testing, materials consultancy & investigation facility in alignment with global standards and technology advancements. MatterLab is an independent professional and technical services provider to all who are concerned with quality and performance of materials & products.

IPE Global Ltd. which provides technical support consultancy services to the Urban local bodies in different municipalities for the Kerala State Waste Management Project (KSWMP) has entrusted the geotechnical investigative works as part of their DPR study for the remediation of dumpsite in Town ward-15, Koothattukulam, Ernakulam district to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was bored using a rotary drill. The initial site visit was done on 23rd May 2023. During the site visit, it was observed that the dumpsite is situated within a walk-able distance to the bus stand of the town. There are a few houses situated around the dumpsite with a small stream next to the dumpsite. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 06th June 2023 and was completed on 08th June 2023. Standard Penetration test (SPT) was conducted within the borehole as required. Representative and undisturbed soil samples were collected to conduct relevant laboratory tests to acquire the necessary parameters. This report presents results of the geotechnical investigation of the ground encountered after drilling through the waste at the dumpsite.

# 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil samples and performing necessary laboratory tests on the collected samples to obtain the desired parameters of the ground profile.
- Preparation of report with laboratory test results.

## 3 OBSERVATIONS FROM SITE VISIT

Matterlab has deputed a team from our geotechnical department along with Mr. Ajit Kumar Nayan and Mr. Ravi Kumar of IPE Global during the fourth week of May 2023, in order to collect the information regarding the site prior to mobilizing the equipment for drilling.

The location of the dumpsite is situated within a walk able distance from bus stand. There are a few houses situated around the dumpsite with a small stream next to the dumpsite.



**Figure 1** : Location of the borehole drilled at the dumpsite.

## 4 GEOTECHNICAL INVESTIGATIONS

### 4.1 Rotary drilling

Rotary drilling technique was adopted for advancing and cleaning out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste in the landfill.

### 4.2 Drilling equipment

Mechanical rotary drilling machine was used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The borehole of 150mm diameter was formed using a drag bit (Soil Cutter) in soil. The drag bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by drilling mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

### 4.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as representative samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

**Extraction of Cores:**

The core samples were extracted from the core barrels in a manner to prevent disturbances to the core. All the pieces of cores were sequentially numbered from top to bottom. Arrows indicating the lower end of the piece are marked on each core. Rock classification in terms of weathering and state of fractures and strength is carried out in the following manner. Tabulations given in below explain it briefly.

**Table 1: Rock Classification**

| Terms | Description | Grade |
|---|---|---|
| Fresh | No visible sign of rock material weathering; perhaps slight discoloration on Minor discontinuity surfaces. | I |
| Slightly Weathered | Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discoloured by weathering. | II |
| Moderately Weathered | Less than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as core stones. | III |
| Highly Weathered | More than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as core stones | IV |
| Disintegrated Rock | All rock material is decomposed and / or disintegrated to soil. The original mass structure is still largely intact. | V |
| Residual Soil | All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported. | VI |

-As per IS 4464-1985 (Reaffirmed 2004)

It should be understood that all grades of weathering may not be seen in a given rock mass and that in some cases a particular grade may be present to a very small extent. Distribution of the various weathering grades of rock material in the rock mass may be related to the porosity of the rock material and the presence of open discontinuities of all types in the rock mass.

**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log the commencement and completion date, location of borehole, elevation of top and bottom of boring, ground water table, boundaries of each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelog is attached as **Appendix-I.**

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant Standard Codes. A summary of laboratory tests carried out is shown below in **Table 1** and the complete results of laboratory testing are presented in **Appendix II**.

**Table 1: Details of various laboratory tests and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 1 | Soil | Grain-Size Analysis | IS: 2720(Part-4)-1985 |
| 2 | | Atterberg's Limit | IS: 2720(Part-5)-1976 |
| 3 | | MDD\OMC(Light Compaction) | IS:2720(Part-7)-1980 |
| 4 | | Direct Shear | IS:2720(part-130-1986 |
| 5 | | Permeability | IS :2720 (Part-17)-1986 |
| 6 | | Bulk Density & Dry Density | BS:1377-(Part-2)-1990 |
| 7 | Rock | Point Load Test | ISRM suggested Method |
| 8 | | Water Absorption | IS: 1124 - 1974 |
| 9 | | SSD specific gravity | ISRM suggested Method |
| | | Dry specific gravity | |
| 10 | | Rock density | ISRM suggested Method |
| 11 | | Mohrs' Hardness | Using Mohrs' scale |



**Figure 2 :** Laboratory tests performed at MatterLab.

## 6 SUMMARY

The geotechnical investigation of the original ground below the waste at the dumpsite in Town ward-15, Koothattukulam, Ernakulam district was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a single borehole was drilled through the waste into the ground using a rotary drilling method. The maximum depth of investigation was 7.5m (3.00 in waste and 4.0m in the ground). SPT, collection of undisturbed soil samples and collection of rock samples from cutting were carried out at regular intervals within the ground. Various laboratory tests were carried out on the SPT, undisturbed soil samples and rock samples.

Based on the investigations carried out, it is observed that below the dumped waste, a 1.5m thick clay with sand layer is present, followed by a 1.5m thick layer of clay which is restin on slightly weathered light greyish biotite gneiss with an core recovery of 54% for the depth of cutting of 1.0m. The tests mentioned in the above table were performed on the samples in the laboratory following the respective codes to obtain the necessary parameters. The laboratory results on samples obtained from the site are appended in **Appendix II**.

# APPENDIX-I

# BORELOGS

Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT** | **: Geotechnical Investigation at Dumpsite in Town ward-15, Koothattukulam** | **SHEET NO.** | **: 1 of 1** | **START DATE** | **: 06/06/2023** |
| **CLIENT** | **: IPE Global** | **BORE DIAMETER (mm)** | **: 150** | **END DATE** | **: 08/06/2023** |
| **Proposed Structure** | **: Dumpsite** | **BORING TYPE** | **: Rotary** | **REDUCED LEVEL (m)** | **: -** |
| **LOCATION** | **: Town ward-15, Koothattukulam, Ernakulam district** | **TERMINATION DEPTH (m)** | **: 7.0** | **EASTING (m)** | **: 76.590928** |
| **BOREHOLE NO.** | **: BH-01** | **WATER LEVEL** | **: 2.5m** | **NORTHING (m)** | **: 9.863904** |

| DEPTH m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM N1 | BLOW COUNT/15CM N2 | BLOW COUNT/15CM N3 | SPT N VALUE | DEPTH V/S N VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.00 | | Waste | 3.00 | | | | | | | | |
| 4.50 | | Dark yellowish soft CLAY | 1.50 | 3.0<br>3.5<br>4.0 | SPT-1<br>UDS-1<br>UDS-2 | 1 | 1 | 1 | | | |
| 6.00 | | Soft dark greyish CLAY | 1.50 | 4.5<br>5.0<br>5.5 | SPT-2<br>UDS-3<br>UDS-4 | 1 | 1 | 2 | | | Sample slipped<br>Sample slipped |
| 7.00 | | Slightly weathered light greyish biotite gneiss with closely spaced horizontal fracture | 1.00 | 6.0 | SPT-4 | 50 | - | - | > | | Refusal<br>CR 54%, RQD 39% |
| | | **Bore hole terminated at the depth of 7.0m below top of waste (4.0m below original ground)** | | | | | | | | | |

Abbreviations
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
CR- Core Recovery, RQD- Rock Quality Designation

Sd/-
Site Supervisor

# APPENDIX-II

# LABORATORY TEST RESULTS

# SUMMARY OF LABORATORY TEST RESULTS

**Report Number : ML23/R-02005 Report Date:27/06/2023**

**Project : Geotechnical Investigation at Dumpsite in Town ward-15, Koothattukulam**

**Borehole ID : BH-01**

| N value | MatterLab ref. | Depth (m) | Type of sample (DS/UDS/RC) | Soil description | IS Classification | Atterberg Limit | | | Grain size distribution | | | | | | | Maximum dry density, gm/cc | Optimum moisture content, % | Bulk Density, gm/cc | Cohesion (c), kPa | Internal friction angle, ° | Permeability, cm/s | Unconfined Compressive Strength (UCS), kPa | Rock cores | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit,% | Plastic Limit,% | Plasticity Index | Coarse Gravel,% | Fine Gravel,% | Coarse Sand,% | Medium Sand,% | Fine Sand,% | Silt,% | Clay,% | | | | | | | | Core recovery (%) | RQD (%) | Point load (MPa) | Water Absorption (%) | Rock density (kg/m$^3$) | Mohrs Hardness | SSD specific gravity, gm/cc | Dry specific gravity, gm/cc |
| 2 | ML23/W-02005/S1 | 3.0 | SPT | Clay of high plasticity with sand | CH | 63 | 30 | 33 | | | 2 | 7 | 10 | 21 | 60 | | | | | | | | | | | | | | | | |
| | ML23/W-02005/S2 | 3.5 | UDS | | | | | | | | | | | | | | | 1.66 | 8 | 22 | 1.44 E-05 | | | | | | | | | | |
| | ML23/W-02005/S3 | 4.0 | UDS | | | | | | | | | | | | | 1.57 | 20 | | | | | 477 | | | | | | | | | |
| 3 | ML23/W-02005/S4 | 4.5 | SPT | Clay of high plasticity | CH | 63 | 29 | 34 | | | 1 | 4 | 7 | 41 | 47 | | | | | | | | | | | | | | | | |
| | ML23/W-01957/S5 | 6m - 7m | RC | | | | | | | | | | | | | | | | | | | | 54 | 39 | 3.6 | 0.4 | 2630 | 5.5 | 2.65 | 2.64 |

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Mini Bypass Road, Thiruvannur Naka (PO) Thiruvannur,
Kozhikode, Kerala, 673019.

TC-9748

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-02005/1
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavenatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala – 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 3.00m |
| Work Order ID: | ML23/W-02005 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02005/S1 | Source*: | BH 01, Depth 3.00m |
| Date Sampled: | 08/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Stesihg): | 5 Approx |
| Sample Location*: | Town Ward-15, Koothattukulam, Ernakulam | Date Tested : | 21/06/2023 - 23/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 3.00m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 3.00m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.5 Mechanical Method | Liquid Limit,% | 63 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 30 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 33 | - |

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**Comments**

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Kozhikode, Kerala, 673020.

TC-10742

ULR-TC107423000004519F

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-020052
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 4.50m |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/54 | Source*: | BH 01, Depth 4.50m |
| Date Sampled: | 08/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Town Ward-15, Koothattukulam, Ernakulam | Date Tested : | 21/06/2023 - 23/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 4.50m |
| Tested By: | VY | Client Sample Desc* : | Soil, BH 01, Depth 4.50m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.5 Mechanical Method | Liquid Limit,% | 63 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 29 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 34 | - |

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Kozhikode, Kerala, 673029.

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/R-02000/B
Issue No: 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanjangad Village, Kakkanad, Ernakulam, Kerala – 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Tel / Email: | - |

**Sample Details**

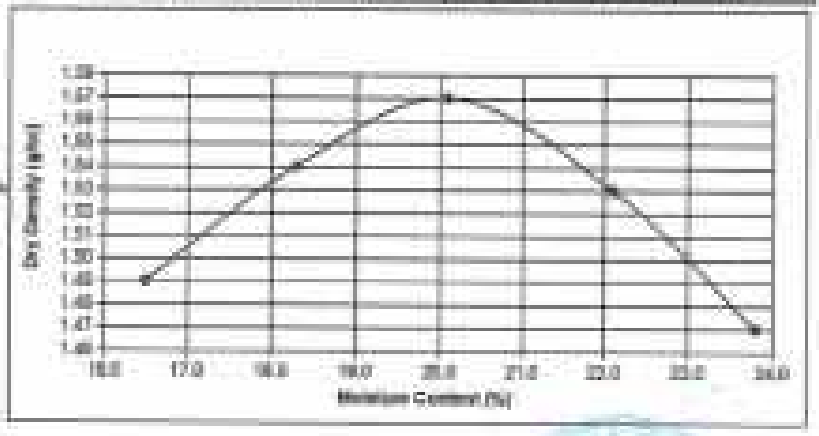
| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*): | Soil (UDS-2), BH 01, Depth 4.00m |
| Work Order ID: | ML23/W-02000 | Sample Submitted By.*): | Geotechnical Division |
| Sample ID: | ML23/W-02000/S3 | Source*): | BH 01, Depth 4.00m |
| Date Sampled: | 09/06/2023 | Sampled By*): | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 8 Approx |
| Sample Location*): | Town Ward-15, Koothattukulam, Ernakulam | Date Tested : | 21/06/2023 - 22/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 4.00m |
| Tested By: | DK/GK | Client Sample Desc.: | Soil (UDS-2), BH 01, Depth 4.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Mould volume | $V_m$ (cm³) | 1000 | | | | |
|---|---|---|---|---|---|---|
| Test No. | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | $W_m$ (g) | 4093 | | | | |
| Mass of mould + compacted sample | W (g) | 5799 | 5879 | 6049 | 5923 | 5879 |
| Mass of sample | | 1736 | 1816 | 1886 | 1858 | 1816 |
| Wet density | $(W-W_m)/V_m$ $\gamma_w$ (Mg/m³) | 1.74 | 1.82 | 1.89 | 1.87 | 1.82 |
| Mass of wet sample | $W_w$ (g) | 485.7 | 456.4 | 432.7 | 428.4 | 456.2 |
| Mass of dry sample | $W_d$ (g) | 400.8 | 385.8 | 360.3 | 350.9 | 370.1 |
| Moisture content | $((W_w-W_d)/W_d)\times100$ m (%) | 16.5 | 18.3 | 20.1 | 22.1 | 23.8 |
| Dry density | $\gamma_w/(1+m/100)$ $\gamma_d$ (Mg/m³) | 1.49 | 1.54 | 1.57 | 1.53 | 1.47 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc | 1.57 |
| Optimum moisture content, % | 20 |
| Material retained on 20mm,% | 0 |
| Sample used: | Single |
| Size of mould | 1000cm³ |
| Weight of rammer | 2.6 kg |




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Thiruvennur, Kozhikode, Kerala, 673029

# Hydrometer Analysis Test Report

Report No: [illegible]
Sample No: 1
Report Date: 27/04/2023

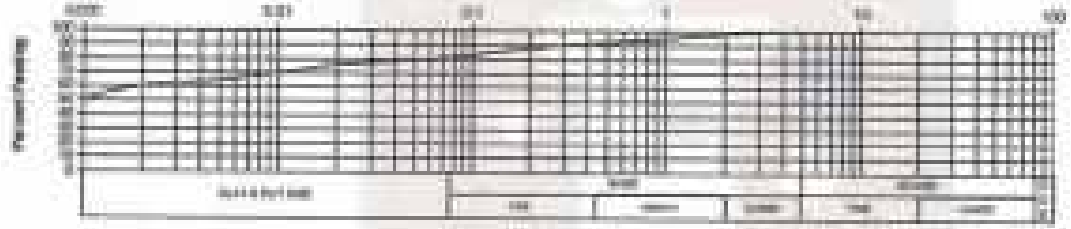
| | | | |
|---|---|---|---|
| Client: | IITE Global | Consultant: | - |
| Address: | Kavanatil Building, Kanayannur Village, Kathikudam, Ernakulam, Kerala - 628008 | Owner: | KSWSP |
| Contact: | Mr. Renatal Dey | Contractor: | - |
| Project No: | - | Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam | Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 19/04/2023 | Client Sample Ref.*): | Soil, BH 01, Depth 3.00m |
| Work Order ID: | ML23/W/-03008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W/-03008/01 | Source*): | BH 01, Depth 3.00m |
| Date Sampled: | 19/04/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2131 - 1981 | Sample Stockpile: | 3 Approx |
| Sample Location*): | Town Ward-15, Koothattukulam, Ernakulam | Date Tested: | 21/04/2023 - 23/04/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 3.00m |
| Tested By: | RH | Client Sample Desc.*): | Soil, BH 01, Depth 3.00m |
| Test Location: | MatterLab - Koothikode | | |

## Particle Size Distribution

Method: IS: 2720 (Part 4)-1985, Cl.9.5




| Sieve Size (mm) | % Passing |
|---|---|
| 4.750 | 100 |
| 2.000 | 99 |
| 0.600 | 94 |
| 0.425 | 93 |
| 0.300 | 92 |
| 0.150 | 89 |
| 0.075 | 81 |
| 0.055 | 78 |
| 0.040 | 76 |
| 0.029 | 71 |
| 0.020 | 64 |
| 0.012 | 57 |
| 0.008 | 54 |
| 0.005 | 42 |
| 0.003 | 30 |
| 0.001 | 21 |

| | |
|---|---|
| Gravel % | 08 |
| Sand % | 19 |
| Silt % | 21 |
| Clay % | 60 |

SREELESH T.V.

For and on behalf of MatterLab

Comments:
"Information provided by client

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## Hydrometer Analysis Test Report

Report No: [illegible]
Issue No: 1
Report Date: 27/09/2023

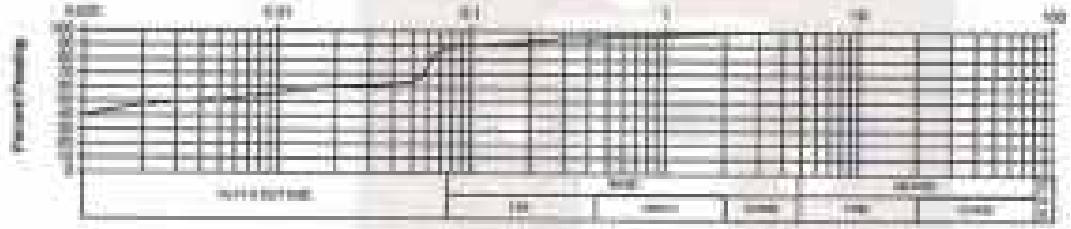
| | | | |
|---|---|---|---|
| Client: | IFE Global | Consultant: | - |
| Address: | Kaveriatt Building, Kanapacoor Village, Kakkanad, Ernakulam, Kerala - 682030 | Owner: | KSWMP |
| Contact: | Mr. Ramalal Dey | Contractor: | - |
| Project No: | - | Project Location: | Town Ward-19, Kozhikkulam, Ernakulam |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-19, Kozhikkulam | Tel / Email: | - |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 19/09/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 4.50m |
| Work Order ID: | ML23/W-03099 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-03099/04 | Source*: | BH 01, Depth 4.50m |
| Date Sampled: | 18/09/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS 2131 - 1981 | Sample Stored@: | 3 Approx |
| Sample Location*: | Town Ward-19, Kozhikkulam, Ernakulam | Date Tested: | 21/09/2023 - 23/09/2023 |
| Sample Cert. No: | - | Test Method Variations: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 4.50m |
| Tested By: | RH | Client Sample Desc.*: | Soil, BH 01, Depth 4.50m |
| Total Location: | MatterLab - Kozhikode | | |

### Particle Size Distribution

Method: IS: 2720 (Part 4)-1985, Cl.9.5



Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 4.750 | 100 |
| 2.000 | 99 |
| 0.850 | 97 |
| 0.600 | 97 |
| 0.425 | 96 |
| 0.300 | 95 |
| 0.150 | 93 |
| 0.075 | 88 |
| 0.053 | 84 |
| 0.037 | 82 |
| 0.026 | 80 |
| 0.014 | 56 |
| 0.010 | 50 |
| 0.007 | 50 |
| 0.005 | 47 |
| 0.003 | 46 |
| 0.002 | 47 |
| 0.001 | 40 |

| | |
|---|---|
| Gravel, % | Nil |
| Sand,% | 12 |
| Silt,% | 41 |
| Clay,% | 47 |

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Thiruvannur, Kozhikode, Kerala, -673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-020005
Issue No: 1
Report Date: 27/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 029306 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-18, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-18, Koothattukulam, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 19/09/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 3.60m |
| Work Order ID: | ML23/W-02005 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02005/02 | Source*: | BH 01, Depth 3.60m |
| Date Sampled: | 08/09/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(Kg): | 5 Approx |
| Sample Location: | Town Ward-18, Koothattukulam, Ernakulam | Date Tested : | 23/09/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.60m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 3.60m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 1.88 | - |

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## Comments

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Thiruvannur, Kozhikode, Kerala, 673029

# Chemical Test Report of Soil

Report No: ML23/R-02570/2
Issue No: 1
Report Date: 06/10/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building,Kanayanoor Village,Kakkanad,Ernakulam,Kerala - 626030 |
| Contact: | Mr.Ranabir Dey |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward -15,Koothattukulam |
| Owner: | KSWMP |
| Project Location: | Koothattukulam |
| Tel No: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 12/07/2023 | Client Sample ID:* | Soil and Rock |
| Work Order ID: | ML23/W-02570 | Source:* | Borehole - 1 (1.5 m from orginal ground level) |
| Sample ID: | ML23/W-02570/S1 | | |
| Date Sampled: | 06/06/2023 | Sampled By: | Geotechnical Division |
| Tested By: | MatterLab,Kozhikode | Date Tested: | 13/06/23 - 20/06/23 |
| Sample Location: | Koothattukulam | Test Method Variation: | |

**CHEMICAL ANALYSIS - Test Method:IS 9334:2021 & CPHEEO Manual**

| Test/Parameters | Units | Results |
|---|---|---|
| pH Value | - | 6.79 |
| Electrical Conductivity | mS/cm | 0.807 |
| Nitrogen (N) | % | 0.38 |
| Phosphorus (P) | % | 0.02 |
| Potassium (K) | % | 0.22 |
| Carbon | % | 3.88 |
| Carbon / Nitrogen Ratio | % | 10.16 |
| Biodegradable Factor | % | < 0.1 |

**HEAVY METALS - Test Method: EPA 3050 (ICP OES)**

| | | |
|---|---|---|
| Arsenic (As) | mg/Kg | 2.0 |
| Cadmium (Cd) | mg/Kg | < 5.0 |
| Chromium (Cr) | mg/Kg | 172.4 |
| Copper (Cu) | mg/Kg | 82.9 |
| Lead (Pb) | mg/Kg | 39.9 |
| Nickel (Ni) | mg/Kg | 68.8 |
| Zinc (Zn) | mg/Kg | 921.0 |
| Mercury (Hg) | mg/Kg | < 0.1 |

ANWAR. P
Lab Manager-Chemistry
For and on behalf of Matter Lab

**Comments:**
*Information provided by client

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Mini Bypass Road, Thiruvennur Nada (PO)
Thiruvennur, Koshikode, Kerala, 673020

## UNCONFINED COMPRESSIVE STRENGTH(UCS) OF SOIL TEST REPORT

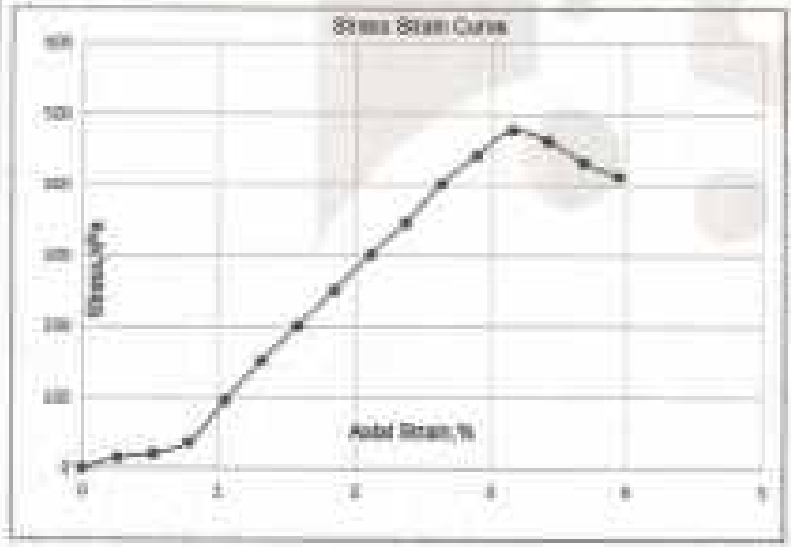
Report No: ML/SW-[illegible]
Issue No : 0
Report Date: [illegible]

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarattil Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranjoy Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-16, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-16, Koothattukulam, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-2), BH 01, Depth 4.00m |
| Work Order ID: | ML/SW-[illegible] | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML/SW-[illegible] | Source: | BH 01, Depth 4.00m |
| Date Sampled: | 08/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 6 Approx |
| Sample Location: | Town Ward-16, Koothattukulam, Ernakulam | Date Tested : | 21/06/2023 - 22/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 4.00m |
| Tested By: | GKJJ | Client Sample Desc.: | Soil (UDS-2), BH 01, Depth 4.00m |

**Test Results** — Method: IS: 2720 (Part 10)-1991 (R2019)




| | |
|---|---|
| Unconfined Compressive Strength(kPa) | 477 |
| Specimen Height (mm) | 76 |
| Specimen Dia(mm) | 38 |
| Specimen Density(g/cc) | 1.87 |
| Moisture Content(%) | 20 |
| Type of specimen | Undisturbed |
| Specimen Condition | - |

For and on behalf of Matter Lab

**Comments:**
*Information provided by client

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# POINT LOAD INDEX OF ROCK TEST REPORT

Report No: ML23/R-0200585
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-18, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-18, Koothattukulam, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client sample Ref.:* | BH 01, Depth 6m - 7m |
| Work Order ID: | ML23/W-02005 | Source*: | BH 01, Depth 6m - 7m |
| Sample ID: | ML23/W-0200585 | Sampled By*: | Geotechnical Division |
| Sampling Location: | Town Ward-18, Koothattukulam, Ernakulam | Sampling Method: | IS: 2131 - 1981 |
| Sample Cert. No: | - | Date Tested : | 23/06/2023 - 24/06/2023 |
| Tested By: | GK | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Sample Description: | Rock Core sample |

**Test Results** — Test Method: ISRM Suggested Method

| Specimen No | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Sampling Date | | 06/06/2023 | | | | |
| Moisture Condition @ Test | | As Received | | | | |
| Moisture Content | (%) | 0.21 | 0.25 | 0.19 | 0.23 | 0.29 |
| Test type | | Axial | Axial | Axial | Axial | Irregular |
| Direction of Loading to Plane of Weakness | | Perpendicular | | | | |
| Specimen Diameter | (mm) | 54.2 | 54.4 | 54.2 | 54.4 | 46.5 |
| Specimen Thickness | (mm) | 26.2 | 33.0 | 24.8 | 24.8 | 39.5 |
| Failure Load | (kN) | 6.948 | 8.830 | 6.666 | 9.645 | 6.407 |
| Equivalent Core Dia | (mm) | 1741 | 2286 | 1712 | 1715 | 1600 |
| Point Load Index, $I_s$ | (MPa) | 3.42 | 3.87 | 3.91 | 5.50 | 3.88 |
| Corrected Point Load Index, $I_{s(50)}$ | (MPa) | 3.48 | 3.78 | 3.89 | 3.48 | 3.52 |
| Mean Point Load Index, $I_{s(50)}$** | (MPa) | 3.6 | | | | |

** After discarding highest and lowest values.

For and on behalf of MatterLab

**Comments**
*Information provided by client
Test conducted on available bore hole samples.

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# Water Absorption - Test Report

Report No: ML23/K-02000/R
Issue No: 1.1
Report Date: 27/06/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kaveseti Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628000 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Town Ward-15, Koothattukulam, Ernakulam |
| **Tel / Email:** | - |

## Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 19/06/2023 | **Client Sample Ref*:** | Rock Core, BH 01, Depth 6m - 7m |
| **Work Order ID:** | ML23/W-02005 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02005/05 | **Source*:** | BH 01, Depth 6m - 7m |
| **Date Sampled:** | 08/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method:** | IS: 2131 - 1981 | **Sample Size(kg):** | - |
| **Sample Location*:** | Town Ward-15, Koothattukulam, Ernakulam | **Date Tested :** | 23/06/2023 - 26/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Rock Core, BH 01, Depth 6m - 7m |
| **Tested By:** | GK | **Client Sample Desc.*:** | Rock Core, BH 01, Depth 6m - 7m |
| **Test Location:** | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Water Absorption,% | 0.4 | - |

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## Comments

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# Density - Test Report

Report No: ML23/R-02005/D
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref*: | Rock Core, BH 01, Depth 6.0m - 7.0m |
| Work Order ID: | ML23/W-02005 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02005/05 | Source*: | BH 01, Depth 6.0m - 7.0m |
| Date Sampled: | 08/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Town Ward-15, Koothattukulam, Ernakulam | Date Tested : | 24/06/2023 - 25/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Rock Core, BH 01, Depth 6.0m - 7.0m |
| Tested By: | GK | Client Sample Desc.*: | Rock Core, BH 01, Depth 6.0m - 7.0m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Rock Density kg/m³ | 2630 | - |

SREELESH T.V

For and on behalf of MatterLab

**Comments**

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# POROSITY - TEST REPORT

Report No: ML23/R-03008/11
Issue No: 1
Report Date: 27/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 629000 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Rock Core, BH 01, Depth 6.0m - 7.0m |
| Work Order ID: | ML23/W-03006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-03006/05 | Source*: | BH 01, Depth 6.0m - 7.0m |
| Date Sampled: | 08/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location: | Town Ward-15, Koothattukulam, Ernakulam | Date Tested : | 24/06/2023 - 26/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Rock Core, BH 01, Depth 6.0m - 7.0m |
| Tested By: | GR | Client Sample Desc.*: | Rock Core, BH 01, Depth 6.0m - 7.0m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Porosity,% | 0.8 | - |

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**Comments**

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Thiruvannur, Kozhikode, Kerala, 673028

# SCRATCH HARDNESS OF SURFACE ACCORDING TO MOHS'SCALE OF ROCK TEST REPORT

Report No: ML23/W-02005/R2
Issue No : *
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveratti Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 626030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-18, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-18, Koothattukulam, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 15/06/2023 | Client Sample Ref.*: | Rock Core, BH 01, Depth 6.0m - 7.0m |
| Work Order ID: | ML23/W-02005 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02005/05 | Source*: | BH 01, Depth 6.0m - 7.0m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Town Ward-18, Koothattukulam, Ernakulam | Date Tested : | 25/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Rock Core, BH 01, Depth 6.0m - 7.0m |
| Tested By: | GK | Client Sample Desc.*: | Rock Core, BH 01, Depth 6.0m - 7.0m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| Using Mohs' Scale | Mohs' Hardness | 5.5 | - |

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**Comments**

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# Specific Gravity - Test Report

Report No: ML23/R-02005(01)
Issue No : 1
Report Date: 27/09/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Town Ward-15, Koothattukulam, Ernakulam |
| **Tel / Email:** | - |

## Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 13/09/2023 | **Client Sample Ref*:** | Rock Core, BH 01, Depth 6.0m - 7.0m |
| **Work Order ID:** | ML23/W-02005 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02005/05 | **Source*:** | BH 01, Depth 6.0m - 7.0m |
| **Date Sampled:** | 08/09/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method:** | IS: 2131 - 1981 | **Sample Size/kg:** | - |
| **Sample Location*:** | Town Ward-15, Koothattukulam, Ernakulam | **Date Tested :** | 24/09/2023 - 25/09/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Rock Core, BH 01, Depth 6.0m - 7.0m |
| **Tested By:** | GK | **Client Sample Desc.*:** | Rock Core, BH 01, Depth 6.0m - 7.0m |
| **Test Location:** | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | SSD Specific Gravity g/cc | 2.65 | - |
| | Dry Specific Gravity g/cc | 2.64 | |

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## Comments

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# Permeability of Soil Test Report

Report No: ML23/R-02805/A
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Town Ward-15, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02805 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02805/02 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Town Ward-15, Koothattukulam, Ernakulam | Date Tested : | 22/06/2023 - 23/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.50m |
| Tested By: | DNGK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 1.44 E-05 | - |

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# SHEAR STRENGTH TEST REPORT

Report No: ML/SW-[illegible]
Issue No.: 1
Report Date: [illegible]

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanyakoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Town Ward-15, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/09/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 3.00m |
| Work Order ID: | ML/SW-[illegible] | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML/SW-[illegible] | Source:* | BH 01, Depth 3.00m |
| Date Sampled: | 08/09/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Quantity: | 1 Approx |
| Sample Location:* | Town Ward-15, Koothattukulam, Ernakulam | Date Tested: | 13/09/2023 - 24/09/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab - Kozhikode | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.00m |
| Tested By: | MV | Client Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.00m |

**Test Results**

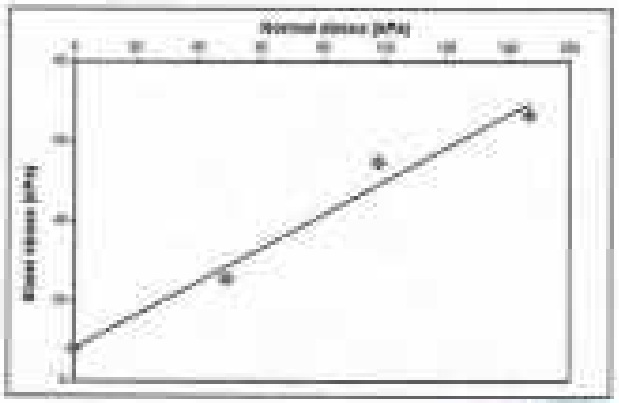
Method: IS 2720 (Part 13)-1986

| | |
|---|---|
| Area of specimen (cm²) | 36 |
| Height of specimen (mm) | 25 |
| Rate of strain (mm/min) | 1.25 |
| Test Condition | Unconsolidated Drained |
| Bulk Density (Mg/m³) | 1.55 |
| Moisture content (%) | 18 |
| Dry Density (Mg/m³) | 1.40 |

| Load Increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Shear (mm) |
|---|---|---|---|
| 1 | 49 | 85.5 | 2.4 |
| 2 | 98 | 94.6 | 2.8 |
| 3 | 147 | 99.7 | 3.6 |

Cohesion Intercept (C'), kPa: 8

Angle of Internal Friction (ϕ'): 22°




[illegible] T.V.
[illegible] Civil Laboratory

For and on behalf of MatterLab

**Comments**

*Information provided by client

Material tested was passing 4.75 mm test sieve, recompacted at maximum achievable density and moisture content

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Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

# Size Distribution of Solid Waste - Test Report

Report No: ML23/R-02006/23
Issue No : 1
Report Date: 19/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628035 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-18, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-18, Koothattukulam, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/S5 | Source*: | - |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 15 Approx |
| Sample Location*: | Town Ward-18, Koothattukulam, Ernakulam | Date Tested : | 09/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No./ Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GK | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Particle Size Distribution** — Method : IS: 2720 (Part 4)-1985

| Sieve Size (mm) | % Retained |
|---|---|
| 80.0 | 13.5 |
| 37.5 | 13.8 |
| 10.0 | 47.3 |
| 4.0 | 25.5 |
| Passing | 0.1 |

SREELASH T.V
Quality Manager

For and on behalf of MatterLab

**Comments:**
*Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673039

# Field Density (Core-Cutter Method) of Solid Waste - Test Report

Report No: ML23/W-02008/24
Issue No: 1
Report Date: 15/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Karayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Tel / Email: | - |

**Test Results**

| | | | |
|---|---|---|---|
| Date Recieved: | 09/08/2023 | Client Ref:* | - |
| Work Order ID: | ML23/W-02008 | Layer | - |
| Sample ID: | ML23/W-02008/ST (1-2) | Depth of test (mm): | - |
| Sample Description: | MSW | Date Tested | 09/08/2023 - 10/08/2023 |
| Source* | - | Tested By | GK |
| Location* | Town Ward-15, Koothattukulam, Ernakulam | Method Variation | None |
| Test Methods : | IS 2720 : Part 29 : 1975-(DRY DENSITY OF SOILS IN PLACE BY THE CORE-CUTTER METHOD)<br>IS 2720 : Part 2 : 1973 -(DETERMINATION OF WATER CONTENT) | | |

| Test No. | 1 | 2 |
|---|---|---|
| Sample ID | ST-1 | ST-2 |
| Test Location | Town Ward-15, Koothattukulam, Ernakulam | |
| Weight of wet Material (g) | 1748 | 1914 |
| Volume of core-cutter ($cm^3$) | 992 | 1005 |
| In-situ Bulk Density ($g/cm^3$) | 1.76 | 1.89 |
| In-situ Water Content (%) | 20 | 19 |
| In-situ Dry Density ($g/cm^3$) | 1.47 | 1.59 |

SREELESH T.V
Lead Chief Laboratory

For and on behalf of MatterLab

**Comments**

*Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673029

# Moisture Content of Waste Test Report

Report No: ML23W-02000439
Issue No : 1
Report Date: 19/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarat Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 626030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-16, Kozhikkulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-16, Kozhikkulam, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23W-02000 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02000/58 | Source*: | - |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 15 Approx |
| Sample Location*: | Town Ward-16, Kozhikkulam, Ernakulam | Date Tested : | 09/06/2023 - 10/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GK | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Moisture Content, % | 17 | - |

SREELESH TV
Head-Civil Laboratory

For and on behalf of Matter Lab

**Comments**

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# Solid Waste - Test Report

Report No: ML23/R-02005/09
Issue No : 1
Report Date: 15/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanah Building, Kariyattoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Nandal Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Tal / Basil: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-02005 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02005/09 | Source*: | - |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Quantity: | 15 Approx |
| Sample Location*: | Town Ward-15, Koothattukulam, Ernakulam | Date Tested : | 14/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GK | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Waste Materials retained on | | | |
|---|---|---|---|---|---|
| | | 80 mm | 37.5 | 10 mm | 4 mm |
| CPHEEO (2000) | Percentage of Plastic Waste, % | 42.7 | 6.9 | 1.6 | Nil |
| | Percentage of Cloth Waste, % | 2.1 | Nil | Nil | Nil |
| | Percentage of Glass Waste, % | Nil | Nil | 0.2 | Nil |
| | Percentage of Wood Waste, % | 0.7 | 3.4 | 0.8 | Nil |
| | Percentage of Construction Debris, % | Nil | Nil | Nil | Nil |
| | Percentage of Bio Fraction, % | Nil | Nil | Nil | Nil |
| | Percentage of Gravel, % | 47.0 | 89.7 | 96.7 | 100 |
| | Rubber, % | 7.5 | Nil | Nil | Nil |
| | Metals, % | Nil | Nil | 1.0 | Nil |

SREELESH T.V
Lab Technician

For and on behalf of Matter Lab

**Comments**
*Information provided by client

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# Solid Waste - Test Report

Report No: ML23/R-03005/07
Issue No : 1
Report Date: 19/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 629030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*: | MSW (4mm Sieve Passing Fraction) |
| Work Order ID: | ML23/W-03005 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-03005/08 | Source*: | - |
| Date Sampled: | 09/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 15 Approx |
| Sample Location*: | Town Ward-15, Koothattukulam, Ernakulam | Date Tested : | 14/08/2023 - 15/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW (4mm Sieve Passing Fraction) |
| Tested By: | GK | Client Sample Desc.*: | MSW (4mm Sieve Passing Fraction) |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Silt & Clay, % | 31 | - |

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**Comments**

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# Solid Waste Size Analysis - Test Report

Report No: ML23/W-0000656
Issue No : 1
Report Date: 19/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Ravanat Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 629030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Town Ward-15, Koothattukulam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Town Ward-15, Koothattukulam, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-00006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-0000656 | Source*: | - |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 10 Approx |
| Sample Location*: | Town Ward-15, Koothattukulam, Ernakulam | Date Tested: | 14/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | MV | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

Test Methods: CPHEEO - 2000

| Type of Waste Material | 80 mm | | 37.5 mm | | 10 mm | |
|---|---|---|---|---|---|---|
| | Minimum Size of a Single Waste Material, m | Maximum Size of a Single Waste Material, m | Minimum Size of a Single Waste Material, m | Maximum Size of a Single Waste Material, m | Minimum Size of a Single Waste Material, m | Maximum Size of a Single Waste Material, m |
| Plastic Waste | 0.2000 | 0.3400 | 0.0420 | 0.2418 | 0.0109 | 0.0332 |
| Cloth Waste | 0.1600 | 0.4000 | - | | - | |
| Glass Waste | - | | - | | 0.0144 | |
| Wood Waste | 0.814** | | 0.0248 | 0.1758 | 0.0143 | 0.0265 |
| Metals | - | | - | | 0.0414** | |
| Rubber | 0.0830 | 0.1287 | - | | - | |

For and on behalf of MatterLab

Comments

*Information provided by client

** Only one piece of glass waste,wood waste & metals included in the waste composite

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Phone : 0484-2544030, 8281982322, 9747400085.www.poluchem.com, poluchem@gmail.com

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5254/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 17/06/2023 |
| | Date of monitoring | 03/06/2023 |
| | Date of sample received: | 03/06/2023 |
| | Date of analysis | 04/06/2023 |
| | Sample Description | Waste Analysis –Koothattukulam- Town –ward 15 |
| | Sample Location | Gps Reading : : N- 09 °51'49.639"<br>E -76°35'27.473" |

**CHEMICAL PARAMETERS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | -- | 7.43 |
| 02 | Biodegradable Factor | USEPA | % | 3.4 |
| 03 | Total carbon | USEPA 9060A | % | 5.3 |
| 04 | Phosphorus(P) | USEPA | % | 0.064 |
| 05 | Nitrogen(N) | USEPA | % | 0.32 |
| 07 | Potassium(K) | USEPA | % | 0.047 |
| 08 | C/N Ratio | USEPA | -- | 16.5:1 |
| 09 | Calorific Value | ASTM D 5865 | K.cal/kg | 124 |

Conti.....

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5254/2023 |
|---|---|---|
| M/s. IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 17/06/2023 |
| | Date of monitoring | 03/06/2023 |
| | Date of sample received: | 03/06/2023 |
| | Date of analysis | 04/06/2023 |
| | Sample Description | Waste Analysis –Koothattukulam-Town-ward 15 |
| | Sample Location | Gps Reading : : N- 09 °51'49.639"<br>E -76°35'27.473" |

**TOXICITY ANALYSIS- HEAVY METALS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 10 | Iron (Fe) | USEPA 3050 | % | 2.7 |
| 11 | Arsenic(As) | USEPA 3050 | mg/kg | <0.1 |
| 12 | Selenium(Se) | USEPA 3050 | mg/kg | <0.1 |
| 13 | Nickel(Ni) | USEPA 3050 | mg/kg | <0.1 |
| 14 | Zinc (Zn) | USEPA 3050 | mg/kg | 6.98 |
| 15 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 |
| 16 | Copper (Cu) | USEPA 3050 | mg/kg | 87.47 |
| 17 | Chromium(Cr) | USEPA 3050 | mg/kg | 6.3 |
| 18 | Lead(Pb) | USEPA 3050 | mg/kg | 42.2 |
| 19 | Mercury(Hg) | USEPA 3050 | mg/kg | <0.1 |
| 20 | Manganese(Mn) | USEPA 3050 | mg/kg | 471 |

* End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD.

AUTHORIZED SIGNATORY

QUALITY MANAGER

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5216/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 17/06/2023 |
| | Date of monitoring | 03/06/2023 |
| | Date of sample received: | 03/06/2023 |
| | Date of analysis | 04/06/2023 |
| | Sample Description | Waste Analysis - Koothattukulam-Town-ward 15 |
| | Sample Location | GPS Reading : N- 09 °51'49.639"<br>E -76°35'27.473" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 28.01 |
| 02 | Bulk Density | | | USEPA | $kg/m^3$ | 1098 |
| 03 | Density | | | USEPA | $g/cm^3$ | 1.0555 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 124 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 75 | -- | | | 46.3 |
| | | 40 | -- | | | 24.5 |
| | | 20 | -- | | | 10.6 |
| | | 8 | -- | | | 18.6 |
| | | 4.75 | 4 | | | 0 |

* End of the Report*

| | |
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SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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## TEST REPORT



**Ref.No: PL/RT/5217/2023** **Date of Issue: 17/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Leachate- Koothattukulam- Town-ward 15
Sample Location : Gps Reading : N-09 °51'49.621"
E -76°35'27.456"

Sample code : F/5217/2023
Date of sample collected : 03/06/2023
Date of receipt of sample : 03/06/2023
Date of analysis started : 04/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Results |
|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 7.48 |
| Total Dissolved Solids(Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 367 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 142 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 52.1 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 480 mg/l |
| B O D (3 days at 27° C) | IS 3025 (P) 44 – 1993RA 2014 | 110 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 24.3 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 19.07 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 1.3 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 1.2 mg/l |
| Cyanide as CN | IS 3025 (P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 2.3 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 3.5 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
SREEJA RAJESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

*End of the report*

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TC-8589

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/SD/5213/2023(ULR NO:TC658923000000005061F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 17/06/2023 |
| | Date of monitoring | 03/06/2023 |
| | Monitoring Location | Koothattukulam-Town-ward 15<br>GPS Reading : N- 09°51'49.123"<br>E -76°35'27.791" |
| | Sample Description | Ambient Sound Level |

| HOURLY INTERVAL | | RESULT | HOURLY INTERVAL | RESULT |
|---|---|---|---|---|
| 03.06.2023 | 11.00 Hrs | 56.5 dB (A) | 04.00 Hrs | 48.0 dB (A) |
| 12.00 Hrs | | 54.3 dB (A) | 05.00 Hrs | 53.7 dB (A) |
| 13.00 Hrs | | 51.4 dB (A) | 06.00 Hrs | 51.0 dB (A) |
| 14.00 Hrs | | 53.0 dB (A) | 07.00 Hrs | 52.1 dB (A) |
| 15.00 Hrs | | 53.4 dB (A) | 08.00 Hrs | 50.0 dB (A) |
| 16.00 Hrs | | 54.9 dB (A) | 09.00 Hrs | 50.4 dB (A) |
| 17.00 Hrs | | 52.2 dB (A) | 10.00 Hrs | 51.6 dB (A) |
| 18.00 Hrs | | 50.7 dB (A) | | |
| 19.00 Hrs | | 51.8 dB (A) | | |
| 20.00 Hrs | | 50.6 dB (A) | | |
| 21.00 Hrs | | 54.7 dB (A) | | |
| 22.00 Hrs | | 51.6 dB (A) | | |
| 23.00 Hrs | | 52.0 dB (A) | | |
| 04.06.2023 | 00.00 Hrs | 49.5 dB (A) | | |
| 01.00 Hrs | | 45.8 dB (A) | | |
| 02.00 Hrs | | 50.3 dB (A) | LeqDay | 52.3 dB (A) |
| 03.00 Hrs | | 49.1 dB (A) | LeqNight | 49.9 dB (A) |

Limits: Industrial Area Day Time-75dB(A),Night Time- 70dB(A),Commercial area Day Time -65 dB(A),Night Time55dB(A),
Residential area Day Time -55 dB(A),Night Time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am

*End of the Report *

For Poluchem Laboratories (P) Ltd.

Authorized Signatory

SREEJA RANJEEV
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

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**ACCREDITED BY NABL - GOVT. OF INDIA AND KSPCB AS "A" GRADE LABORATORY**


## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/132/2023 (ULR NO:TC658923000000132F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 17/06/2023 |
| | Date of monitoring | 03/06/2023 |
| | Date of sample received | 04/06/2023 |
| | Date of analysis Started | 04/06/2023 |
| | Sample description | Ambient air –Koothattukulam-Town-ward 15 |
| | Sample Code | G/F/132/2023 |
| | Sample Location | GPS Reading : N- 09 °51'50.529" E -76°35'28.395" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 68.8µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 32.4µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 9.4 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 14.6 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 1.1 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
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BREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5212/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 17/06/2023 |
| | Date of monitoring | 03/06/2023 |
| | Date of sample received | 04/06/2023 |
| | Date of analysis Started | 04/06/2023 |
| | Sample description | Ambient air –Koothattukulam-Town-ward 15 |
| | Sample Code | G/F/5212/2023 |
| | Sample Location | GPS Reading : N- 09 °51'50.529" E -76°35'28.395" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 µg/m$^3$ | 400 µg/m$^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m$^3$ | 1 µg/m$^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 6 ng/m$^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 20 ng/m$^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m$^3$ | 180 µg/m$^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m$^3$ | 5 µg/m$^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m$^3$ | 1 ng/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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For and on behalf of
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AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/131/2023 (ULR NO:TC589230000000131F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 17/06/2023 |
| | Date of monitoring | 03/06/2023 |
| | Date of sample received | 04/06/2023 |
| | Date of analysis Started | 04/06/2023 |
| | Sample description | Ambient air –Koothattukulam-Town-ward 15 |
| | Sample Code | G/F/131/2023 |
| | Sample Location | GPS Reading : N- 09 °51'49.824"<br>E -76°35'27.186" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 55.4 $\mu g/m^3$ | 100 $\mu g/m^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 36.4$\mu g/m^3$ | 60 $\mu g/m^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 15.1 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 22.7 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 1.6 $mg/m^3$ | 4 $mg/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5211/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 17/06/2023 |
| | Date of monitoring | 03/06/2023 |
| | Date of sample received | 04/06/2023 |
| | Date of analysis Started | 04/06/2023 |
| | Sample description | Ambient air –Koothattukulam-Town-ward 15 |
| | Sample Code | G/F/5211/2023 |
| | Sample Location | GPS Reading : N- 09 °51'49.824"<br>E -76°35'27.186" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | 3.4 µg/m$^3$ | 400 µg/m$^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m$^3$ | 1 µg/m$^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 6 ng/m$^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 20 ng/m$^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m$^3$ | 180 µg/m$^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m$^3$ | 5 µg/m$^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m$^3$ | 1 ng/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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TC-6589

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## TEST REPORT



**Ref.No: PL/RT/SW/1429/2023** **Date of Issue: 17/06/2023**

(ULR NO:TC658923000000001429F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- Up stream
Sample Location : Koothattukulam-Town-ward 15
Gps Reading : N- 09 °51'46.143"
E -76°35'35.968"

Sample code : F/1429/2023
Date of Sample Collected : 03/06/2023
Date of receipt of sample : 03/06/2023
Date of analysis started : 04/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 –1983RA2017 | 6.63 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 –1983RA2017 | 12 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 8.5 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 140 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 84 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 24 mg/l | --- | -- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 36 mg/l | 200 mg/l | -- |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 28 mg/l | -- | -- |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 15.77 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 9.99 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 –1989RA2014 | 2.9 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.74 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 2.82 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.13 mg/l | 1.5 mg/l | 1.5 mg/l |

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

# POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 1429/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 240 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | — | — |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/SW/5219/2023** **Date of Issue: 17/06/2023**

Name & address of customer :M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- Up stream
Sample Location : Koothattukulam-Town-ward 15
Gps Reading : N- 09°51'46.143"
E -76°35'35.968"

Sample code : F/5219/2023
Date of Sample Collected : 03/06/2023
Date of receipt of sample : 03/06/2023
Date of analysis started : 04/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | – | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | --- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | — |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27° C ) | IS 3025 (P) 44 -1993RA2014 | 4.1 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 12 mg/l | --- | -- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 –1988 RA2014 | 4.3 mg/l | --- | -- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

*End of the report*

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TC-4089

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## TEST REPORT



**Ref.No: PL/RT/SW/1430/2023**
(ULR NO:TC658923000000001430F)

**Date of Issue: 17/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- Down stream
Sample Location : Koothattukulam- Town-ward 15
Gps Reading : N- 09 °51'49.635"
E -76°35'26.27"

Sample code : F/1430/2023
Date of Sample Collected : 03/06/2023
Date of receipt of sample : 03/06/2023
Date of analysis started : 04/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 –1983RA2017 | 6.28 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 –1983RA2017 | 8 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 6.4 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 150 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 96 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 22 mg/l | --- | -- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 36 mg/l | 200 mg/l | -- |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 36 mg/l | -- | -- |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 17.1 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 5.59 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 –1989RA2014 | 1.8 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 1.16 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 4.31 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.19 mg/l | 1.5 mg/l | 1.5 mg/l |

Conti...

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 5218/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 300 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | --- | --- |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/SW/5218/2023** **Date of Issue: 17/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water-Down stream
Sample Location : Koothattukulam- Town-ward 15
Gps Reading : N- 09 °51'49.635"
E -76°35'26.27"

Sample code : F/5218/2023
Date of Sample Collected : 03/06/2023
Date of receipt of sample : 03/06/2023
Date of analysis started : 04/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | --- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | --- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27°C ) | IS 3025 (P) 44 -1993RA2014 | 3.8 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 12 mg/l | --- | -- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 3.9 mg/l | --- | -- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory
QUALITY MANAGER

*End of the report*

# POLUCHEM LABORATORIES PVT LTD

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

Phone: 0484-2544030, 8281982322, 9747400065, www.poluchem.com, poluchem@gmail.com

TC-6569

**ACCREDITED BY NABL - GOVT. OF INDIA AND KSPCB AS "A" GRADE LABORATORY**


## TEST REPORT



**Ref.No: PL/RT/GW/1428/2023**
(ULR NO:TC658923000000001428F)

**Date of Issue: 17/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Ground water-2
Sample Location : Koothattukulam
Gps Reading : N- 09 °51'48.685"
E -76°35'26.369"

Sample code : F/1428/2023
Date of sample collected : 03/06/2023
Date of receipt of sample : 03/06/2023
Date of analysis started : 04/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.09 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 0.5 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 100 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 60 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1 mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 24 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 2 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 15.77 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 6.24 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL-0.05 mg/l) | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 1.86 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

Conti...

SREEJA RAMESH
QUALITY MANAGER
for POLUCHEM LABORATORIES (P) LTD

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Continuation of Test Certificate No: 1428/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 50 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Polachem Laboratories (P) Ltd

Authorized Signatory-

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/5215/2023** **Date of Issue: 17/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-2
Sample Location : Koothattukulam
Gps Reading : N- 09 °51'48.685"
E -76°35'26.369"

Sample code : F/5215/2023
Date of Sample Collected : 03/06/2023
Date of receipt of sample : 03/06/2023
Date of analysis started : 04/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P)54-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P)41-1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P)47-1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P)42-1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P)59-2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P)48-1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P)49-1994RA2014 | BDL(MDL-0.01 mg/l) | 5.0 mg/l |
| C O D | IS 3025(P)58-2006RA2017 | 6 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025(P) 34-1988RA2014 | BDL(MDL- 1mg/l) | --- |
| Total Chromium as Cr | IS 3025(P)52-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P)37-1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Conti..

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**ACCREDITED BY KSPCB AS "A" GRADE LABORATORY**




Continuation of Test Certificate No: 5215/2023

## RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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## TEST REPORT



**Ref.No: PL/RT/GW/1427/2023** **Date of Issue: 17/06/2023**

(ULR NO:TC658923000000l427F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Ground water-1
Sample Location : Koothattukulam
Gps Reading : N- 09 °51'51.018"
E -76°35'29.292"

Sample code : F/1427/2023
Date of sample collected : 03/06/2023
Date of receipt of sample : 03/06/2023
Date of analysis started : 04/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.71 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 8 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 4.7 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 260 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 169 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 8 mg/l | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 76 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 28.85 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 22.8 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 8.5 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.64 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 3.2 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

Conti...

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 1427/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 110 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

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**TEST REPORT**

ACCREDITED BY KSPCB AS "A" GRADE LABORATORY



**Ref.No: PL/RT/GW/5214/2023** **Date of Issue: 17/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Koothattukulam-
Gps Reading : N- 09 °51'51.018"
E -76°35'29.292"

Sample code : F/5214/2023
Date of Sample Collected : 03/06/2023
Date of receipt of sample : 03/06/2023
Date of analysis started : 04/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P)54-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P)41-1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P)47-1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P)42-1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P)59-2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P)48-1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P)49-1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025(P)58-2006RA2017 | 12 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025(P) 34-1988RA2014 | 1.3 mg/l | --- |
| Total Chromium as Cr | IS 3025(P)52-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P)37-1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Conti..

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CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

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Continuation of Test Certificate No: 3214/2023

## RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Polachem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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N 1080
N 1070
N 1060
N 1050
N 1040
N 1030
N 1020
N 1010
N 1000
E 1000
E 1010
E 1020
E 1030
E 1040
E 1050
E 1060
E 1070
E 1080
E 1090
E 1100
CANAL
ADJACENT BOUNDARY
CONCRETE PRIVATE ROAD
DUMPING YARD
WALL
38.97
17.24
13.74
7.60
10.39
6.36
13.15
99.71
100.19
GROUND LEVEL
99.98
WATER TANK
100.29
TANK
TILE AREA
BUILDING
FLOOR LEVEL
100.45
100.29
99.94
99.92
99.99
BRIDGE
100.38
100.04
100.33
99.73
100.41
3.65
4.90
16.48
3.59
13.48
SREEDHAREEYAM HOSPITAL ROAD
100.14
100.06
100.03
100.18
100.18
100.14
100.11
100.13
100.05
100.02
100.01
100.0
100.02
3.05
3.47
GATE
6.39
5.73
2.14
4.14
TBM 100 TAKEN FROM THE ROAD

SCALE : 1:100
PRINT SCALE :

| | |
|---|---|
| DATE | 14/01/2023 |
| DRAWN | SINSHA |
| CHECKED | PRAKASH |

LEGENDS

ELECTRIC POST
SPOT LEVELS
BOUNDARY
ROAD
BUILDING
WALL
RUBBLE
CANAL

AREA

CONTOUR INTERVAL - 1 METRE
GRID INTERVAL - 5X5 M

**AREA - 40.347 CENTS**

ALL DIMENSIONS ARE IN METRE

CLIENT

KSWMP
KAKKANAD

ARCHITECTS

SURVEYED BY

SOEL
NANDHU
KIRAN

TITLE

CONTOUR & TOPO SURVEY

DRAWING CODE

D.N. : 11642

SITE AT

KOOTHATUKULAM
(9.663843° North , 76.5910123° East)
( N0.663843 , E76.5910123 )

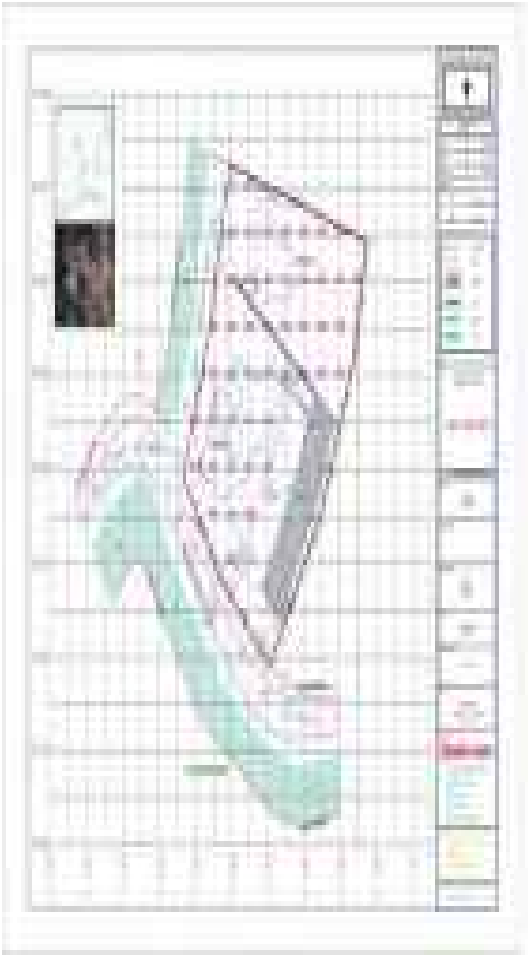

SURVEYED BY

Spreads SURVEY

G-171, NR.SHOPPING COMPLEX
PANAMPILLY NAGAR
COCHIN - 682 036
Ph:0484 2323446
Mobi: 98954 48367/8893448368

ROOM NO : 40,30 , VYAPARABHAVAN,
BANK ROAD
CALICUT-1 PH:0495-4020204
Mobi: 98954 48369

spreadsurvey@gmail.com



Contour Map – Koothattukulam



Proposed Operation Plan

Land shall be reclaimed i.e. all the legacy waste will be removed till it reaches the surface of the earth/ soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the contractor to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to bi-weekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site.



# FEASIBILITY REPORT - SOCIAL SAFEGUARDS

## KOOTHATTUKULAM DUMP SITE KOOTHATTUKULAM MUNICIPALITY IN ERNAKULAM DISTRICT

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## 1. Introduction

Social safeguard aspects during dump site remediation mainly focusing on meaningful stakeholder engagement, understanding stakeholder's risk perception, and restoring them to a safe and environmentally sustainable state. It involves a series of systematic social actions which include social inclusion, effective labour management, prevention of gender violence during the process, successive rehabilitation of the affected people and reduction of health risk of the host community. The remediation process of Koothattukulam municipal dumpsite has been included in the World Bank supported KSWMP project. This chapter addresses the current situation of the dumpsite, potential possible social impacts due to the implementation of the project, recent fire incidents, remediation efforts, the quantity of legacy waste, the dumpsite's location within the solid waste management facility, and the complaints received from nearby communities.

## 2. Koothattukulam Municipality- Brief Profile



**Figure 2.1 Koothattukulam Municipality**

Koothattukulam is a town and Municipality situated in Muvattupuzha Taluk, towards the southeast corner of Ernakulam district in Kerala, South India. It lies at the junction of three districts Ernakulam, Kottayam, and Idukki

The following are the basic details of the ULB:

- Area -23.18 sq.km
- No. of wards: 25
- Population (2011): 17253
- Population (2022): 18208
- Population density (2011): 744
- No. of Households (2022): 5075

## 3. Profile of Dumpsite

Koothattukulam dumpsite is located at 0.65 km from the centre of Koothattukulam town in south-east side and encompasses a total area of approximately 0.40 acres of land. Out of this, 0.29 acres of land is covered with solid waste. The dumps site is not very far from human settlement. The coordinates of the dumpsite are 9°51'49.2" N & 76°35'27.3" E. It is in ward no. 15 of the municipality. Koothattukulam municipality holds the ownership of the dumpsite.

Dumping was started 30 years back approximately and stopped in 2017. Currently, the quantity of waste dumped at this site is about 2073.63 cum. As of now 60 % of the area is covered with solid waste. The legacy waste present at site is about 0.8 m above and 3 m below from the existing ground level. Hence bioremediation of the dumpsite is essential to mitigate the environmental impacts. Dumpsite reclamation involves excavation, screening, and separation of material from dumpsites into various components such as soil, recyclable materials, and residues.

**Table 3.1 Dumpsite Profile**

| | |
|---|---|
| 1. Location of the sub-project | Koothattukulam |
| 2. GPS coordinate of the Site | LAT 9.863805, LONG. 76.591078 |
| 3. Name of the sub-project | Dump site remediation |
| 4. Name of ULB | Koothattukulam |
| 5. District | Ernakulam |
| 6. Taluk | Muvattupuzha |
| 7. Total population in the ULB | 17529 |
| 8. Proposed dumpsite area (in acres) | 0.40 |
| 9. Land use and other details | Land use: MSW dumpsite- currently not in use which needs to be cleared by Municipality for expanding the existing MCF for better use.<br>Adjacent Land Use: It is accessed through a 3m wide Pocket Road. A Fire station, a veterinary and a beverages outlet are within 200 meters of the dumpsite. However, it should be noted that a functioning Cattle Market is located close to the site.<br>Ownership details: Koothattukulam Municipality, Government Land<br>Ward: 15, Town ward |

## 4. Socio economic baseline of Host community

11 families are residing within 200m radius of the dump site. These families are coming under lower middle-class category. Vulnerability mapping of Host community

The following vulnerable data are collected during the transect walk conducted at site

**Table 4.1 Vulnerability Map Details of host community families**

| Sl. No | Particulars | Number |
|---|---|---|
| 1 | Number of Senior citizens residing Near dumpsite | 5 |
| 2 | Number of single women staying near the dumpsite | 3 |
| 3 | Number of persons with disabilities | 2 |
| 4 | Number of persons with severe disease | 0 |
| 5 | Number of persons with respiratory issues | 1 |
| 6 | Number of Kids below 5 years old | 8 |

## 5. Data Collection Tools

### a. Social Screening

Social screening was conducted using the social and tribal screening checklist in accordance with the requirements of the ESMF. It has been observed that the only anticipated risk is associated with labour, with no other adverse social impacts on dwellings, land, labor, livelihood, or community resources of the host and other vulnerable communities. The assessment of the social screening indicates that the remediation of the dumpsite can have a positive impact on the living conditions of the host community.

### b. Transect walk

A transect walk was conducted in and around the dumpsite on 06/06/2023. The aim of transect walk was to identify the potential social impacts of the project, issues of land availability, any adverse impacts and elicit necessary community participation in the program. A team of experts from Technical Support Consultancy, District Project Management Consultancy, and the District Project Management Unit, along with Standing Committee Chairperson, Ward Councilor, Health Supervisor of ULB, PIU, and influential persons at the locality participated in the transect walk.

The group exercise that entails walking between two points to intentionally cross or transect a community. The group explores environmental and social resources, conditions, and systems by observing, asking, listening, looking and producing a transect diagram. Information collected can

be used to reveal land use practices, hazards, and vulnerabilities to inform disaster mitigation and water management.

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*Figure 5.1 Transect Walk Map*

### c. Focused Group Discussion

A preliminary discussion was conducted on 20/10/2023 in the municipal hall with the families and representatives from the nearby institutions to identify their concerns about the remediation process. The dumpsite remediation process, benefits of the remediation were discussed during the meeting and addressed all the doubts and concerns of the host community during the stakeholder meeting.

## 6. Site specific Observations from Transect walk and social screening

Major findings identified during the screening process are given below.

- There is a MCF and RRF working inside the boundary of the Dumpsite.
- 22 HKS workers were deployed in MCF and RRF for SWM activities.
- A fire station, veterinary hospital and a beverage outlet are situated within 200 meters. A Weekly cattle market is- also functioning adjacent to the site, it is sharing the same compound wall.
- Land acquisition or land loss is not applicable here for the execution of the work.
- There are no scheduled tribes, rag pickers living near to the dumpsite.
- There is no requirement for government, forest, or private land acquisition for the dumpsite remediation project. The currently designated plot has space for the transportation or mobilization of construction materials
- The access road to the dump site is having only 3m width.

## 7. Stakeholder Analysis

Social safeguard aspects during dump site remediation are mainly focusing on meaningful stakeholder engagement, understanding stakeholder's risk perception, and restoring them to a safe and environmentally sustainable state. The remediation process requires collaboration of the following stakeholders.

**Table 7.1 Stake Holders**

| Sl. No. | Stakeholders | Roles of the Stakeholders W.R.T Remediation Process |
|---|---|---|
| **Service Providers** | | |
| 1 | ULB Council | Providing ground support to the remediation process |
| 2 | Govt institutions like PCB, KSEB, KWA, Fire station, Police Station, Thaluk Hospital etc. | To deliver necessary approvals and provide necessary services during emergency if required during remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | KSWMP-DPMU | Monitoring and Evaluation |
| 5 | TSC/PMC | Technical support and Supervision |
| 6 | Contractor | Execution of the Remediation process |
| 7 | Rag Pickers | Participation of informal sector to strengthen the collection process to prevent further dumping |
| 8 | Scrap dealers | Informal participation in NBD waste management to prevent further dumping after remediation |
| 9 | End recyclers | Process the inert and legacy waste safely after remediation |
| **Affected Community** | | |
| 1 | 22 HKS workers working in the MCF and RRF daily on shift basis | Support and cooperation for the remediation process |
| 2 | 11 families residing in the 200 m radius of the dumpsite | Support and cooperation for the remediation process |
| 3 | Labors of contractor/Agency at site | Execution of work timely by strictly following Labour Management plan and Preventive GBV Action plan |

| | | |
|---|---|---|
| 4 | Staffs of the fire station, Veterinary hospital and the beverage outlet are situated within 200 meters | Cooperating with the remediation process |
| 5 | Staffs and Customers of weekly market place which is situated adjacent to the site and shared the same compound wall of the dumpsite. | Cooperating with the remediation process |

## 8. Positive social impacts after remediation.

### a) Enhanced quality of life

The remediation can restore the aesthetics of the area, reducing visual blights, foul odour and improving air and water quality. According to the opinion of people residing nearby the dumpsite, the project can contribute to an improved sense of well-being. Also it results to a clean and hygienic work environment for the workers engaged in MCF and RRF.

### b) Livelihood and employment of vulnerable community

It is identified that no rag pickers are currently engaged in collecting waste from the dumpsite or making a living from it. Therefore, the proposed dumpsite rehabilitation project will have no impact on housing or livelihood of any rag pickers.

### c) Economic opportunities

After remediating the site, the Municipality is planning to enhance the capacity of the MCF and RRF to process more non biodegradable waste and to set up a centralized waste management unit to process the biodegradable waste. These projects will create more job opportunities to the people who are looking for employment in waste management sector. Remediation creates new opportunities for economic development in the area. The cleaned-up land can potentially be used for new construction, commercial development, or recreational activities. Remediation process will help to increase property values for surrounding residents.

### d) Access to service

It is observed that the project will not affect access to any facilities, services, or natural resources as there is enough space/land available in the exiting site.

## 9. Expected Risk/Impact identified

- During the remediation process, the current activities of the dumpsite may be stopped, and it may result livelihood loss to the SWM workers.
- As a result of remediation process, the health and safety of the nearby 11 households may get negatively affected.
- GBV issues may happen due to labour influx.

## 10. Suggestions/recommendations

- Effective FGD'S should be conducted with the host community, political leaders, community influencers, ULB councilors, members of action council regarding the remediation process and the benefits of dumpsite remediation.
- Visiting similar project site with the selected members from the host community will be helpful to create a positive thinking about remediation process among the local people.
- ULB must identify a suitable land or facility to relocate of the MCF and RRF units during remediation period.
- Arrangements shall be made for proper fencing and Noise barriers to safeguards the 11 households which are located within the 200m radius of the dumpsite.
- Public access towards the dumpsite should be restricted during the execution of the project.
- Adequate health and safety measures to be provided to the contractor to his labours during the process.
- A project-level grievance redressal mechanism will be instituted to receive and facilitate the resolution of stakeholders' concerns and grievances. Awareness campaigns about the Grievance Redressal Mechanism (GRM) will be conducted through Information, Education, and Communication (IEC) activities for the community and Urban Local Body (ULB) functionaries
- Proper capacity building is essential for municipal councilors, health wing officials, SWM workers of the Urban Local Body (ULB), and other functionaries involved in the operation and management of this project.
- It is recommended to install essential information/warning boards at site.
- Ensure safe gender friendly toilet facilities at the dumpsite
- Prior information shall be given to Fire station, Police station and nearby Govt hospital about the process to get immediate service in the case of emergency.

## Scoping of Social Impact Assessment and required Action plans

All the social risks were identified through the social screening and Transect walk conducted at site. Considering the social impact assessment, certain action plans have been formulated to be followed at site

- **Labour Management Plan**

Maximum of 12 labours are expected to be engaged in remediation process at a time. A detailed labour Management plan has been formulated and to be followed at site by the contractor.

- **Labour Influx Management Plan**

Since 11 families are residing in 200 m Households there are chances of influx issues. A detailed labour Influx Management plan has been formulated and to be followed at site by the contractor. The plan is attached as Annexure.

- **Preventive GBV Action plan**

Since there is a proximity to households, it is required to prepare and follow an action plan by the contractor and labours to prevent GBV incidents. A detailed GBV action plan has been formulated and followed at site. The plan is attached as Annexure.

- **Citizen Engagement Plan**

  There will not expect much protest from the local community. Still a Citizen Engagement Plan has been prepared to avail maximum cooperation from the nearby families and employees of nearby institutions. The pan has been prepared and attached as Annexure.

As per the detailed assessment of potential social risk during the remediation process, the identification from social screening with screening checklist, transect walk and focus group discussion indicates that there will be a chance of temporary loss of livelihood of SWM workers in the existing MCF and RRF located in the same site. A detailed impact assessment shall be conducted by the TSC, and Livelihood Action Plan will be prepared accordingly.

It is identified that land acquisition is not required as sufficient land is available.

## 11. Conclusion

The Social Screening and Transect Walk helped to analyze and identify the potential social impacts on host community related to the remediation of the dump site. There will not be any adverse social impacts on any valuable community, tribes, dwellings, land and community resources of host communities. It is observed that limited space is available at site for proper vehicular movement and machinery installation related to the remediation process. So the MCF will have to be shifted to any other suitable space while executing the work. No other specific social risks are identified for initiating the remediation process except the occupational hazards to the workers engaged in the remediation process at the site. Since there is not much risk with respect to the social and economic conditions of the host communities, the dumpsite can be classified into “Moderate Risk” Category.

## Annexure-1

# Citizen Engagement Plan

### 1. Stakeholder Identification

As part of social safeguard initiatives for the Bioremediation of dumpsite at Koothattukulam, the social experts of TSC, DPMC and DPMU conducted interactive meetings with local community and functionaries of Koothattukulam Municipality and PIU team. A detailed list of primary and secondary stakeholders is prepared based on these exercises.

**Waste Generators**

Since the dump site has been officially closed for the last 3 years, the waste generators in Koothattukulam Municipality do not have any stake in the programme at present. But 11 families staying close to the Dump site and the employees of the nearby institutions such as from the Veterinary Hospital, Fire Station, Beverage Outlet and the workers in the cattle market are the primary stakeholders.

**Service Providers**

For the successful completion of the bioremediation project, service of many people, agencies and departments are to be ensured by proper advocacy and networking initiatives. Following is the list of service providers identified through stakeholder analyses and their expected role/responsibility in the project.

| SL No | Stakeholder | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| 1 | Municipal Council | Providing ground support and Monitoring |
| | Officials/staff members of the Municipality | Administrative supports and support for the monitoring of the process |
| 1 | Govt institutions like PCB, KSEB, KWA, and health department | To deliver necessary approvals and provide services for the remediation purpose |
| 3 | KSWMP | Monitoring and Evaluation |
| 4 | TSC/PMC | Technical support and supervision |
| 5 | Contractor | Execution of the Remediation process |
| 6 | Service providers/HKS of the Municipality | Proper collection, segregation and transportation of waste to appropriate processing units to prevent the formation of such dumping yards in the in future |
| 7 | Labors of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |

| | | |
|---|---|---|
| 8 | Waste Generator in the Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |
| 9 | End recyclers | Process the inert and legacy waste safely after remediation |
| 10 | Media | Create an enabling environment for the successful completion of the project through positive reporting by the media. |
| 11 | Police | Ensure law and order in the area, if required |
| 12 | Fire and safety | Extend assistance in case of an emergency. |

## 2. Need of the plan

Citizen engagement as part of the proposed bioremediation of Koothattukulam dumpsite aims to facilitate two-way communication between the project and its stakeholders in order to make better informed decisions that are of value to the residents of the Municipality. Such an engagement will certainly pave the way for better implementation of the project, and it will ensure public participation in trouble shooting at all the stages of the implementation of the project.

## 3. Objective of the plan

The citizen engagement plan for the proposed dump site remediation is prepared with following objectives.

- To create a conducive environment for the smooth implementation of the proposed bioremediation of the dumpsite by promoting constructive dialogues between the project and its stakeholders.
- To ensure stakeholder participation in the planning, implementation, and monitoring of the project.
- To suggest appropriate activities with a monitoring plan and an expected budget for engaging the stakeholders with the motive of enhancing their ownership in the project through increased participation.

## 4. Stakeholder concern

### 4.1 Waste Generators

The waste generators of Koothattukulam Municipality, who were dumping the waste on the site, solely dropped it and depends on other approaches for waste management. The existing dump on the site is now the concern of the host community for the prevailing environmental and social problems facing them. The remediation work may create some discomfort to the 11 families residing near to the site. This can be managed through proper orientation and proper awareness generation.

### 4.2 Service Providers

Major concerns of the service providers which has to be addressed by the citizen's engagement plan can be summarized as follows.

- The policy makers and decision leaders of the Municipality are not aware about the urgency and importance of remediating the dumpsite. Hence there is an apathy observed among the councilors and officials to the project. Their improved involvement through proper sensitization is essential to the effective implementation.

- SWM related Service providers/HKS of the should be trained and motivated for proper timely collection, segregation and transportation of waste to appropriate processing units to prevent the formation of such dumping yards in the future.

## 5. Community/citizen Awareness

- Orientation meeting and focused group discussions with host community
- Organize exposure visit to any of the site where the remediation process completed successfully. Members from the primary stakeholders and ULB council may be participated in the exposure visit.
- Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency.

## 6. Awareness to Service providers

- Sensitization on the bio-remediation activity is to be conducted for the Municipal Council and officials prior to the commencement of the actual bio-remediation process.
- Meeting with Contractor to understand their plan of operations/ labors involvement/timeline etc.
- Orientation to the Service providers/HKS of the Municipality
- Sensitize the local and district level police officials on the proposed bio remediation in the dumpsite and anticipated issues and action required.

## 7. Citizen Engagement Plan Matrix

| S. No | Engagement Challenge | Impacts on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| 1 | Awareness on Project activities | | | |
| 2 | To facilitate timely support from the ULB and avoid delays in decision making. | To establish transparency and building confidence in the project commitments to ULB elected members and officials. | Sensitization on the bio-remediation activity is to be conducted for the Municipal Council and officials prior to the commencement of the actual bio-remediation process. | Contractor/TSC |

| | | | | |
|---|---|---|---|---|
| 3 | To create awareness to the 11 families of host community) about the proposed bio remediation activities and safeguard measures to be adopted | To establish transparency and build confidence in the project commitments to the host community. | Sensitization meeting to host community | Contractor/TSC |
| 4 | To facilitate and establish problem solving mechanism at dumpsite site level | To facilitate host community participation in the Bio remediation activity and establish a mechanism to solve the issues raised at the site level at the earliest and avoid any delay and interruptions. | Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency. | Contractor/TSC |
| 5 | Understand the actual operational plans ( Time of operations, Machineries involved , No of workers and labour details, action to be taken for dust, odour and sound pollution, Vehicle movements etc. for mitigation measures to be planned. | To inform actual plan of operations to the host community and prevent any social and environmental issues and plan mitigation measures | Meeting with Contractor to understand their plan of operations/No labors involvement/timeline etc. | Contractor/TSC |
| 6 | Confidence building measures in the host community to create community participation and generate positive attitudes for bio mining activities. | To avoid delays and completion of remediation activity as planned | Organize exposure visit for the host community and ULB council members | Contractor/TSC |

| | | | | |
|---|---|---|---|---|
| 7 | To facilitate proper collection, segregation and transportation of waste to appropriate processing units to prevent the formation of such dumping yards in the in future | To safeguard the environment, promote a healthy society, and implement measures for climate-resilient activities. | Orientation to the Service providers/HKS Municipality | Contractor/TSC |
| 8 | To secure support from the line department and prevent delays in decision-making. | To avoid delays and completion of remediation activity as planned | Issue based one to one meeting with Govt institutions like PCB,KSEB,KWA, Health Department | Contractor/TSC |
| 9 | To garner public support and ensure the smooth implementation of bioremediation activities | To raise awareness about the positive impact within the community and dispel any doubts regarding the remediation process. | Orientation to the Media persons on the proposed remediation in the dumpsite. | Contractor/TSC |
| 10 | To ensure peaceful and smooth bio remediation activity and prevent any law and enforcement issue | To prevent unrest and social issues | Sensitize the local and district level police officials on the proposed bio remediation and anticipated issues and action required | Contractor/TSC |
| 11 | Making aware of labours of the contractor about the Laboour management Plan and GBV action plan to be followed at the site | To prevent violations in the action plans | Interactive session with Labours | Contractor/TSC |

**8. Budget**

| S. No | Activity | Specification | Quantity | Cost |
|---|---|---|---|---|
| 1 | Sensitization on the bio-remediation activity is to be conducted for the Municipal Council and officials prior to the commencement of the actual bio-remediation process | Half day Programme for the Councilors and Health Staff | 1 | [redacted] |
| 2 | Sensitization meeting to host community | Half day Program at site | 2 | [redacted] |
| 3 | Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency. | Committee formation | 1 | [redacted] |
| 4 | Meeting with Contractor to understand their plan of operations/No labors involvement/timeline etc. | One to one interaction | As required | [redacted] |
| 5 | Organize exposure to the members representing the host community families, employees of nearby institutions and council members | Exposure visit to Alappuzha Sajivothapuram site | 15 participants-1programme | [redacted] |
| 6 | Orientation to the Service providers/HKS of Municipality | Half day programme | 2 | [redacted] |
| 7 | Issue based one to one meeting with Govt institutions like PCB,KSEB,KWA, Health Department | One to one | As required | [redacted] |
| 8 | Orientation to the Media persons on the proposed remediation work | Half day programme | 1 | [redacted] |
| 9 | Sensitize the local and district level police officials on the proposed bio remediation and anticipated issues and action required | One to one interaction | As required | [redacted] |
| 10 | Orientation to Labours deputed by the contractor about the LMP and GBV Action plans | Half day program | 1 | [redacted] |
| | | | **Total** | **Rs.** [redacted] |

**Annexure-2**

# Preventive GBV Action Plan

## 1. Sub project information

Bio Remediation of existing dumpsite in ward -15 of Koothattukulam Municipality

### 1.1 Details of labors

The project is under pre planning stage. ULB has to finalize contactor/Agency for Remediation. So the exact number of Labors are not available. But approximately we can expect maximum of 12 labors

| | |
|---|---|
| Total number of labors | : 12 (Approx.) |
| Category of labors (Age/sex/gender) | : Not available |
| Data of migrant labors, if any | : Not available |

## 2. GBV Issues likely to be identified at site

1. Issues against female workers at site
2. Lack of safe and Gender friendly toilets at work sites
3. Disparity in work and wages based on gender
4. Threat of GBV or Sexual Exploitation Abuse (SEA) incidents to female members of the host community

## 3. Activities under GBV Action plan

1. **Formation of Internal Complaints Committee**
   The committee should be Presided by a senior women and more than half of the total Committee members should be women. There should be an external member who has experience in dealing with issues related to women. Preferably a Social Worker /Advocate/NGO Representative.

**Placing of ICC informatory board at Work site**

| Insert Logos of KSWMP,WB,AIIB | | | |
|---|---|---|---|
| **Project Name (KERALA SOLID WASTE MANAGEMENT PROJECT)** | | | |
| **Sub Project Name:** | | | |
| **Internal Complaints Committee** | | | |
| Sl.No | Name | Designation | Contact Number |
| | | | |
| | | | |
| | | | |
| **EMERGENCY CONTACT NUMBER** | | | |

**2.Gender Sensitization trainings for Labors**

The Project expect around 12 labours will be employed in a day and women participation in the labor force is limited, even the project is taking precaution to protect and prevent any GBV incidence at the site. Taking into consideration all these aspects, the project plan to conduct a half day sensitization program in the following subjects, viz. the type of GBV, the action to be taken by the victim, the laws and the support organizations which extend support to the victim of GVB and the role of ICC and their contact details etc.

**3. Sensitization for female host community members**

The citizen engagement plan has proposed an activity of host community meeting in which the importance and expected social risk of GBV will be discussed and the mitigation measures inbuilt in the project will be elaborated to the host community members especially to the women.

**4. Allocation of Gender friendly and safe toilet facilities for women**

Project has taken special care to arrange a separate toilet, wash and rest facility for female workers to protect their privacy and safety, and the same has to be arranged by the contractor.

**5. Keeping of wage register at site to restrict wage disparity based on gender**

The project actively opposes gender-based wage disparity at any site funded under the KSWMP-supported SWM project. To ensure gender parity in various aspects such as wages, division of labor, and facilities, an appropriate monitoring mechanism, such as a wage register, should be maintained for the scrutiny of the project implementers.

**6. Details of GBV Service Providers identified**

The government of Kerala has constituted a help desk under Kudumbashree to support or to prevent and extend support to the GBV victims, and their details are given below.

Kudumbashree Snehitha Gender Help Desk
Contact Number – 0484-2428745
Toll free number - 180042555678

**Preventive GBV Implementation plan Matrix**

| Sl No | Activity | Timeline | Primary Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 1 | Formation of Internal complaint committee | Pre-Construction Phase. | Contractor/ULB | TSC |
| 2 | Placing of ICC informatory Board at worksite | Pre-Construction Phase. | Contractor | TSC |
| 3 | Gender sensitization Training to labors | During Construction | Contractor/TSC | DPMU |
| 4 | Group Discussion with female host community members | Pre-Construction Phase. | Contractor/TSC | DPMU |
| 5 | Ensuring Gender friendly and safe toilet facilities | Construction stage | Contractor | TSC |
| 6 | Keeping Wage Register at site | Construction stage | Contractor | TSC |

**Budget**

| Sl No | Particulars | Cost |
|---|---|---|
| 1 | Placing of ICC informatory board at site | [redacted] |
| 2 | Gender sensitization trainings to labor | [redacted] |
| 3 | FGD among female host community members | [redacted] |
| | **Total Cost** | [redacted] |

**Monitoring plan**

| Activity | Monitoring Indicators | Means of Monitoring | Reporting Period | Responsibility |
|---|---|---|---|---|
| Formation of Internal complaint committee | Minutes of Meeting/Bye Law of Committee/Reports | Verification of Minutes of Meeting and Reports | 15 days after commencement of work | DPMU |
| Placing of ICC informatory Board at worksite | Photos of Board placed | Physical verification | 15 days after the commencement of work | DPMU |
| Gender sensitization Training to labors | Attendance and Photographs | Verification of Documents | 5 days after the commencement of work | DPMU |
| FGD among Female host community members | Attendance and Photographs | Verification of Documents | 5 days after the commencement of work | DPMU |
| Ensuring Gender Friendly and safe toilet Facilities | Gender friendly signage's, Condition of latches, Floor Condition, Status of Flush | Physical verification | Before Commencement of work | DPMU |
| Keeping Wage Register at site | Photographs | Verification of Register | 5 days after the commencement of work | DPMU |

**Annexure-3**

# Labour Management Plan

## 1. INTRODUCTION

1.1 PROJECT TITLE:

Project for the remediation of dumpsite at ward 15 owned by Koothattukulam Municipality

1.3 PROJECT AREA

The Dumpsite of Koothattukulam Municipality is situated in ward 15 of the municipality, covering an area of .29 acres.

## 2. SCOPE AND STRUCTURE OF THE LABOUR MANAGEMENT PLAN

The scope of the LMP shall be as outlined in the World Bank's ESMF. The engagement will be planned as an integral part of the project's social assessment and project design and implementation. This document has 10 chapters. This chapter viz., chapter 1 served as introduction. Scope and structure of LMP is provided in chapter 2. An overview of labour use in the project is presented in chapter 3. Key potential labour risks are listed in chapter 4. Legislative framework governing labour employment in India/Kerala is discussed in chapter 5. Implementation Arrangements, policies and procedures follow in the subsequent chapter. Grievance redressal mechanism, contractor management are presented in the last chapters.

## 3. OVERVIEW OF LABOUR USE ON THE PROJECT

3.1 Details of Labours

The proposed remediation process requires following category and number labors

| Sl.No | Equipment | Category of labors | Required No.of labors |
|---|---|---|---|
| 1 | One trommel | Labours for waste segregated purpose | 5 |
| 2 | One excavator | Operator | 1 |
| 3 | One JCB | Operator | 1 |
| 4 | Two small tippers | drivers | 2 |
| | | Helpers | 2 |
| 5 | | Supervisor | 1 |

| | |
|---|---|
| **Total Labours** | 12 |

## 4. ASSESSMENT OF KEY POTENTIAL LABOUR RISKS

4.1 Project Activities:

The bioremediation of the dumpsite includes the following activities;

- Mobilization of plant and machinery for bio-mining
- waste excavation and forming of windrow
- Spraying with inoculum and waste stabilization
- Waste segregation and refinement
- sorting materials into recyclable, RDF, compost and inert
- Transport to the authorized recyclers and end users

4.2 Key Labour Risks

It is assessed that key labour risks would be associated with health and safety risks related to the construction activities such as exposure to physical hazards during construction activities such as: use of heavy equipment, exposure to noise and dust, falling objects, exposure to hazardous materials and exposure to electrical hazards from the use of tools and machinery, lack of proper sanitation facilities, availability of separate toilet for women workers. As the construction activities will involve hazardous work, persons under the age of 18 will not be employed by the Project. Many workers will be exposed to occupational health and safety hazards, primarily including but not limited to:

- Injuries/accidents/ fatalities leading to even death, while at work.
- Inadequate accommodation facilities at work force camps, including inadequate sanitation and health facilities.
- Non-payment of wages by Employer.
- Non-payment of benefits (compensation, bonus, maternity benefits etc.) by Employer
- Discrimination in Employment (e.g., abrupt termination from employment, working conditions, wages or benefits etc.)
- Engagement of child labour.
- Sexual harassment at work sites.
- Forced labour or trafficking.
- Security of women workforce.
- Inadequate facilities for pregnant women and lactating mothers.
- Inadequate facilities for the children of the workforce at workforce camp sites
- Possibility of Gender based violence as the work is mostly carried out within the premises of the existing facilities like MCFs/ RRFs etc where female SWM workers are engaged.

- Absence or inadequate or in accessible emergency response system for rescue of labour/workforce.
- Health risks of labour relating to HIV/AIDS and other sexually transmitted diseases.
- Unclear terms and conditions of employment.
- Discrimination and denial of equal opportunity in hiring and promotions/incentives/training opportunities.
- Denial for workers' rights to form workers organizations, etc.
- Absence of a grievance redressal mechanism for labour to seek redressal of their grievances/issues.

## 5. BRIEF OVERVIEW OF LABOUR LEGISLATION: TERMS AND CONDITIONS

| Sl No | Applicable Acts | Details |
|---|---|---|
| 1. | Employees Compensation Act 1923: | The Act provides for compensation in case of injury, disease or death arising out of and during employment |
| 2. | Contract Labour (Regulation & Abolition) Act 1970 | The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. |
| 3. | Minimum Wages Act 1948: | The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. |
| 4. | Payment of Wages Act 1936: | It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the workers. |
| 5. | Equal Remuneration Act 1976: | The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training, and promotions etc. |
| 6. | Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: | The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc. |

| | | |
|---|---|---|
| 7. | Child Labour (Prohibition & Regulation) Act 1986: | The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in the Building and Construction Industry. |
| 8. | Employees State Insurance Act 1948: | The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the Central Government. The Act also provides for benefits to dependents of insured persons in case of death because of an employment injury. |
| 9. | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: | This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee |
| 10. | Industrial Disputes Act 1947: | the Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing the establishment. |
| 11. | Trade Unions Act 1926: | The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. |

## 6. RESPONSIBILITY MAPPING

The ULB (Urban Local Body) will award the proposed work to the contractor through competitive bids. The contractor will be responsible for hiring labourers for both civil and skilled work. In the recruitment process, the contractor is obligated to provide opportunities to members of the host community who possess the necessary skills and willingness to engage in the activities available at the dumpsite for remediation.

The contractor is required to adhere to existing labour laws in the state of Kerala while employing labourers, ensuring compliance with all applicable welfare measures mandated by the relevant labour legislation and rules. Additionally, the contractor is responsible for implementing measures to protect and assist vulnerable groups of workers, including individuals with disabilities, migrant

workers, and women workers. These protective measures should be explicitly outlined in the work agreement.

Furthermore, the contractor must prioritize occupational health and safety measures for the labourers. The ULB will actively monitor the contractor's compliance with legal and welfare requirements. The ULB will also organize training sessions for the workers and establish a forum at the ULB level to address any grievances raised by the workers.

It is a prerequisite for the contractor to possess a valid Labor License, and all laborers working on the site must be registered with the appropriate authorities. This comprehensive approach ensures the well-being and fair treatment of workers throughout the remediation project.

## 8. CODE OF CONDUCT

A code of conduct needs to be incorporated with the contract under the project. The contractor should conduct continuous awareness generation and training activities to ensure that the workers abide by the code of conduct. While preparing the code of conduct, following aspects should be ensured;

- Compliance with applicable laws, rules, and regulations of the jurisdiction
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment (PPE), preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment)
- The use of illegal substances
- Non-Discrimination (for example based on family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction)
- Interactions with community members (for example to convey an attitude of respect and non-discrimination)
- Sexual harassment (for example to prohibit use of language or behavior, towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate)
- Violence or exploitation (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favors or other forms of humiliating, degrading or exploitative behavior)
- Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behavior with children, limiting interactions with children, and ensuring their safety in project areas)
- Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by their employer and not open areas)
- Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favors, are not provided to any person with whom there is a financial, family, or personal connection)
- Respecting reasonable work instructions (including regarding environmental and social norms)
- Protection and proper use of property (for example, to prohibit theft, carelessness, or waste)
- Duty to report violations of this Code

- No retaliation against workers who report violations of the Code, if that report is made in good faith.

## 9. SYSTEMATIZING THE CODE OF CONDUCT

Awareness raising: The Contractor is required to conduct ongoing awareness-raising and training activities to ensure that workers consistently adhere to the Code of Conduct. Additionally, the Contractor must take measures to ensure that local communities are well-informed about the Code of Conduct, enabling them to report any concerns or instances of non-compliance. This proactive approach aims to foster a shared understanding of ethical standards and accountability within both the workforce and the surrounding communities.

## 10. TRANSPARENCY IN CONTRACT SPECIFIC TERMS AND CONDITIONS

All contracts must contain

- Wages: Specific wages and payment modality, timeline
- Working Hours: hours of work, maximum number of hours that can be worked on the project, overtime, compensation
- Leaves: rest per week, annual leave, maternity leave, sick leave
- Benefits: medical treatments in case of accidents or otherwise
- Notice of termination of employment and details of severance payments in a timely manner
- Collective agreements that apply to the project, other specific terms, and conditions
- Details of the grievance redressal mechanism

## LABOUR MANAGEMENT PLAN MATRIX

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To complete the registration by the Principal Employer, the ULB, as per the provisions of the Contract Labour (Regulation & Abolition) Act 1970 (CL Act), Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979 (ISML Act) and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 (BOCW Act) and procure certificate to that effect. | 3 Registration Certificates to be procured by the ULB under CL Act, ISML Act and BOCW Act respectively. | Before Awarding works | Registration Certificate issued by District Labour Officer under CL Act, ISML Act and BOCW Act | PIU |
| To Procure license under CL Act, ISML Act and registration under BOCW Act by the contractor | 2 Licenses and One registration under CL Act, ISML Act and BOCW Act respectively. | Before commencing the work at site | License and registration certificate issued by the competent Authority. | Contractor |
| To procure Workmen Compensation insurance policy proportionate to the number of labour force deployed. (By the Contractor) | One insurance policy. | Before commencing work at site | Copy of insurance policy | Contractor |
| To display a copy of the certificate of registration at the conspicuous place at the premises where the building and other construction work is being carried on.<br><br>To establish a labour information signboard at camp site by including following details like, date of payment of wages, working hours, holidays, wages rates for different categories of labours and name and contact details of local labour inspector and his/ her office and emergency contact numbers. | One notice board<br><br>One notice board | As soon as the work is started.<br><br>Do | Photographs of the notice board where the license is displayed.<br><br>do | Contractor |

| | | | | |
|---|---|---|---|---|
| To conduct pre- employment medical examination (as per the provisions of BOCW Act)- to ensure medical fitness of the employee. | All workers must be examined | No of workers employed by the contractor | Pre-Medical Examination certificate issues as per Rule 223(C) of BOCW Act (Form No. IX) by the Registered Medical Practitioner. | Contractor |
| To conduct Periodical Medical Check-ups (once in every six months) | All workers must be examined. | No of workers employed by the contractor | Medical Examination certificate issued by a registered medical practitioner. | Contractor |
| To provide safe drinking water- the contractor must provide safe drinking water at worksite as well as camp site* (Guideline is provided along with this document) | As per requirement | During the entire contact period | Photographs of supply of potable water, Bill of water purchase. | Contractor |
| To arrange first Aid facility at work site as well as camp site (Specifications and items to be maintained in the box is mentioned in this document) | As per requirement | During the entire contract period | First Aid Register, Bill of purchase, photographs of First Aid kit | Contractor |
| To arrange separate First Aid room at work site | Allot one specified room | To be made available during the construction period | Photographs of the facility | Contractor |
| To provide first Aid training to selected labourers or staff members through an authorized agency. | One training with authorized agency | Within one month of commencement of the work | Training records & Photographs | Contractor |
| To establish linkage with local hospitals/ health care institutions for emergency medical assistance | Tie up with at least one hospital | Within one month of the commencement of the work | Letters issued by the hospital or correspondence and agreement with the hospital. | Contractor |

| | | | | |
|---|---|---|---|---|
| To establish rest room at work site or camp site | | Before the commencement of the work | Photographs of the rest room | Contractor |
| To establish Canteen facility for labours if the contractor engages more than 250 labours | | Before the commencement of the work | Photographs of the facility, canteen register etc | Contractor |
| To maintain essential registers and records like Form A (Registration of employees), Attendance Register, Wages Register, and other registers like incidents registers including Accident register, Harassment complaints, recovery register, Maternity leave, Termination etc | | As and when the work starts | Copy of registers. | Contractor |
| Constitute GRC for labours (maximum members to be six. Number of members from employer and employee to be equal. Female members should be minimum 50%. ) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| Constitution of ICC (minimum members to be four. The presiding member should be a senior female employee) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| To publish the abstract of labour laws within the premises of the labour camp.<br>1. The Payment of Wages Act<br>2. The Employee Compensation Act<br>3. The Building and Other Construction Workers (RECS) Act<br>4. The Contract Labour (A&R) Act<br>5. The Child and Adolescent Labour (P&R) Act<br>6. The Maternity Benefit Act | Abstract of Six acts | As and when the camp is established | Photos of the notices published. | Contractor |
| To establish code of conduct and provide induction trainings | | As and when new employees are joined | Training reports and other documents | Contractor |

| | | | | |
|---|---|---|---|---|
| Conduct HIV/AIDS awareness programs | As per requirement | Once in six months | Reports, photographs etc | Contractor |
| All the Drivers should possess effective and valid Driving License | Drivers should be selected after verification of DL | As and when drivers are appointed | Photocopy of licence ids to be collected | PIU |
| All the vehicles involved in the project shall be insured to cover the third-party risk | Vehicle must be allowed to be plied in the project only after procurement of third-party insurance to the vehicle | As and when vehicles are plied in the project | Photocopy of insurance is to be collected | PIU |

**Budget for LMP**

| S.No | Item | Cost |
|---|---|---|
| 1 | Labour compliance as per LMP | [redacted] |

**Annexure-4**

**LABOUR INFLUX MANAGEMENT PLAN**

| RISK | MITIGATION MEASURES | IMPLEMENTATION RESPONSIBILITY | MONITORING INDICATORS | MONITORING RESPONSIBILITY |
|---|---|---|---|---|
| Social and Community wellbeing | 1. Joint Meeting with the community by ULB officials and Elected members | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Economic and Livelihood Issues | 1. Skilled /Unskilled jobs for the Community members in the sub-project | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Accommodation /labour camp | 1. Ensure basic amenities are provided to the labourers( Toiltes,Water ,Kitchen facilities etc)<br>2. Daily briefing to the labourers | Contractor | • Risk identification report<br>• Proposed action/mitigation plan<br>• List of facilities in labour camp<br>• Details of labours | TSC/DPMU |
| Communicable Diseases | 1. Access to Medical Check-up | Contractor | • SOP for prevention of communicable disease | TSC/DPMU |

| | | | | |
|---|---|---|---|---|
| | 2.Aaresness to the laboures | | and health wellbeing on worksite and labour camp<br>• Report on medical check-up | |
| Crimes | 1. Intimation to the Local police about the camp | Contractor | Work site complaint register<br>Number of cases reported, and action taken | TSC/DPMU |
| Child Labour | 1. Ensure Adhar card of all labourers at the site | Contractor & TSC | • Number of child labour issues reported<br>• Data of labours | ULB/DPMU |
| Gender-based violence, including sexual harassment child abuse and exploitation | 1.Gender sensitisation briefing to the labourers | Contractor/TSC | • Number of cases reported<br>• Action taken report<br>• Number of cases resolved<br>• Time taken for resolving complaints | ULB/DPMU |
| Laour licences | To be ensured by the contractor | Contractor/PIU | Number of labours having licence | DPMU |

**Summary of SMP budget**

| S.No | SMP Activity | Cost |
|---|---|---|
| 1 | Labour Management Plan | [redacted] |
| 2 | Labour Influx Management Plan | [redacted] |
| 3 | Preventive GBV action plan | [redacted] |
| 4 | Citizen Engagement Plan | [redacted] |
| **Total** | | [redacted] |

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR

# DUMPSITE BIOMINING AND BIOREMEDIATION PALAPARAMBA, KOOTHUPARAMBA MUNICIPALITY



Submitted By:

Kerala Solid Waste Management Project

# PART A

# Environmental Impact Assessment

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## SUMMARY

### Introduction

The Koothuparamba municipality has an area of 16.76 Sq.km with 28 wards. The Solid waste generated from Koothuparamba ULB is 13.26 TPD. In Koothuparamba ULB there is an existing dumpsite at Ward 5 Palaparamba. Koothuparamba ULB did not possess a designated landfill site as mandated by the Solid Waste Management Rules of 2016. Consequently, unsegregated waste was disposed of in an unscientific manner. In order to promote a healthy and sustainable environment, it is imperative to undertake the remediation of the dumpsite.

### Subproject Description

The Biomining and Bioremediation at the Koothuparamba ULB dumpsite is proposed as part of the Kerala Solid Waste Management Project (KSWMP) with support from the World Bank and the Asian Infrastructure Investment Bank. The dumpsite situated in Ward 5 Palaparamba, covers a total area of 0.98 acres and contains a legacy waste quantity of 12,625.27 tons. The waste at the site is approximately 50 years old, with dumping activities started in 1973 and. Initially, the dumpsite served as a trenching ground for the disposal of sewage from pit latrines. The total volume of waste accumulated is approximately 15,102 cubic meters, and the dumpsite spans across an area of 0.98 acres.

- Status of Subproject Development at the time of EIA

The access road to the dumpsite is facilitated by a 5-meter-wide approach road in good condition, located in Palaparamba stretch. But premises internal roads are not in good condition. And within the premises, there is a operational MCF, RRF and organic waste composter units (windrow composting unit and vermin-composting unit).

- Technical Aspects

Following a comprehensive evaluation, the method or technique of Bio-mining with a goal of achieving 100% land reclamation and recovery is found to be the most suitable rem ediation approach, ensuring long-term sustainability and environmentally responsible treatment of legacy waste, leading to the complete remediation of the dumpsite. Based on the Feasibility

and site conditions, Mobile trommel machinery would be the most suitable option for for such a small site at Palaparamba. Koothuparamba. The optimal time frame for conducting the Biomining Process would be from December to April Months, a period characterized by lower rainfall levels as per climate data.

**Application of Regulatory and Guidance Framework**

In accordance with the SWM Rules of 2016, the selection of an appropriate method or technique for remediating a dumpsite should be determined through a feasibility study that considertechnical, financial and Environmental aspects complying with regulatory requirements (KSPCB/NGT). The formulation of the subproject adhered to the State/National and World Bank safeguards policies, both in its planning phase and will continue to do so during the implementation and monitoring stages. This commitment to compliance will be upheld by the ULB during the Project period.

**Baseline Environmental Scenario**

A detailed environmental baseline study was conducted for analyzing quality of air, groundwater, surface water, noise levels, and leachate characteristics. The preliminary Environmental Screening [Annexure -1] and the detailed assessment showed that this sub project falls under “E2” category. (Please note that suggestive environmental categorization of dumpsite biomining / bioremediation as per EMF for KSWMP is E1. However, considering the very small extent of the dumpsite, absence of any sensitive environmental feature in or around the site, short biomining period, and the overall positive impacts of the proposed development post mitigation measures; this is categorized as E2. At this stage, locations for disposal of biomined wastes is unknown, the subproject would be recategorized if the locations are near any sensitive areas. In case the biomining is clubbed with other multiple sites also, the overall categorization would be reconsidered)

An analysis has been conducted at the site to review and comprehend the physiography, climate, soil, cultural heritage, ecology, and biodiversity of the dumpsite. This assessment aims to identify potential impacts on the environment, human health, and biodiversity.

Additionally, a traffic assessment has been performed to analyze traffic patterns and movements during the project's implementation phase.

**Terrestrial Ecology:**

The site is situated outside of a forested region. The nearest Forests/Protected Areas, known as Kannavam Range Forest, are located approximately 12.4 kilometers away. Various indigenous flora and fauna species commonly inhabit the vicinity of the site.

*Dalbergia sissoo (sonokeling (Indian Rosewood)), Cinnamomum cassia (cassia) Pycnonotus cafer (*Red-vented Bulbul), *Acridotheres tristis (*common myna*), Ictinaetus malaiensis (*Black Eagle), *Eutropis carinata (*Brahminy Skink), *Funambulus tristriatus* (Jungle palm squirrel), *Artocarpus heterophyllus (Tree), Cyathula prostrate (Herb), Aporosa cardiosperma (Shrub). Ailanthus sp. (*Tree), and *Areca catechu (Tree),*

The species listed were not classified as Critically Endangered by IUCN. (International Union for Conservation of Nature)

**Air Quality:**

Air monitoring was conducted continuously for a 24-hour duration at all sites, and the obtained results were meticulously analyzed against the National Ambient Air Quality Standards of 2009. It is noteworthy that all measured pollutants' concentrations were found to be well within the permissible limits. Furthermore, no presence of hazardous or toxic gases was detected during the monitoring process.

**Water Quality:**

The monitoring of water quality was carried out at 3 locations for Ground water & 1 Location for Surface Water.

Groundwater samples were collected from three distinct locations, each within a radius of 200 meters from residences. The analysis of these samples revealed that all parameters examined fall within acceptable limits, with the exception of pH levels.

Surface water assessment indicates that the Anjarakandy River is located approximately 3.5 kilometers from the site. There is no connectivity for the leachate pathway to reach the river. Surface water sample had been taken nearby pond which is not connected with river.

**Noise Level:**

Sample for noise level monitoring were collected within the dumpsite to assess the current ambient noise levels. The results indicate that the noise levels observed are comfortably within the permissible limits. However, it shall be noted that there is no activity currently on site. And noise levels are expected to increase with biomining activity.

**Assessment of Risks/Impacts and Proposed Mitigation measures and Monitoring**

The anticipated impacts of the interventions proposed have been analyzed in detail and mitigation measures proposed. The Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) documents, which assess the potential environmental and social impacts of the proposed project, serve to identify potential risks, formulate mitigation measures and ensure compliance with environmental and social standards regulations. This dumpsite remediation project comprises an overview of the current environmental conditions within the project area. Furthermore, the report delineates the environmental baseline data, Disaster Management Plan, identification of sensitive receptors and a Fire Risk Assessment. Key environmental risks include leachate and storm water from the site impacting the nearby areas, odour (including gas), visual blight, flies & pests, storage and disposal of retrieved materials, fire, accidents & other disasters, and health and safety of workers. Possible future dumping of wastes after biomining is also a concern. Mitigation and management measures for these in line with mitigation hierarchy are included in the EMP.

Proposed mitigation measures are designed to address environmental and social impacts effectively, with the goal of minimizing negative consequences while maximizing positive outcomes. Additionally, this report encompasses an Environmental Management Plan (EMP) and a Social Management Plan (SMP), providing detailed strategies for the management of the project's environmental and social facets.

In addition, a detailed Environment Monitoring Plan and Social Monitoring Plan will outline the monitoring procedures to assess the efficiency of mitigation measures and guarantee adherence to environmental and social standards. To ensure seamless and timely execution, the dumpsite remediation subproject report also includes an Environmental and Social Budget. This ensures a sustainable and responsible bio-mining process that prioritizes the protection of the environment and the well-being of nearby communities throughout the waste remediation process.

**Implementation Mechanism & Budget**

The Bio-mining project, with the objective of achieving 100% land recovery, will be carried out exclusively through an outsourcing model. The biomining process will be conducted separately at each site. The bio-earth and coarse fraction segregated during the time of remediation are proposed to be used for filling low lying areas or can be used for agricultural land, after ensuring the desirable quality. If the land is found to be contaminated, proper remedial measures will be followed before utilizing for future facilities. The recyclables will be handed over to the authorized recyclers and the RDF is proposed to be handed over to the cement factories/boilers. The land will be restored to its pre-waste dumping condition, necessitating the complete removal of all legacy waste until it reaches the original land surface. Following the completion of the bio-mining process, the machinery and vehicles belonging to the implementing agency must be vacated within 7 days. The reclaimed land, free of any encumbrances, will then be transferred to the Urban Local Body (ULB).

The total budget proposed for environmental and social budget is [redacted]/- and including the social budget of [redacted]/-.

**Consultation & Disclosure**

A transect walk was also carried out to assess the social and-environmental characteristics in the vicinity of the dumpsite. To understand the social dynamics, demographic profile, livelihood patterns, social dynamics of the community and to understand the needs, concerns, and aspirations of the community, a transect walk was carried out on 03.06.2023,

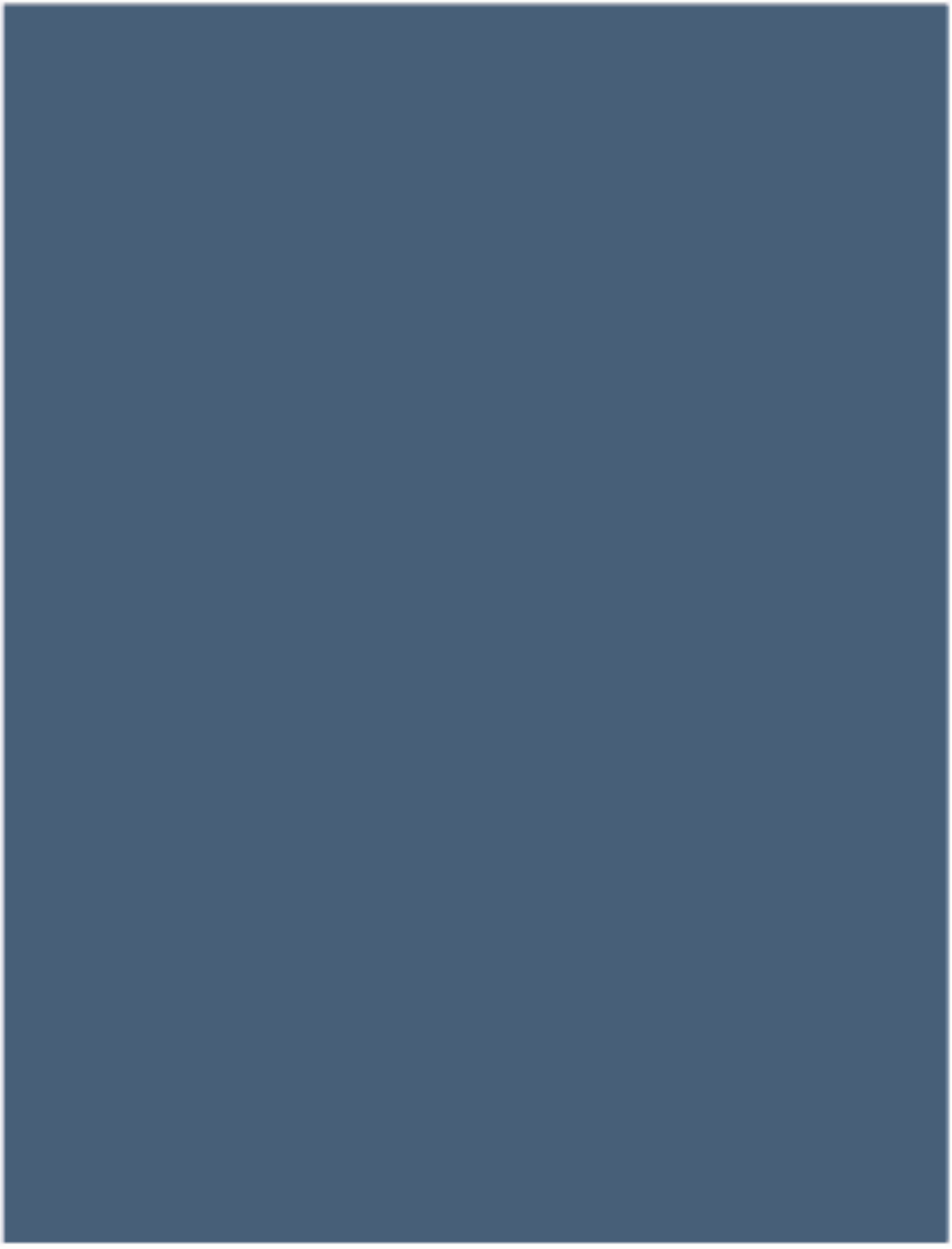
(Attendees – 12 nos) which was crucial for developing effective dumpsite remediation strategies that align with their priorities. The findings and recommendation of the transect walk is shown in the following table.

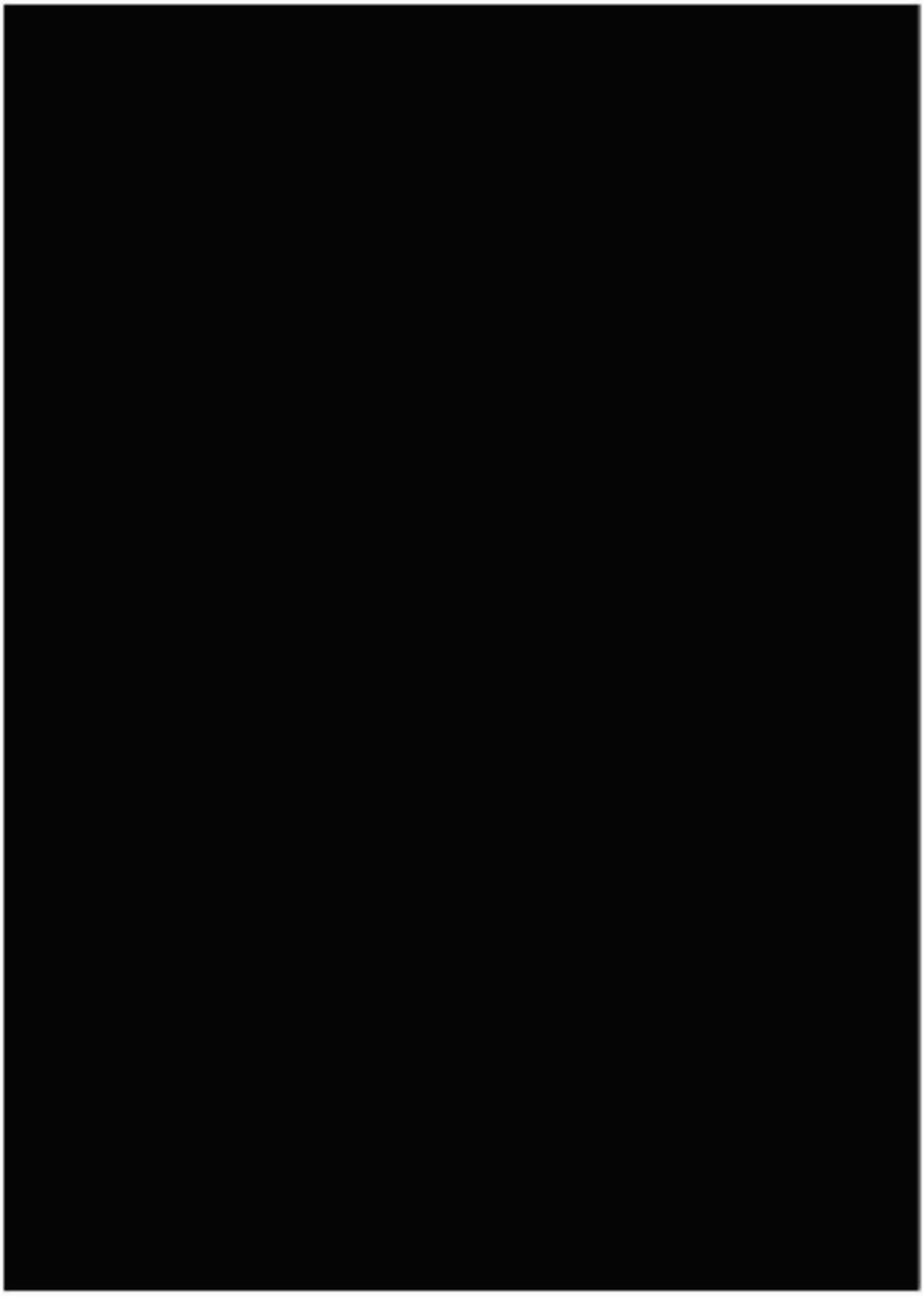
*Table 1 Findings and recommendation of the transect walk*

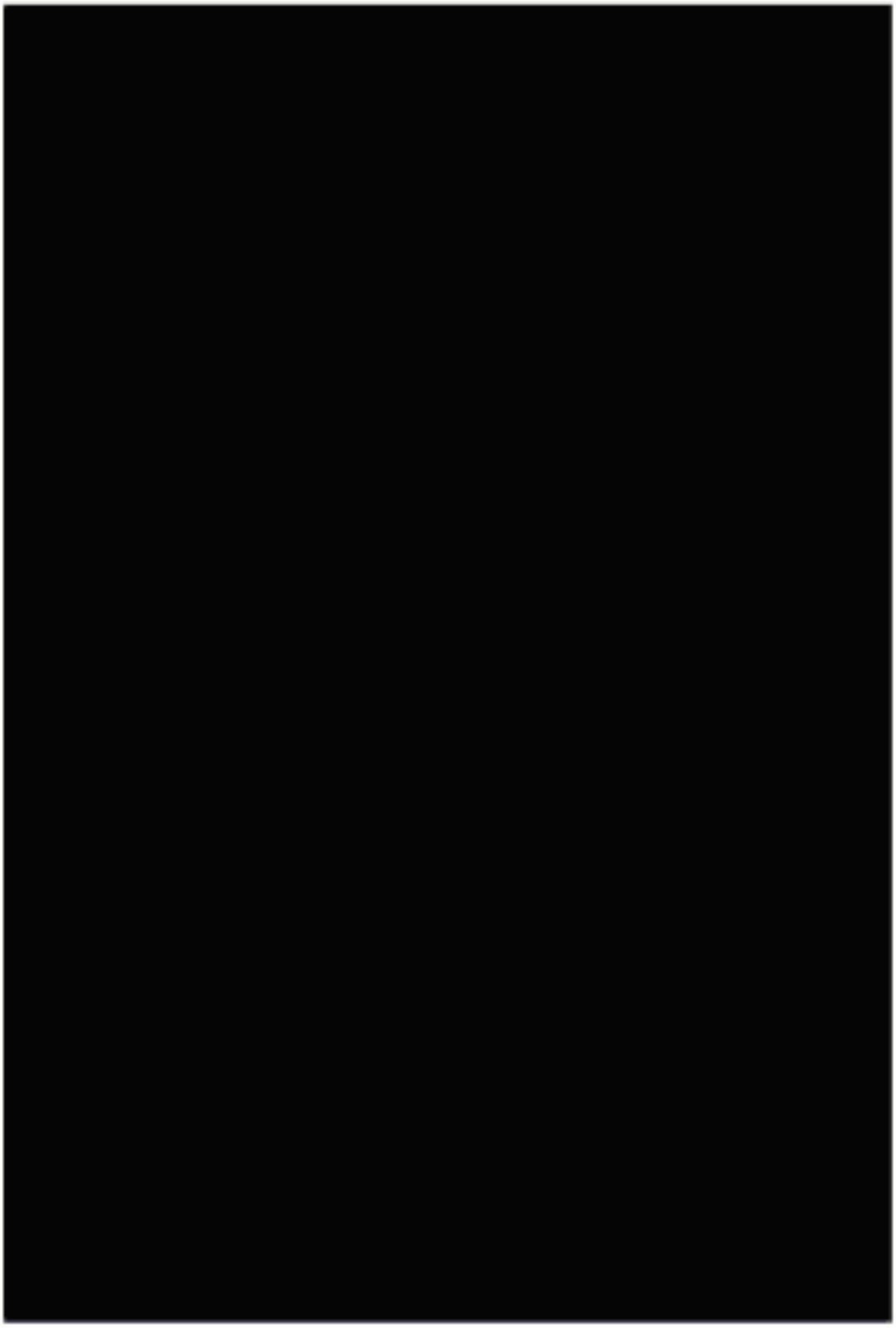
| S.No | Social risks | Findings and Recommendations |
|---|---|---|
| 1 | Presence of 20households and one other public utilities near (200m) the dumpsite. | a. Free movement of the residents needs to be ensured<br>b. Working hours of public utilities including shops and establishments may be restricted, that should not affect the livelihoods of the workers attached to these facilities |
| 2 | Sound pollution, health issues and foul smell most affects 20 families residing very close to the site (200m). | GRM cell under the ULB needs to be made operational. Stress management including counseling services to be ensured |
| 3 | Health risk of vulnerable groups residing near to the site which includes patients with breathing issues, pregnant women, PWDs, cancer patients, children below the age of two and elderly above the age of seventy-five. | Health issues may aggregate duringwork operations.<br>These factors should be considered strongly especially for all vulnerable groups |

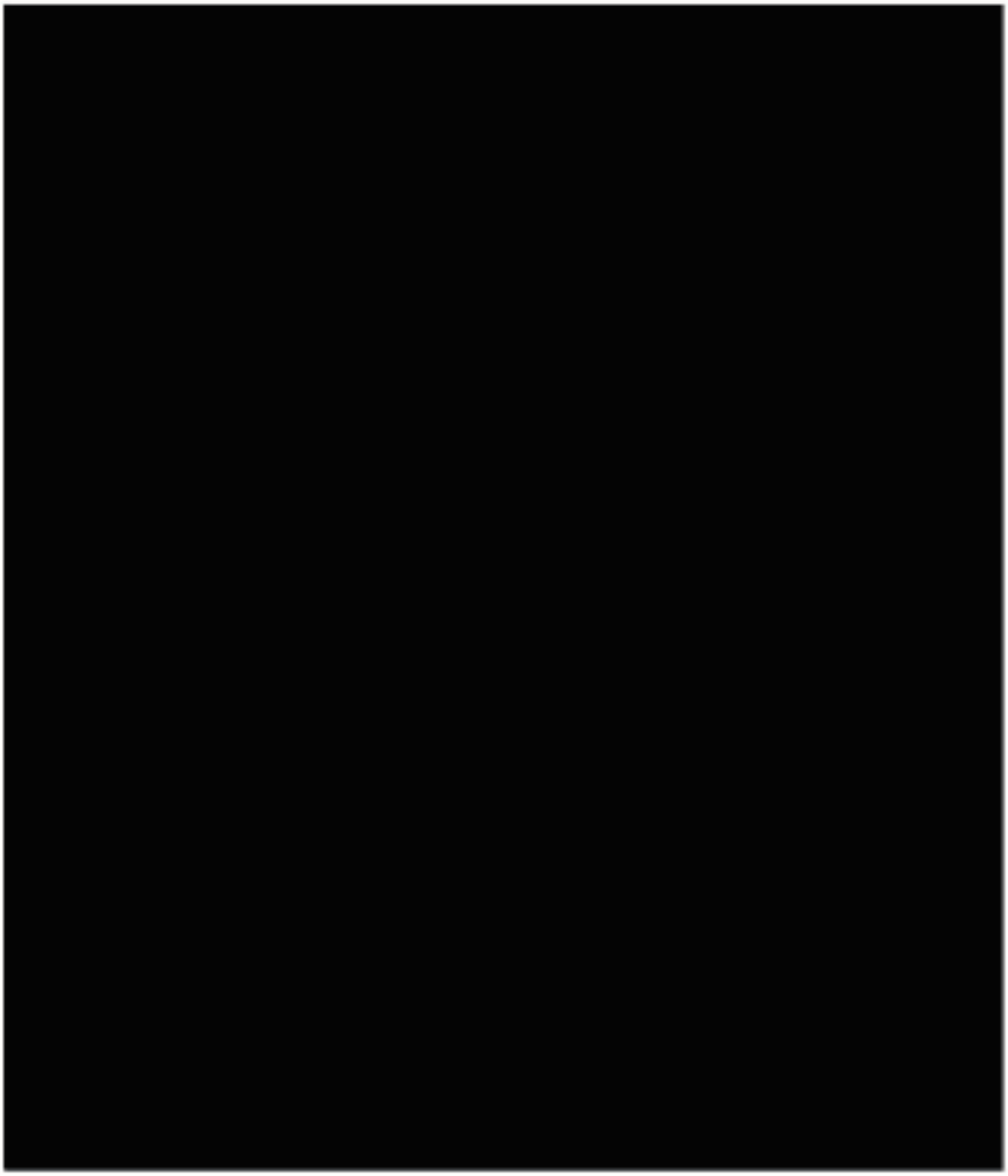
***Note: All the references to Social Impact Assessment and Social Management Plan may be referred to Part B- Social Impact Assessment which is a separate document attached along with this document.***

## Summary [Malayalam]









# 1. INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-Financing Framework agreement and as agreed Project Co-lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake biomining of multiple Legacy Waste Dumpsites in various districts. As per the Feasibility Study and methodology statement for implementing the subproject, proposed dumpsites for biomining are grouped into a single cluster. It is expected that one single contractor bids for one Cluster. However, bidding modality is yet to be finalized- whether as a single or multiple.

## 1.2 The rationale for the Proposed Sub-Project

Palaparamba dumpsite in Koothuparamba ULB at ward no.5 has a total waste quantity of 15,102 Tons, spreading over 0.98 acres. The site is located between Lat- 11°50'10.6"N and Long - 75°34'19.2"E and has an elevation of MSL +38 (m). During the monsoon season, the positioning of the dumpsite causes legacy waste to flow downhill affecting nearby residential areas. Koothuparamba ULB proposes biomining and bioremediation of the Palaparamba legacy waste dumpsite site under KSWMP supported by the World Bank and Feasibility Report has been prepared for this subproject. Considering the environmental and social impacts associated with legacy dumpsite biomining and bioremediation, it is proposed to

undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

### 1.3 Objectives and scope of Environmental& Social Impact Assessment (ESIA)

***Environmental Categorisation and Assessment:***

As per indicative categorization for dumpsite biomining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (4.87 acres) and waste spread (0.98 acres) and absence of environmentally sensitive features around, this sub-project is individually considered as E2, and EIA is prepared accordingly. Required monitoring and analysis will be carried out considering the possible impacts.

***Social Impact Assessment:***

Under this category social impact assessment is also a key factor to be considered. Accordingly, detailed assessment of the environmental and social impacts was carried out.

### 1.4 Proposed sub project details

*Table 2 Proposed Sub Project Details*

| Description | Details |
|---|---|
| Name of ULB | Koothuparamba |
| District | Kannur |
| Taluk | Thalassery |
| Total present population in the ULB | 34,501 |
| Name of the sub-project | Dumpsite Remediation at Palaparamba |
| Location of the sub-project | Koothuparamba ULB, Ward 5, Palaparamba |
| Total dumpsite area (in acres) | 4.89 |
| Total waste accumulated area (in acres) | 0.98 |
| GPS Co-ordinate of the Site | Latitude:11°50'10.6"N<br>Longitude:75°34'19.2"E |
| Legacy waste quantity | 15,102 cu.m |

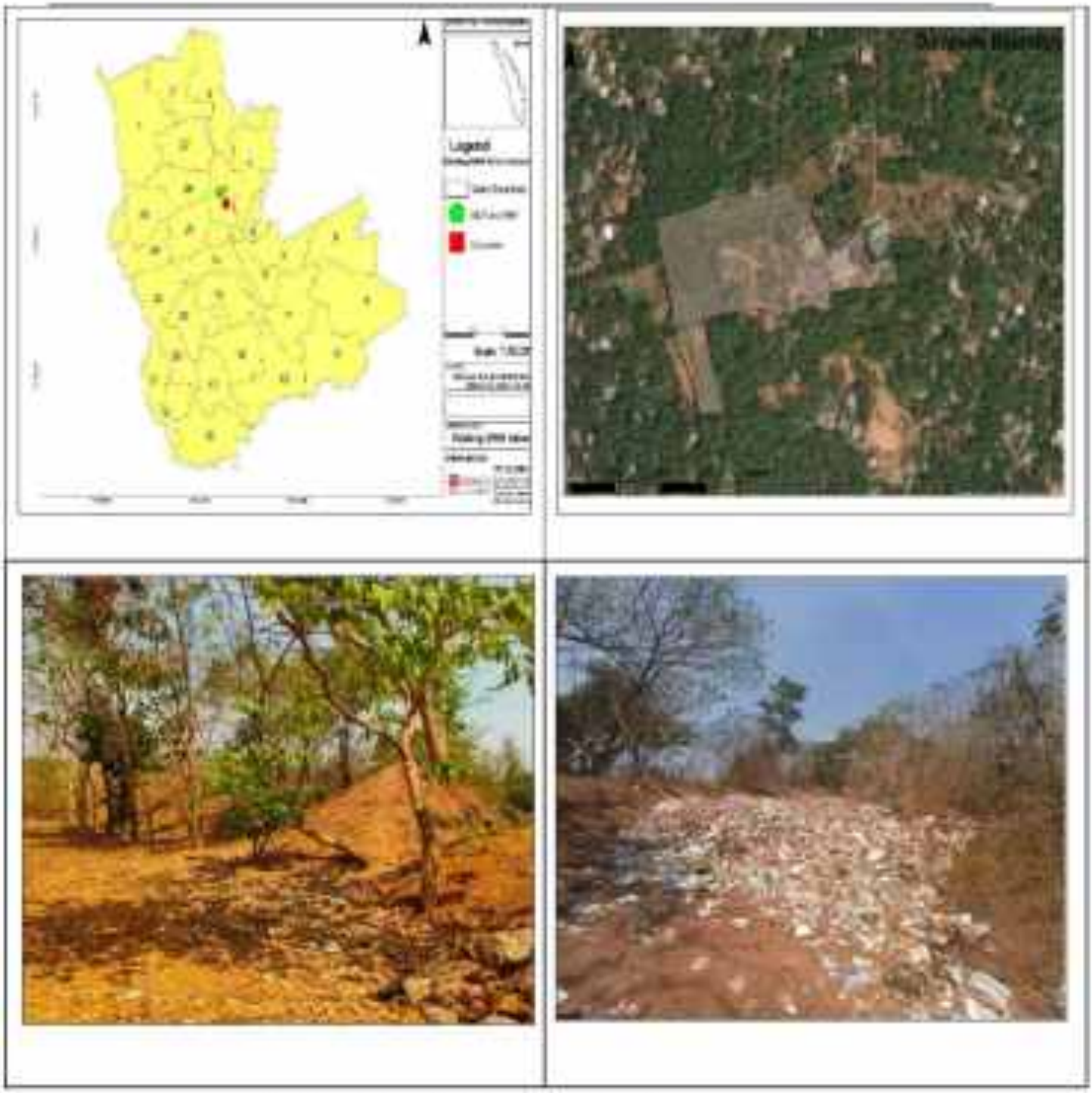



*Figure 1 Location of Koothuparamba dumpsite*

The technology proposed is Bio mining and the valuable fractions other than the bio earth & course fraction obtained from this process will be sold to authorized recyclers. The various phases in the biomining process (as per Legacy Waste biomining Guidelines of CPCB) are shown below.

*Table 3 Phases of Biomining*

| Phases of Bio-mining | |
|---|---|
| **Phase 1:** Stabilization | The legacy waste is formed into equal-sized windrows and which are turned frequently, bio-culture is added and de-odourizer (an odour-controlling agent) sprayed. This phase removes stench, reduces moisture and eliminates pathogens. |
| **Phase 2:** Sorting & Segregation | In this phase, stabilized legacy waste is sorted/segregated into bio earth, recyclables, refused derived fuel (RDF) and C&D through series of various sizes of Trommels/circular rotatory sieves and manpower. |
| **Phase 3:** Disposal & Utilization | In this phase, the non-combustible fractions such as soil and stones are disposed of for further processing into finer aggregates or for earth filling. The combustible fractions are called refuse-derived fuel (RDF) are sent for co-processing in cement industries. |

**1.5 Site Management Plan**

The plan aims to minimize potential adverse impacts on sensitive receptors while maximizing the recovery of valuable resources and promoting site restoration.

Mobile machineries will be used for biomining of Koothuparamba dumpsite and they do not require a separate area for erection. The waste will be excavated and directly fed into mobile screeners for processing. This approach minimizes the need for additional infrastructure and optimizes the efficiency for the biomining process. The proposed plan is as follows

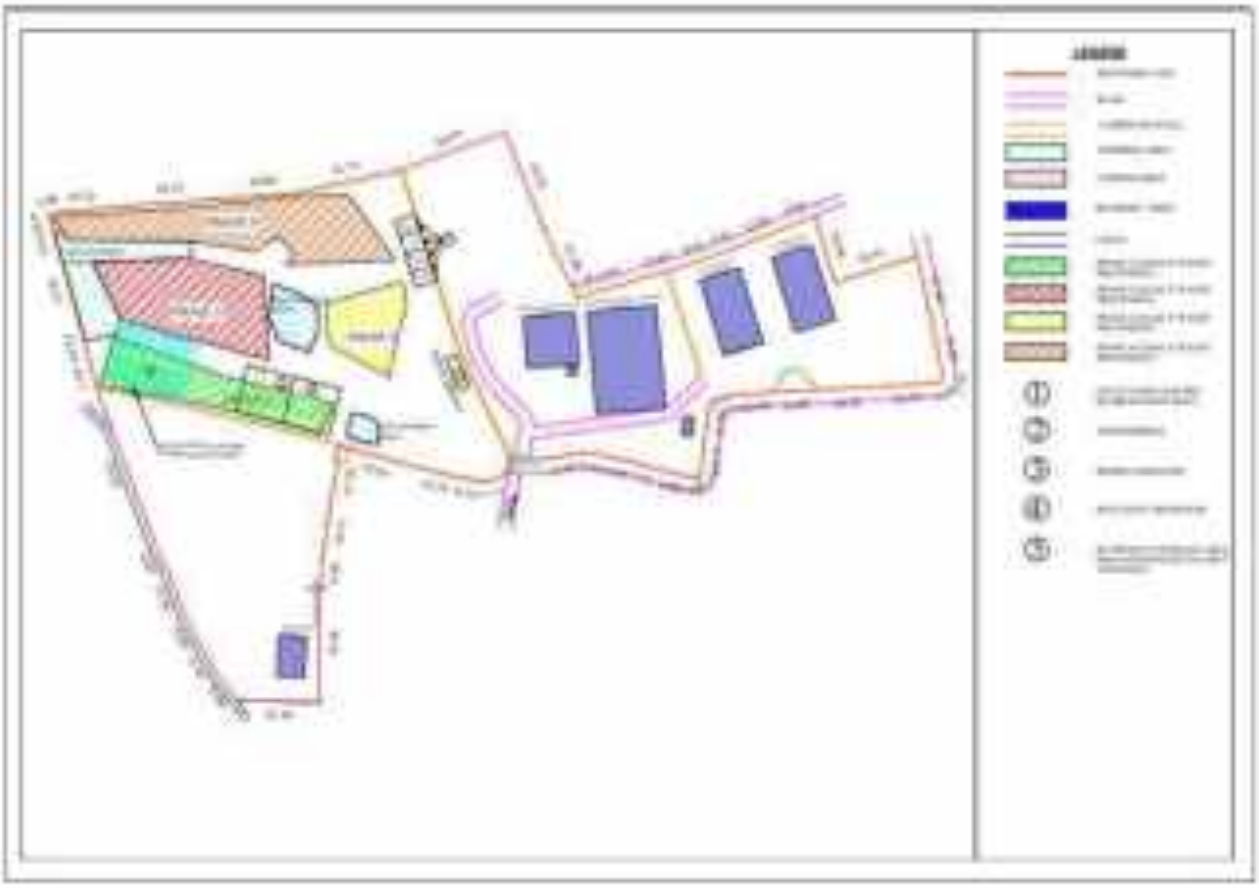


*Figure 2.Site Management Plan for Keezhuparumba*

## 1.6 Structure of the report

*Table 4 Structure of the report*

| Chapter | Structure |
|---|---|
| 1 | Introduction |
| 2 | Policy and Regulatory Framework |
| 3 | Environment and Social baseline |
| 4 | Analysis of Alternatives (technology and site) |
| 5 | Assessment of Environmental and Social Risks and Impacts |
| 6 | Environmental and Social Management and Monitoring Plan |
| 7 | Institutional Arrangements |
| 8 | Public consultation and Information Disclosure |

## 2.1 National, State Legislations and Technical Guidelines related to environmental and social aspect of dumpsite remediation

*Table 5 Applicable rules and regulations for Kaathuparambu dumpsite remediation*

| S. No | Rules and Regulations | Relevance |
|---|---|---|
| 1 | The Motor Vehicle Act. 1988 | All vehicles used for installation and operation will need to comply with the provisions of this act and should have valid Pollution Under Control Certificate. |
| 2 | Authorization from PCB for storing Hazardous material like diesel for DG sets as per Hazardous and Other Wastes (Management & Trans boundary Movement) Rules, 2016 | Hazardous waste (used oil from DG Sets) is likely to be generated during the erection and operation stage. Hence, authorization under the purview of the rule shall be requiring. |
| 3 | Labour Act. | Occupational safety and health administration. |
| 4 | Solid Waste Management Rules, 2016 (MSW Rules) | To operate the mobile Bio mining plant, it is necessary to follow the existing MSW rules. |
| 5 | The Water (Prevention and Control of Pollution) Act, 1974 | Consent to Establish and Consent to Operate to be obtained during the construction phase and operation of waste recycling/disposal facilities |
| 6 | The Air (Prevention and Control of Pollution) Act. 1981 | Consent to Establish and Consent to Operate to be obtained during the construction phase and operation of waste recycling/disposal facilities |
| 7 | safety of the workers as per the ILO Convention No. 62 | Safety aspects |
| 8 | NOC from fire department | Safety aspects |
| 9 | Tree felling permission:<br>If felling of trees as defined in Kerala Preservation of Trees Act, 1986 | If any tree needs to be cut or replanted concerned permission is required from Forest Dept. Government of Kerala. The ULB will take the necessary permission. |
| 10 | NGT guidelines upto date | Relevant to the subproject to be considered for the successful implementation of the project. |

| S. No | Rules and Regulations | Relevance |
|---|---|---|
| 11 | Building and Other Construction Workers (Welfare Cess Act) 1996, | Discusses Health and Safety and environmental aspects associated with construction and allied works |
| Other Applicable Rules | | |
| 12 | Solid Waste Management Rules, 2016 (SWM Rules) | |
| 13 | Plastic waste Management Rules, 2016 | |
| 14 | Construction & Demolition, Waste Management Rules, 2016 | |
| 15 | Batteries (Management and Handling) Rules, 2001 | |
| 16 | E-Waste (Management) Rules, 2016 | |
| 17 | SBM-Urban Advisory on Landfill Reclamation, CPHEEO, June 2020. | |
| 18 | Kerala Municipality Act, 1994 & Rules | |
| 19 | Hazardous & Other Wastes (Management And Transboundary Movement) Rules, 2016 | |
| 20 | The Operational Policies (Safeguards) of the World Bank and the Environmental and Social Management Framework | |
| 21 | Bio-medical Waste (Management & Handling) Rules, 1998 | |

## 2.2The World Bank Safeguards Policies

*Table 6 World Bank Safeguard Policies*

| S.No. | WB Policy | Safeguard policy applicable | Description |
|---|---|---|---|
| 1 | Environmental Assessment (OP/BP 4.01) | Yes | The project has potential impacts and pose risks to various environmental factors during the implementation phase. Consequently, this policy is implemented, necessitating a structured approach to safeguard management for risk mitigation in alignment with regulatory requirements, and Environmental and Social Management Framework (ESMF). |
| 2 | Natural Habitats (OP/BP 4.04) | Yes | Though the project will not support any activities that involve conversion or degradation of natural habitats; but in turn by improving SWM in ULBs; ensure their long-term sustenance by preventing |

| S.No. | WB Policy | Safeguard policy applicable | Description |
|---|---|---|---|
| | | | impacts due to waste, leachate, and landfill gas generation. |
| 3 | Pest Management (OP 4.09) | Yes | Considering the possible pest related issues as the project deals with wastes and improvements to dump sites, OP 4.09 Pest Management is triggered. As per this policy the banned pesticides/insecticides listed by the Nation / State and the World Health Organization (WHO) should not be used in the project, and as much as possible Integrated Pest Management Options shall be followed |
| 4 | Physical Cultural Resources [PCR] (OP 4.11) | Yes | The proposed project will not support any activities that could potentially harm nearby cultural heritage, archaeological sites and physical resources valuable to the community |

### 3.1 Project location of the site

The Koothuparamaba municipality has a dumpsite situated in Ward 5 at Palaparamba, with GPS coordinates Latitude:11°50'10.6"N, Longitude:75°34'19.2"E. The total quantity of legacy waste is 15,102 cum. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes.

*Table 7 Sensitive Receptor around the Dumpsite*

| S.No | Sensitive Receptors | Distance |
|---|---|---|
| 1 | Residential buildings | 20 households are located within 200 m radius of the dumpsite |
| 2 | Educational institutions such as Govt. HSS-Koothuparamba. | 730.00 m |
| 3 | Nearest pond | 180.00 m |
| 4 | Anjarakandy river | 3.5 Km |

### 3.2 Methodology for Environmental Baseline studies

Baseline Study in ESIA process usually includes data collection and analysis on various aspects of the project area, such as: Physical Environment (e.g., topography, geology, soil, water, air quality, and climate). Biological Environment (e.g., flora and fauna, habitat, biodiversity, and ecological processes). The overall methodology of ESIA

1) Scoping, Environmental Screening, Exclusion and Categorization
2) Environmental Baseline study like analysis of Air, Water, Soil and Noise/Vibration and impacts on biodiversity, workers and people around
3) Environmental Impact Assessment
4) Avoidance of adverse impacts, minimization, mitigation, and management measures
5) Environmental Management Plan (EMP)
6) Environmental Monitoring Plan (EMoP)
7) Budget for implementation of EMP and EMoP

The below table indicates the environmental attributes and frequency of monitoring

*Table 8 Environmental Attributes*

| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| 1 | Meteorology | Temperature humidity and rainfall | - | Study area | Data collected from IMD |
| 2 | Ambient air quality | $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$, VOCs | A1 – 11°50'10.14 "N, 75°34'18.95"E A2 – 11°50'10.14"N, 75°34'17.45"E | 2 | 24 hourly samples |
| 3 | Noise levels | Noise levels in dB(A) Leq | 11°50'10.27"N, 75°34'18.95"E | 1 | Once |
| 4 | Surface water quality | Physical, chemical and biological parameters including pH, temperature, turbidity, magnesium hardness, total alkalinity, chlorides, sulphates, fluoride, Copper, DO, BOD, COD, salinity, Zinc, Lead, Arsenic. | 11°50'08.06"N, 75°34'23.08"E | 1 | Once |

| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| 5 | Groundwater quality | Physical, chemical and bacteriological parameters including pH, temperature, turbidity, magnesium hardness, total alkalinity, chlorides, sulphates, fluoride, Copper, DO, BOD, COD, salinity, Zinc, Lead, Arsenic. | G1- 11°50'09.32"N, 75°34'21.18"E<br><br>G2- 11°50'09.55"N, 75°34'24.80"E<br><br>G3- 11°50'12.69"N, 75°34'23.08"E | 3 | Once |
| 6 | Leachate | pH, BoD, CoD, TSS, TDS, Fluoride, Cyanide, Nickel, Cadmium, Lead, Copper, Mercury, Zinc | L1- 11°50'10.9"N 75°34'18.7"E | 1 | Once |
| 7 | Biological environment | Existing flora and fauna | - | Study Area | Through field visits and substantiated through secondary data sources. |

| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| 8 | Soil characteristics | Physical, chemical and biological parameters to assess agricultural and afforestation potential including pH, Total Hardness, Nitrites, Phosphates, Organic matter, Fluorides, Total Iron, Nickel, Copper and Lead, TOC, Permeability. | - | - | Once |
| 9 | Land use/land cover | Land use for different land use Classifications. | - | Study Area | Land use / Land Cover Analysis using satellite imaging and GIS Technique |
| 10 | Socio-economic Environment | Socio-economic characteristics, population statistics existing amenities and quality of life | - | Study Area | Based on field survey and data collected from Census of India |

### 3.3 Existing Facilities on site and Environmental Audit

There is a functional MCF, RRF and organic composter units (Windrow Composting and Vermi-composting) for dry and wet waste present on a part of the Palaparamba dumpsite, Koothuparamba.

The MCF, RRF and composting units are not supported under KSWMP under this subproject. However, an environmental audit of the facility is important as this is an associated facility to which organic waste treatment mechanisms and some recyclables may be channelized to and is situated at the same site and might be impacted by the booming activities.

*Table 9 Environmental Audit of MCF, RRF and Organic waste treatment facilities*

| S. No | Aspects | Remarks |
|---|---|---|
| **A** | **MCF** | |
| 1 | Structural Characteristics | Area - 276 (in Sqm)<br>Buffer/setback around the MCF – 60 mtr (Distance from waste pile of dumpsite)<br>Roof: Tin shed (Steel) Roofing<br>Floor: Concrete Flooring<br>Walls: Brick wall and Mesh<br>Doors & windows: Available<br>There will be the dust emission and odour can impact the MCF and other facilites in the same premises. |
| 2 | Functional Characteristics | Activities in the MCF:Storing of waste (handling by private agency – Ibrahim Agency)<br>Materials and condition of stacking: NBDW<br>Activities spilling out onto the dumpsite:NIL<br>Access to the MCF:Separate access for MCF & Dumpsite<br>No: of workers: 3 (of Ibrahim Agency) |
| 3 | Facilities | Parking area-120 sqm<br>Loading/unloading area-1200 sqm<br>Storage room & area:NIL<br>Worker snack/rest areas:NIL<br>Worker / other washrooms & sewerage:NIL<br>Water supply for Cleaning, Washroom:Available<br>Greenbelt:Nil |
| **B** | **RRF** | |
| 1 | Structural Characteristics | Area - 276 (in Sqm)<br>Buffer/setback around the RRF – 40 mtr (Distance from waste pile of dumpsite) |

| S. No | Aspects | Remarks |
|---|---|---|
| | | Roof: Tin shed (Steel) Roofing<br>Floor: Concrete Flooring<br>Walls: Brick wall and Mesh<br>Doors & windows: Available<br>There will be the dust emission and odour can impact the RRF facility. |
| 2 | Functional Characteristics | Activities in the RRF: Waste segregation (by private agency – Ibrahim Agency)<br>Materials and condition of stacking: NBDW<br>Activities spilling out onto the dumpsite:NIL<br>Access to the MCF: Separate access for RRF & Dumpsite<br>No: of workers: 3 (of Ibrahim Agency) |
| 3 | Facilities | Parking area-120 sqm<br>Loading/unloading area-1200 sqm<br>Storage room & area: NIL<br>Worker snack/rest areas: NIL<br>Worker / other washrooms & sewerage: NIL<br>Water supply for Cleaning, Washroom: Available<br>Greenbelt: Nil |
| C | **Windrow Composting Unit** | |
| 1 | Structural Characteristics | Area - 600 (in Sqm)<br>Buffer/setback around the Windrow Composting Unit – 10 mtr (Distance from waste pile of dumpsite)<br>Roof: Tin shed (Steel) Roofing<br>Floor: Concrete Flooring<br>Walls: Brick wall and Mesh<br>Doors & windows: No doors and windows<br>There will be the dust emission and odour can impact the Windrow Composting Unit facility. |
| 2 | Functional Characteristics | Activities in the unit:BDW decomposition will be done after fully construction (under construction)<br>Materials and condition of stacking: BDW<br>Activities spilling out onto the dumpsite: NIL<br>Access to the windrow composting unit:Separate access for Windrow composting unit& Dumpsite<br>No: of workers: NIL (currently) |
| 3 | Facilities | Parking area- 200 sqm<br>Loading/unloading area-2000 sqm<br>Storage room & area: NIL<br>Worker snack/rest areas: NIL<br>Worker / other washrooms & sewerage: NIL |

| S. No | Aspects | Remarks |
|---|---|---|
| | | Water supply for Cleaning, Washroom: Available<br>Greenbelt: Nil |
| D | **Vermicomposting Unit** | |
| 1 | Structural Characteristics | Area - 217 (in Sqm)<br>Buffer/setback around the Vermicomposting Unit – 7 mtr (Distance from waste pile of dumpsite)<br>Roof: Tin shed (Steel) Roofing<br>Floor: Concrete Flooring<br>Walls: Brick wall and Mesh<br>Doors & windows: Available<br>There will be the dust emission and odour can impact the treatment facility. |
| 2 | Functional Characteristics | Activities in the unit: BDW decomposition but currently not functional<br>Materials and condition of stacking: BDW<br>Activities spilling out onto the dumpsite: NIL<br>Access to the Vermi composting unit: Separate access for Vermi composting unit& Dumpsite<br>No: of workers: NIL |
| 3 | Facilities | Parking area- 200 sqm<br>Loading/unloading area-2000 sqm<br>Storage room & area: NIL<br>Worker snack/rest areas: NIL<br>Worker / other washrooms & sewerage: NIL<br>Water supply for Cleaning, Washroom: Available<br>Greenbelt: Nil |

### 3.4 Analysis of Environmental Baseline

*Table 10 Baseline Condition of Koothuparamba Dumpsite*

| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| 1 | Topography | The elevation of the Palaparamba site is MSL +38(ft), gentle. The land falls under midlands of Kerala. Soil is predominantly lateritic in nature. The legacy waste is spread over an area of 0.98 acres with an average height of 5.5 m, having a portion of the dumpsite which is 15,102 cum of waste being capped. In accordance with the | Leachate from the dumpsite drains out to North and south both side, through a natural slope to residential areas. |

<table>
<tr><th>S No</th><th>Environmental Aspect</th><th>Discussion on Baseline Scenario</th><th>Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject</th></tr>
<tr><td></td><td></td><td>directive from the National Green Tribunal (NGT), the biomining process is mandated to remediate all deposited waste within the premises, encompassing both current and pre-existing accumulations.</td><td></td></tr>
<tr><td>2</td><td>Climate</td><td>Koothuparamba site falls within the tropical to sub- tropical climatic region. The maximum temperature in the region varies almost between 26.4°C to 31.5°C and minimum temperature ranges from 21.2°C to 25.0°C. The average annual rain fall is 238 mm.</td><td>Rains are heavy, and the site is at an elevated draining out of stored waste and leachate during dumpsite biomining & bioremediation works,<br>The biomining project has been scheduled during the off-season for rainfall in anticipation of reduced precipitation.</td></tr>
<tr><td>3</td><td>Hydrology/Hydrogeology & Soil</td><td><table><tr><th>Pre-monsoon (m) *</th><th>Post-monsoon (m) *</th><th>Avg. Fluctuation (m)</th></tr><tr><td>7.15</td><td>5.60</td><td>1.55</td></tr></table>*Groundwater level*</td><td>Lateritic soil is porous and may lead to contamination of nearby wells. Hence, any waste below 5.5 m depth need to be remediated; and adequate measures are necessary to collect and manage leachate during all times</td></tr>
<tr><td>4</td><td>Forests and Ecology</td><td>Site is not located in forest area. Distance to nearest A variety of flora and fauna is observed near dumpsites. Due to the organic contents, mainly dogs, rodents and flies are seen near dumpsite. Also, crow, egrets, and other birds are seen feeding on the wastes. Some of the common flora and fauna found near the site.<table><tr><th>S. no</th><th>Scientific name</th><th>Common Name</th><th>Type</th></tr><tr><td>1</td><td>Dalbergia sissoo</td><td>Indian Rosewood</td><td>Flora [Tree]</td></tr><tr><td>2</td><td>Acridotheres tristis</td><td>Common Myna</td><td>Fauna [Bird]</td></tr></table></td><td>The species listed were not classified as Critically Endangered by the IUCN. (INTERNATIONAL UNION FOR CONSERVATION OF NATURE)</td></tr>
</table>

| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | | 3 *Ictinaetus malaiensis* Black Eagle Fauna [Bird]<br>4 *Eutropis carinata* Brahminy Skink Fauna [Reptiles]<br>5 *Funambulus tristriatus* Jungle palm squirrel Fauna [Mammals]<br>6 *Artocarpus heterophyllus* Moraceae Flora [Tree]<br>7 *Cyathula prostrate* Amarantha ceae Flora [Herb]<br>8 *Aporosa cardiosperma* Euphorbia ceae Flora [Shrub]<br>9 *Ailanthus sp.* Simarouba ceae Flora [Tree]<br>10 *Cinnamomum cassia* Cassia Flora [Tree] | |
| 5 | Socio Economic Aspects | About 20 households residing within the 200m vicinity who are from middle-income and low-income group families. The primary information on socio-economic profiles is collected from the ULB documents and through field visits. Families residing near to the dumpsite, in the vicinity of 200m, fall in different socio income groups. Out of the total households, 5 HH falls under MIG, and the remaining 15 HH falls under LIG.<br>Currently, there is no system in place for leachate drains or management because biodegradable waste was not dumped at site. However, during biomining activities, provisions for drains and leachate management will be established. | The dumpsite remediation process is anticipated to pose social risks, including pollution of food and beverages in nearby establishments and potential health issues for local residents, workers, Labourers, and students. A Social Management Plan, based on social screening and transect walk findings, is essential to mitigate these risks. Furthermore, the proposed remediation will have a positive impact on nearby residents, as it will lead to the removal of legacy waste, improving both environmental and social conditions. |
| 6 | Land use, Development | Surrounding landuses are mostly residential. The working MCF, RRF and two units of organic waste composter are | Odour, leachate and visual impacts on the surrounding landuses |

| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | Pattern and Key Projects | available at site. There are no structural damages in this building. | (residential, employees of industries and shopkeepers) and MCF, RRF and two units of organic waste composter. |
| 7 | **Infrastructure and Services** | | |
| 7.1 | Traffic and Transportation | A detailed incremental load by vehicles during the operation phase is assessed and given under the traffic assessment report. Through assessment it is identified additional 9.4 trucks/day will be the traffic load due to the activity. | The implementing agency shall ensure staggering of the traffic movements from site considering peak hours/school timings. Also, nighttime vehicular movements can be implemented More accurate information shall be available once Contractor is being onboarded. EIA to be updated by the contractor based on his work plan |
| 7.2 | Water Supply<br>a) Surface water<br>b) Ground Water | A) Surface water: Anjarakandi river is 3.5km from the site. There is no water connectivity from the site to river.<br>Sample collected from 1 site nearby pond with the aerial distance of 180 m and results found – all parameters are well within limits except BoD.<br>B) Ground Water collected from 3 different locations (Residences within 200m radius)– all parameters are well within limits except for pH. | Site Drainage & leachate Impacts due to of biomining activity (esp during any seasonal rain) is important with respect to nearby soil & water environment |
| 7.3 | Drainage, Sewerage and Sanitation | Region has an unplanned network of drains eventually leading to - Anjarakandi River and there is no water connectivity from the site to river<br>Leachate samples collected at site, showed BOD value exceeding the limit and all other parameters were within limits | |

| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| 7.4 | Air Quality | Air Samples collected from 2 locations within the dumpsite and results found to be well within the permissible Limits. | |
| 7.5 | Noise Level | Noise Level monitoring samples collected within the dumpsite in order to identify the present noise level and results found well within permissible limit | Proper remedial measures for increased noise level shall be ensured by the contractor while bio mining activity |

### 3.5Description of Environmental Parameters

Under this baseline environmental attributes are arrived at after analysis of samples taken from the dumpsite and surroundings viz ground water, surface water, Noise level and air.

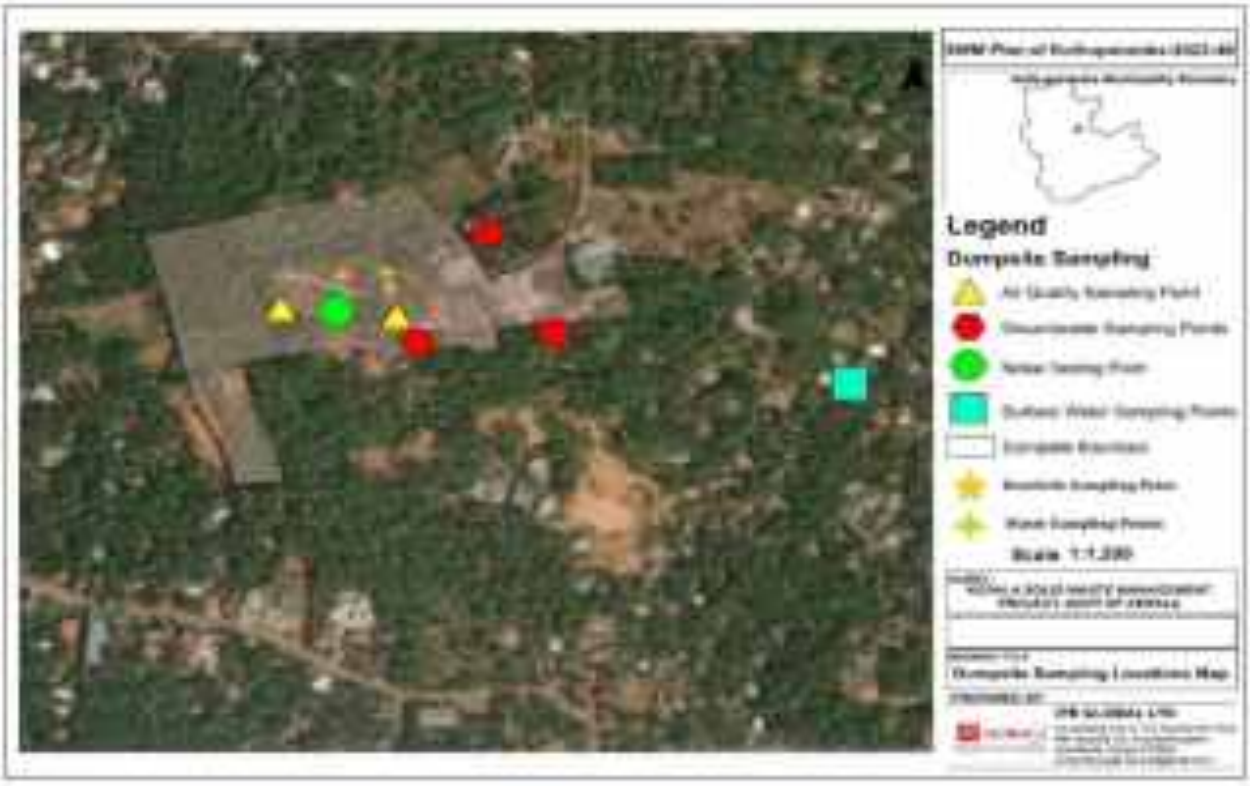



*Figure 3 Sampling location indication*

The map showing sampling locations and the analysis with observations are given below

**Distance of the sampling locations**

*Table 11 Distance of Sampling locations*

| S.No. | Description | Direction | From Centre of the dumpsite(m) | From Boundary of the dumpsite (m) |
|---|---|---|---|---|
| 1 | Surface Water | East | 450 | 180 |
| 2 | Ground water-1 | Centre | Within the boundary | |
| 3 | Ground water-2 | North | 158 | 20 |
| 4 | Ground water-3 | South | 200 | 10 m |
| **Note:** Air and Noise Monitoring are monitored inside the Yard | | | | |

**3.6 Identification of sampling location:**

*Table 12 Identification of sampling location*

| S.No | Description | Place identified | Justification |
|---|---|---|---|
| 1 | Air sampling (2 Locations) | Inside the dumpsite | As per the wind rose diagram, the direction and speed of the wind are determined and based on the existing wind rose data, the air sampling sites were fixed at two locations inside the premises. |
| 2 | Noise (1 Location) | Inside the dumpsite | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. The adjacent MCF, RRF and organic processing units. |
| 3 | Surface water (1 Location) | Surface water near to the dumpsite [stream] | Considering the sites geographical features, it is situated in a predominantly flat terrain, But Both North and south direction possesses a probable risk of leachate runoff, which could result in the contamination of soil. But it never end up with surface water . |
| 4 | Ground water (3 Locations) | 3 wells identified near the dumpsite area | Considering the sites geographical features, it is situated in a predominantly flat terrain, But Both North and south direction possesses a probable risk of |

| S.No | Description | Place identified | Justification |
|---|---|---|---|
| | | | leachate runoff, which could result in the contamination of ground water.<br>Based on the possible infiltration and slope direction the ground water samples were collected and the two samples were collected from outside the dumpsite boundary and one sampling location was inside the dumpsite(and two from well and one from borewell). |

### 3.7 Sampling Methodology

*Table 13 Sampling methodology*

| S.No | Description | Method |
|---|---|---|
| 1 | Air sampling | Calibrated High Volume Sampler, Calibrated rotameter & calibrated Dry gas maters and sampling locations selected based on wind rose and impacts on surrounding land uses. |
| 2 | Noise | Calibrated sound level meter and sampling locations selected based on highest noise level on site and impacts on surroundings |
| 3 | Ground water | Water collected in polyethylene and sampling locations selected based on leachate and run off flow and impacts on surroundings |
| 4 | Surface water | Water collected in polyethylene bottles and sampling locations selected based on leachate and run off flow and impacts on surrounding surface water bodies and drains (line sources of pollution) used be communities |
| NOTE: Sampling Photographs added as Annexure-C in the FR report | | |

### 3.8 Site Connectivity

The Palapparamba dump site is located in Ward No. 5 of Koothuparamba Municipality. The site is at a distance of 2 km from the State Highway 30. The access road of 500m is of 6-meter width.

### 3.9 Traffic Assessment

Traffic assessment refers to the process of evaluating and analyzing the flow of vehicles, pedestrians, and other modes of transportation on roadways, intersections, or specific areas. This assessment helps in understanding current traffic conditions, identifying potential issues, and developing appropriate strategies to improve traffic flow, safety, and efficiency.

**Traffic Load**

The access road to dumpsite is Koothuparamba road which is 6 m width. Considering 90 days of operation phase the trips are planned and the inward & outward of the vehicle to be made during off peak hours.

To promote safety and avoid traffic congestion, it is recommended to impose restrictions on the movement of vehicles used for the Biomining process. These restrictions should be enforced one hour prior to the commencement of school hours and one hour after the conclusion of school activities.

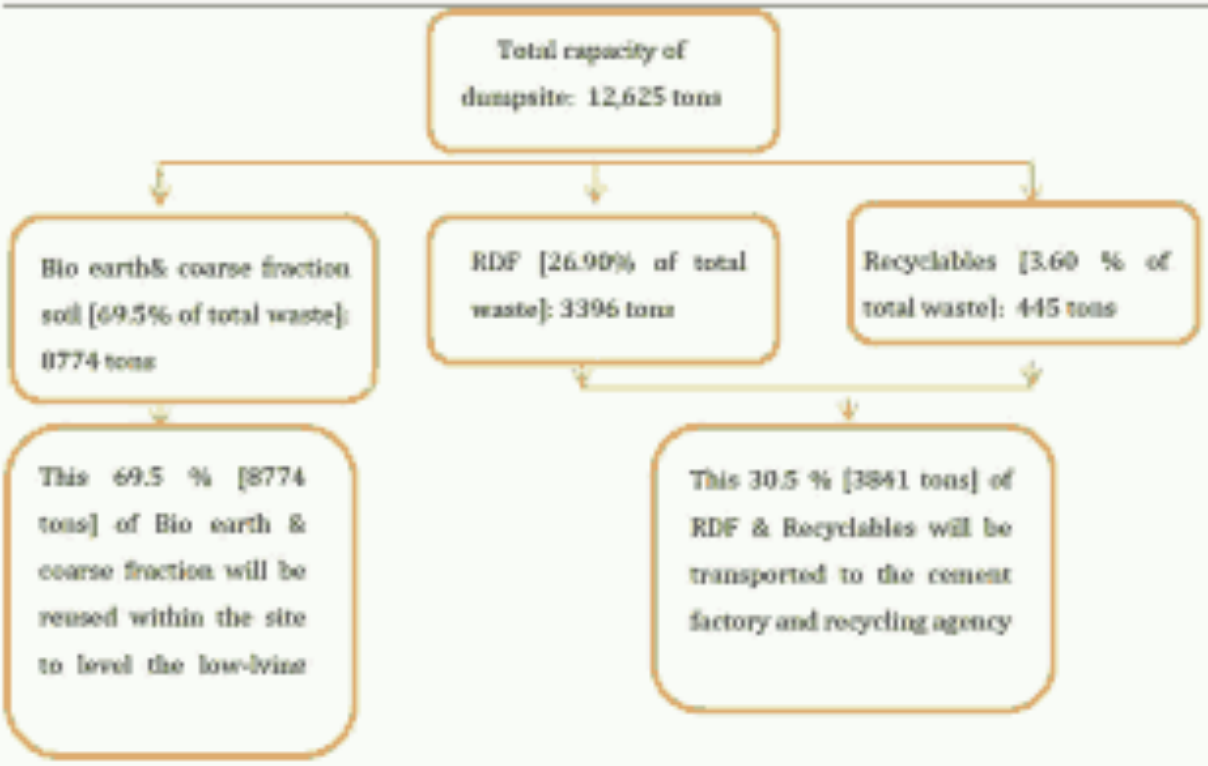



*Figure 4 Traffic load increment due to proposed project*

*Table 14Truck Capacity*

| S. No | Materials | % of Materials | Weight of each material(tons) | Vehicle Type | Max Capacity of load carrying Truck (tons) | No.of Trips |
|---|---|---|---|---|---|---|
| 1 | RDF | 26.9 | 3396 | 12 Wheeler Dumper | 18 | 189 |
| 2 | Glass | 1.65 | 208 | 12 Wheeler Dumper | 25 | 8 |
| 3 | Rubber | 0.51 | 64 | 10 Wheeler Dumper | 8 | 8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | Metals | 1.95 | 246 | Goods Truck | 2 | 123 |
| **Total Weight** | | | **3914** | **Total No.of Trips** | | **328** |

*Table 15 Total Trips Planned*

| S.No. | Materials | Total Trip | Total Days for Disposal | Trip/Day | Remarks |
|---|---|---|---|---|---|
| 1 | RDF | 189 | 90 | 2 | Two Trips per day |
| 2 | Glass | 8 | 90 | 0.1 | Ten days once one trip |
| 3 | Rubber&Footwear | 8 | 90 | 0.1 | Ten days once one trip |
| 4 | Metals | 123 | 90 | 2 | Two Trip Per day |

## 4. ANALYSIS OF ALTERNATIVES

### 4.1 Alternative 1: No project (without project scenario)

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevents further contamination of site.

If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows

1. Foul Odor Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.

2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.

3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.

4.Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the local ecosystem, disrupting natural habitats and potentially causing long-term ecological imbalances.

5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

### 4.2 Alternative 2: Mode of execution / Management Alternative

Regarding the execution strategy, the outcomes of a Transect walk have substantiated the impracticality of waste transfer between Urban Local Bodies (ULBs). As a result, the imperative is for the waste remediation procedure to take place on the premises, allowing only the byproducts to be considered for potential transfer.

The logistical aspects of arranging machinery and designating storage space for these byproducts will hinge upon the extent of land available. At the outset, the existing underutilized, MCF, RRF and organic waste treatment facilities may be considered to cater to the initial storage requirements after improvement, which will, in turn, be known whether the contractor will use this facility for storage. Budget provision is provided in the FR for such arrangements.

## 4.3 Technology Alternative

The selection of the appropriate method or technique for remediation is determined by considering several parameters. These include the significant aspects and suitability of remediation types such as

1. Capping without land recovery,
2. Bio-mining – reclamation/recovery of 100% land
3. Capping with partial land recovery.

Additionally, factors like available resources such as manpower, machinery, finances, and physical site conditions, including the quantity and characteristics of legacy waste, Environmental baseline, social concerns, regulatory compliance (KSPCB/NGT), the need for complete land recovery, and opportunities for utilization of processed aggregates/bi-products are taken into account.

After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

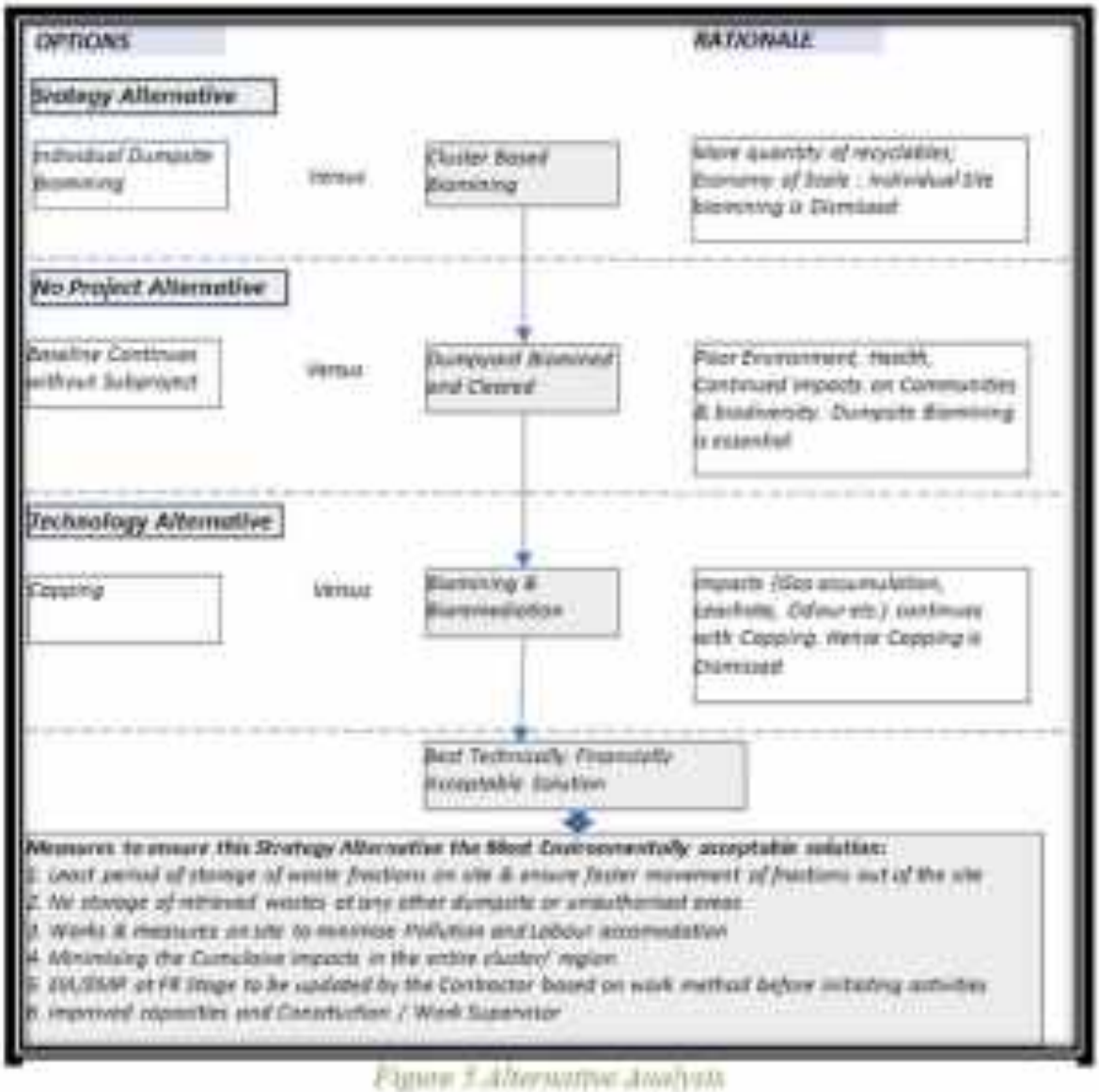



*Figure 3 Alternative Analysis*

## 5. ASSESSMENT OF ENVIRONMNETAL AND SOCIAL RISK IMPACTS

Biomining and bioremediation of existing legacy dumpsites brings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more man-days at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, biomining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration) are important in this case. In addition, cumulative impacts of simultaneous biomining of multiple such legacy waste sites on the environment is important. Especially with respect to

- Drainage and leachate flow into regional waterbodies (Esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies,
- Pollution on land/soil, dust and odour nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks,
- Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and
- Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at this stage, while some would be known only based on the project details that would be known from the work plan of the contactor once on board.

## 5.1 Impact Assessment Methodology

Impacts are assessed based on Magnitude, Duration, and Significance of the impacts and sensitivity of the receptors present within the 500 m aerial distance of Koothuparamba dumpsite.

### 5.1.1 Magnitude and Duration of Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Biomining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;
- The spatial extent of the potential impact;
- Reversibility of the Impact;
- Legal standards and established criteria.
- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table 1 - Aspects for Determining the Magnitude of Impacts. Magnitude is assessed as medium, considering shorter duration of the activity However, magnitude of cumulative impacts of various dumpsite remediation might be High.

*Table 16Aspects for Determining the Magnitude of Impacts*

| Aspects | Large | Medium | Small | Negligible |
|---|---|---|---|---|
| **Duration of the potential impact** | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or Less than the lifespan of the program | Temporary with no detectable potential impact |
| **Spatial extent of the potential impact** | Regional – much beyond project boundaries | Beyond immediate Program components, site | Within program boundary (but cumulative impact of various | A specific location within program component or site |

| Aspects | Large | Medium | Small | Negligible |
|---|---|---|---|---|
| | | boundaries or local area | dumpsite biomining activities will be on larger extent) | boundaries with no detectable potential impact |
| **Reversibility of potential impacts** | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months | Baseline remains constant |
| **Legal standards and established professional criteria** | Against national/approved standards and or international guidelines/obligations | Complies with limits given in national standards but not confirming to international lender guidelines in one or more parameters | Meets minimum national standard limits or international guidelines | Not applicable |
| **Likelihood of potential impacts occurring** | Commonly occurs under typical operating or construction conditions (Certain) | Usually seen occurring under most situations (Likely) | Occurs under abnormal, exceptional or emergency conditions (Occasional) | Unlikely to occur |

**NOTE:** Anticipated Project Duration – 5 to 6 months

### 5.1.2 Sensitivity of Receptor

The dumpsite is surrounded by residential buildings and some commercial establishment, during the time of site assessment the experts observed, some sensitive receptors within 500m from the site. Namely some industries (like brick manufacturing industry), shops (like car washing service centre) and households. The project's lies near residences, within a 200-meter radius, and its potential air, odour, fire, noise, vibration, ground water impact on over 20 families (100 people) over a duration of 5 to 6 months. The sensitivity of these receptors is High.

### 5.1.3 Significance of the impact

- Significance if the impact is high as it would even result in community resistance to biomining and bioremediation.

Since the project operational time 5 to 6 months, then the magnitude of the negative impact can be considered as small and medium sensitivity. In other hand magnitude of the positive impact, after the biomining of the existing land can be used for the recreational park for the public use.

### 5.2 Cumulative Impacts in the Region / Cluster

The impacts that may arise due to clustering of different dumpsites. The following impacts could result from the clustering while implementation, requiring thorough assessment.

1. If a sensitive environmental component (River, mangrove, wetland, etc.) is served by the leachate/drainage from one or more nearby dumpsites, the impacts can be regional.
2. Presence of other projects outside KSWMP; existing or forthcoming landfills, transfer stations or those considered under Track one investments may together create a cumulative impact with this activity.
4. Impact of vehicular movement from various subprojects on biomining of dumpsites may have cumulative impacts on air, odour, traffic issues, and pollution incase of spills/accidents/emergencies due clustering approach.
5. Storage of materials if any at common sites, impacts during rains, floods/emergencies in multiple sites of same water/air shed

However, such impacts will be known only based on final work plan, location and schedule for disposal of Legacy Waste once Contractor is on board. The need to update EIA/EMP based on this will be included in the Bid & Contract Documents.

**Source-Pathway-Receptor Analysis**

**A) Source**: The source of contamination is the legacy waste remaining and being deposited at the Palaparamba closed dumpsite, more specifically the landfill gas and leachate generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. In this case the waste is 50 years old, as dumping had started in year 1973 and the dumpsite is open and live dumpsite. Initially the dumpsite was acting as a trenching ground, depositing sewage from pit latrines. The total waste volume is 15,102 cum with the dumpsite spread over 0.98 ha and rises to a height of approximately 5.5 m from the base. Waste is seen 4 m above ground level and 1.5m below ground level. In addition to the landfill gas and leachate, material spill over the land in the compound and windblown dust and litter are also considered as sources of contamination.

**B) Pathways**: The following pathways for migration of contaminants have been identified: ***Wind***- The main pathway for litter and dust dispersion is the wind. As long as the waste is kept uncovered, the dust and litter will continue to be blown off the dumpsite to the surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. Rainwater runoff through the dumpsite acts as a pathway for transport of leachate to the soil and groundwater. The rainwater flowing off the dumpsite along the slope towards low laying area acts as a pathway for the uncovered waste to flow into the unlined drainage canal along the boundary to low laying side, which runs through the residential areas.

***Lateritic Soil:*** The lateritic soil acts as a pathway for transport of leachate to the groundwater and for uptake of contaminated surface run-off.

***Leachate:*** The leachate flows with groundwater and acts as the pathway. Surface water Contaminants like run-off from the dumpsite, leachate and windblown dust and litter that

reach nearby surface water bodies like canals, rivers and streams are further transported by surface waters and in this case the surface water acts as the pathway.

**Receptors:**

Receptors are air, surface water and ground water. For drinking purpose, they mainly use municipal water supply. (nearby Households, industries and shops within 200 m), soil, flora, fauna and humans. In the case of remediated dumpsite, the most prominent group of receptors are the residences and people involved in industrial activity and shops. As the dump is not contaminated, remediation would improve the pollution scenario provided the bio-earth used is pollution free and of good quality. However, other impacts are expected on the final destinations of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF/MRFs in the region. Depending on the locations of end use of fractions retrieved from biomining, the contractor shall assess the impacts on communities and workers on site & nearby; and near locations of end-use. Key impacts may result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after biomining activity, activities in biomined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post biomining activity.

### 5.2.1 Impacts on Air Environment

Key impacts on air include:

- Emission of Methane and other Greenhouse gases; and its impacts on scavengers, workers on site/other facilities on site (MCF, RRF and Organic Waste Treatment units in this case), nearby communities of Ward 5.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odour, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.

- When the legacy site is opened, existing gases would get emitted. Further, any delay / unexpected stoppage of biomining activity, might further the process of gas formation depending on waste composition, odour and fire risks. In the case of Palapparamba, since the analysis of wastes shows calorific value of 2000 for combustibles with around 3.75% plastics (include MLP/SUP also) and 3.64% cloth rags, it's well combustible; and the risk of fire is high during summers and incidents

### 5.2.2 Impacts on Water Environment

**Groundwater**

- Post and pre-monsoon water levels are 5.6 and 7.15 mbgl. Borehole data indicates waste upto depth of 5.5m with hard lateritic strata after that. Hence it is expected that the ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. With the slope of the ground of the dumpsite, this tends to get accumulated at low-lying gradients. High BOD levels of the drain and ground water wells around are indicative leachate and runoff pollution. Oozing & Pooling of leachate & it draining to nearby areas during rains would be an important aspect to be managed during biomining to prevent ground water contamination.
- Leachate samples: BOD, COD, TDS, E.coli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution.
- Borehole data: Dump below water table; impacts on water resources, wells nearby
- Ground beneath the dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. There is no parameters exceeding the permissible limits for heavy metals.

**Surface water**

- The dumpsite experienced flooding during 2018 floods. The site is at a higher elevation, and hence no submergence was experienced at the site during the floods.

The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas.

- There are no surface waterbodies near the site, except pond within180 m distance.
- At North and South directions, (end direction) there are residential households and mixed vegetation are seen. The leachate from the site may flows through natural slope which endsin residential areas. It is important to contain and treat leachate from the proposed biomining activities on site. Treated leachate may be recirculated or used for other purposes.

### 5.2.3 Impacts on Land/Soil

- Historic land use assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it shall be excluded from the site as biomining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.
- Spillover of activities to nearby road, and land would result in pollution of all types on these areas. Hence it is important to restrict all activities to the site for legacy waste biomining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.
- Ground beneath dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. In Palappramba, all heavy- metals are falling within the limit as per Fertilizers Control Order 1985 and its amendments. Palappramba does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste (including legacy asbestos), e-waste or biomedical waste is found while biomining,

same shall be retrieved, transported, treated and disposed as per specific waste guideline of the Central Pollution Control Board, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste),Feb 2019) and World Bank EHS Guidelines. A plan shall be auditing of all wastes, management, eliminating pollution & OHS risks; and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.

- Wherever fuel, combustibles and retrieved waste is stored, it shall be on impervious surface, at appropriate elevation, protection against rains, flooding (such as cut off drains, berms etc.), wind and fly / pest menace (screens, green cover etc), intruders (compound wall existing at Palappramba), watch and ward, lighting, remote monitoring measures etc). Risk of fire, dust and leachate contamination shall be well assessed by the contractor. Emergency Action Plan shall be prepared and mitigation measures shall be updated based on work plan/DPR, and implemented. Communities shall be made aware of works and advice to follow measures such as use of fly/dust covers/nets on wells etc.
- Of the waste samples analysed, 50 to 60 percent comprises of Bio earth; 30% being <4.75mm size; C/N ratio (15:01) indicating slight unpleasant odour (high Nitrogen; releasing ammonia) less than that suitable for good compost.

### 5.2.4 Impacts due to Noise and Vibrations

Various machines vehicles and activities contribute to noise and vibration on and off site. This includes vehicles carrying recyclables, operation of JCB, and other machines, diesel generator sets, motors on site, etc. In addition, activities on the site and in relation to the existing MCFs such as vehicles transporting the dry waste from households to MCF, loading / unloading of collected waste materials, and workers activities on site would add to noise and vibration. Impacts include disturbance to fauna flora on site, health impacts on communities around due to exposure to large volume of sound.

### 5.2.5 Other impacts on Biodiversity - Fauna/Flora

- There are no sensitive biodiversity areas within 10 km of the site. However, since the project involves transport of wastes, it is important to consider the impact beyond

the project boundaries. Depending on the contractors plan for disposal of retrieved waste fractions, EIA shall be updated for biodiversity impacts.

- Fauna: impacted by direct consumption of the solid wastes, sharps, entanglement, or by consumption of plants and/or animals contaminated by wastes, or as a result of leachate effects on groundwater and surface water.
- Flora Plants near open dumpsites can be impacted directly by the waste, dust or smoke from burning. Disturbance to vegetation due to machinery, trampling by foot, vehicle or animals, or contamination by waste or leachate, the migration of landfill gas, or as a result of burning or smoke effects
- Disturbance to other fauna and flora on site: SWM activities onsite including those related to MCF and RRF may also impact fauna/flora through high noise levels of pre-construction / construction activities.
- Biodiversity of existing site: Available Biodiversity of existing site is mentioned in the Environmental Baseline session and there is no key species listed by IUCN.

### 5.2.6 Other impacts on Workers and Communities

- Contaminants in soil and water: Direct or indirect contact with polluted soil or water by neighboring water users. Additionally, because of their locations, recovered lands are subsequently used as parks, or for SWM facilities or office spaces etc. This may pose risk of bioaccumulation of metals which can constitute a health risk. Also impacts on buildings due to gaseous emissions, risk of fire etc if used after clearing.
- Health Risks: One of the primary health risks of dumps is the spreading of diseases - diarrhea, hepatitis etc. The ways such infection can be spread are numerous but are often related to direct contact with the waste (e.g., clinical waste, fecal matter) by scavengers and other unauthorized persons being on the site. The other main pathway is by vectors such as, foraging animals, rats, birds, flies and mosquitoes etc. - Flies, mosquitoes, rodents, crows, pigeons, pest menace on site, for workers & communities & their assets (such as wells) due to exposure of putrefied wastes
- Impacts if separate common site/s or a site among these dumpsites is chosen to store wastes from other dumps till it is disposed, or as transfer stations or for common

processing of certain fractions: Such activities would result in Air, odor, dust, noise, water, vibration, flora, fauna, communities around the new site. There is also risk of contamination due to newly placed wastes, and pollution impacts and disturbances to communities due to works/activities on this site. Such sites and activities shall be avoided, and if quintessential for the project, be carefully chosen and approved only after thorough discussions with KSPCB, and all stakeholders. An assessment of their sensitivity and appropriateness shall be undertaken considering the environmental risks. They shall be audited and assessed for existing and future environmental impacts of such activities and mitigation shall be implemented. However, details on such sites shall be known only based on the final schema of implementation proposed by the contractor. Hence, the Contractor shall update EIA based on this before starting any activity on site.

- OHS impacts: Infectious wastes, fecal matter, clinical wastes and sharps; batteries, e-waste and possible bursting; Hazardous wastes like asbestos and other chemicals dumped; pesticides/insecticides, inoculum storage, handling and use on wastes/land leading to diarrhea, hepatitis, insect & reptile bites, interactions with foraging animals like rats, dogs, cattle, vector (mosquitoes, flies etc) transmitted diseases etc.
- This activity would result in large influx of workers from the region. Worker facilities in the labour Camp if any, & site are important, as the density of population is high in Kerala. It is important that camp sites are not set up in the land to be remediated. Periodic health checkups (once a week) are very important as the work involves handling of waste. It is important to also provide periodic health checkup and co-ordination with local Primary Health Center/Central Health Services for medical camps for residents, schools and others during the biomining period.
- Risk of Fire during biomining and due to retrieved material storage; possible Burning of retrieved materials; storage and use of firewood for various purposes, fuel for vehicles. The smoke from burning solid waste can result in respiratory complaints, dizziness, and headaches in the short-term, as well as potentially more serious diseases such as cancers and heart disease in the long term.

- Impacts of other site development works shall be well assessed, EIA/EMP updated, and mitigation measures included in Project costs and implemented by the contractor/ULB (whoever is responsible as per FR/Final Bid document).

### 5.2.7 Visual impacts, Noise, Odour, Vibrations

- Odour & impacts on workers and communities during biomining, storage and Transport are key determinants of community agreement to the activity. Such odour would attract flies and vectors in large numbers, who may also contaminate the food, and water sources of nearby communities. It is important to minimize odor emission as guided by the CPCB Guidelines on Legacy Waste Biomining, 2019. also provide periodic health checkup and co-ordination with local PHC/CHS for medical camps for residents, schools and others during the biomining period.
- Visual impacts of the waste being dug up, screened ad heaped/stored is not appealing. It is important to mask this appropriately.

### 5.2.8 Traffic Impacts

- Impacts due to new access road construction/upgradation. Access road to the site is unpaved and slushy during rains. It is important to minimize temporary pollution due to increased movement men, and materials from and to the site during biomining activity and beyond as it is proposed to store material on site including air and noise pollution, access restrictions to properties nearby, and vehicular conflicts
- Large vehicles moving in and out of the site carrying materials, tools, equipment & pedestrian/worker -vehicular conflicts; increased traffic on roads, large equipments & vehicles, noise, air pollution: vehicle emissions, DG sets
- Vehicles, equipment's not adhering to pollution standards

### 5.2.9 Other Impacts on existing or proposed activities on site/s

- There may be approvals from various agencies for biomining activities and associated facilities; depending on utilities and uses on site. & associated activities. These permits shall be obtained prior to initiating activities on site.

- Impacts of biomining on existing facilities on site such as MRF, MCF, composting yard etc (disturbance to activities & people due to dust, leachate, noise, odour; additional load of wastes to these facilities, vibration impacts & structural damage, etc).
- Post biomining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped & impacts if this is dumped elsewhere or not processed. This alternate location, being associated facility need mitigation measures to avoid/minimize pollution, Health &Safety impacts on workers, communities. Also forward linkages are considered as associated facilities/linked activities. Impacts of Transportation of these fractions (traffic increase, odor, leachate, dust) impacts during rains & emergencies, and its handling, storage at the identified locations, reuse etc. shall be mitigated.

## 6.1 Scope of Environmental Management & Monitoring Plan

An Environmental Management Plan (EMP) is a comprehensive strategy designed to manage and mitigate the impacts of activities on humans and the environment, particularly concerning air, water, soil, land, and biodiversity.

## 6.2 Environmental Management Plan

The detailed anticipated impacts and corresponding mitigation measures/management of the impacts are given below

*Table 17 Impacts & mitigation measures on Planning and installation phase*

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| *A* | | **Planning and Pre-Construction Stage** | | |
| *1* | | *Planning for biomining facility* | | |
| 1 | Biomining & Bioremediation Plan & Capacities | • Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / biomined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these biomined material in line wit the agreements with such facility owners and National, State regulations and WB EHS<br>• Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate management Plan.<br>• The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers<br>• Contractor to get all required licenses & permits before start of any activity on site | Contractor | SPMU/DPMU/ ULB |
| 2 | Site Access Closure | • The total cessation of dumping in the site will be implemented before any works.<br>• All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public. | ULB or Contractor as per Bidding mechanism | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance to indicate that the waste dump has been closed from the operation.<br>• To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br>• Grading shall be performed where necessary to provide a neat appearance | | |
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – *impact on air quality, odor, water contamination due to leachate, health and safety impacts of the people working in the site assessment* | • Carry out site assessments as per Guidelines for Biomining of Legacy waste Dumpsites of CPCB<br>• Consider safe biomining & gas / leachate generation from existing capped portion of the site<br>• Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means<br>• Provision of appropriate PPE's to the team undertaking the site assessments<br>• Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits<br>• Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>• Plan for machinery operated which will be operated by skilled operators at all times.<br>• Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures.<br>• Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | TSC, ULB, Contractor | SPMU/DPMU/ ULB |
| 4 | Absence / Delay in Permissions for Developing the biomining facility and associated works as per National regulations | • Required permissions for undertaking biomining at the existing dumpsite and assessments conducted for undertaking biomining as per existing Laws, Regulations including for associated infrastructure, DG Sets, Consent to Establish, and other licenses including those as per Labour Laws, before the start of works on site | Contractor, ULB | SPMU/DPMU/ ULB |
| 5 | Dust impacts due to Site works, screening & stacking of retrieved wastes | • Plan to Provide temporary high screen, buffers around the site before the start of work to curtail dust emissions | Contractor and or ULB depending on | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | *(Air Pollution) and Visual Blight due to excavation* | • Arrange a green belt as early as possible on the area of the site with no / less dump. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers)<br>• PPEs to be used by workers<br>• Awareness to communities & suggest to use PPEs | agreement on bidding mechanism/DPR | |
| 6 | Material sourcing, transport, and stacking of construction materials *(Occupational Health and Safety issues and Air noise pollution)* | • Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism<br>• Prior intimation to nearby Primary Health Centre on work activities need for medical support, emergency support needs, type of Labourers on-site and Labour camp if any<br>• Materials shall be sourced only from approved quarries<br>• Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions.<br>• The driver should be with required license and follow speed regulations<br>• Materials shall be transported preferably through well-surfaced roads. If road it kuchcha, water sprinkling shall be done to prevent dust emission before and after truck passes<br>• Material transport and unloading activities should not result in noise disturbance to locals and should be during day time<br>• Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors.<br>• Provide vehicle wheel wash area on site<br>• Workers to be provided with Personnel Protection Equipment (PPE) including safety boots, jackets, ear muffs, gloves<br>• Proper rest area on site shall be provided with water, first aid, toilets | Contractor | SPMU/DPMU/ ULB |
| 7 | The layout of Labour camp *(Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)* | • Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp<br>• Nearby health center shall be informed about the Labour camp & appropriate medical checkup shall be arranged periodically<br>• Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters)<br>• It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with land owners wherever the labour is accommodated | Contractor | Site engineer of SPMU, Labour Commissioner, PCB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | • Camp must not be provided in an area prone to Hazards<br>• Camp should be adequately at higher plinth levels to prevent water intrusion<br>• Rooms shall be of appropriate sizes with adequate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG)<br>• Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female labourers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc.<br>• The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security<br>• (Refer ECOP section 06 and section 11 of EMF for KSWMP) | | |
| 8 | Nearness/disturbance to sensitive areas such as forests, wildlife habitations, etc. especially in case of providing support facilities *(Impacts on Fauna / Flora)* | • Ensure site selection for any support facilities or activities (such as vehicle storage etc. if no in biomining site) based on the screening checklist and the master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate, Reduce. Obtain requisite permissions from respective authorities such as Pollution Control Board, ULB etc.<br>• Identify appropriate government site to avoid land acquisition and resettlement impacts<br>• Covered and well-marked storage area with cut off drains & odour/fly/dust/ fire prevention shall be ensured for excavated wastes and washing, segregation of the same are to be arranged with due consideration to nearby residences (20 no's near South side of the site), slope (towards south east) other landuses | Contractor | SPMU/DPMU/ ULB |
| 9 | Contamination of groundwater due to leaching, Leachate parameters; BOD, COD, TDS, Ecoli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution | • During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant<br>• Depending on the contractors plan for biomining of the capped area on site, adopt plans to manage leachate | Contractor | SPMU/DPMU/ ULB |
| 10 | Impacts on flora, fauna" consumption of wastes, leachate impacts, dust | • Movement routes of vehicles to be planned to avoid key fauna/flora on site such as *Alleorhus sp.*(Tree) &*Funambulus tristriatus* ( Jungle Palm Squirrel) | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | smoke – burning, trampling/machinery | • Leachate collection & storage/treatment and recirculation shall be planned to avoid imparts on flora, fauna | | |
| 11 | Nuisance hazards to neighboring areas | • Ensure proper design and adequate compound wall; high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements<br>• In case of waste mound and site edges are sliding or unsafe: provide engineered retention walls. | Contractor | SPMU/DPMU/ ULB |
| 12 | Treatment & Disposal of wastes and rejects | • Contractor to Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & inert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventorised and quantified, including Biosarth, rejects, inerts. These shall be tested and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertiliser Control Order 1985 and their amendments. Asbestos Management Plan shall be prepared for management if Asbestos wastes retrieved if any<br>• Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period. | | |
| **II** | **Implementation or Biomining & Bioremediation stage and Construction of ancillary facilities such as access road improvements, compound walls, greenbelts, drainage etc.** | | | |
| | **Implementation of biomining of the dumpsite** | | | |
| 1 | Impact due to the vehicular movement<br>*(Air and noise environment & Vehicular - Vehicular & Vehicular - Pedestrian Conflicts)* | • Vehicles and machinery are to be maintained so that emission conforms to National Ambient air quality standards.<br>• All vehicles and machinery should obtain Pollution Under Control Certificates<br>• HORN PROHIBITION signpost to be erected.<br>• Rumble strips/speed breaker to be provided on access roads.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed.<br>• Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle<br>• Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements. | Contractor, ULB | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | • Avoid heavy vehicle movement through Koothuparamba roads during peak hours 7 a.m to 10 a.m mention school hrs / peak hrs and during important period / festivals when people use the road to access temple<br>• Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents. | | |
| 2 | Impact due to the use of heavy vehicle and equipment<br>*(Air and Noise environment)* | • Mixing equipment (in case of construction of ancillary facilities) should be well sealed and be equipped with a dust-removal device.<br>• Equipment Operators & labourers should wear dust masks, ear protection, and hard hats.<br>• Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load.<br>• Labour to be provided masks / PPEs.<br>• Construction / Biomining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spreading into neighboring sensitive land uses<br>• Noise standards at operation machines are to be strictly monitored to prevent exceeding of GOI noise standards.<br>  ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines.<br>  ▪ Using modern, well-maintained and regularly serviced vehicles.<br>  ▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>  ▪ Provision of earmuffs and ear protection to workers and employees in high noise areas.<br>• Workers in the vicinity of strong noise to wear protectors and their working time should be limited as a safety measure.<br>• As Palapparamba dumpsite has sensitive receptors and settlement areas within 150m of it, noisy works shall be stopped from 22:00 to 06:00.<br>• Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum.<br>• Avoid noisy activities/machines nearby residential area of the site where settlement exist within 50m. Noise barrier shall be provided at all noise-sensitive locations / for noise | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | generating equipment such as DG sets, mixers (for ancillary facilities) especially near South side of the dumpsite<br>• Adopt required measures as per CPCB guidelines, and site & work specific safety requirements | | |
| 3 | Impact during the construction activities *(water environment)* | • Labour camps if any (depending on Contractors work plan & arrangements) are to be located away from water bodies.<br>• Vehicle washing or maintenance near water bodies are to be avoided.<br>• Contaminated water from construction / biomining activities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated on site. | Contractor | SPMU/DPMU/ ULB |
| 4 | Leachate and Runoff from biomining activities *(Soil contamination and groundwater contamination)* | • Provide site cut off drain around the site to divert off stormwater from entering the site, and to prevent contaminating downstream resources with run off from the dumpsite<br>• Depending on the contractors plan for biomining of the capped area on site, implement leachate management to cause no harm to communities & environment<br>• Ensure stormwater drains will lead to drain outlets (along the south east boundary of the site) on roads adjoining the dump yard<br>• Provide leachate drains lined from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area.<br>• Provide proper treatment of leachate and stormwater that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by biomining activities like excavation and waste segregation and stabilization<br>• The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB.<br>• The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata<br>• Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff and hence reduce infiltration<br>• Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism | Contractor | SPMU/DPMU/ ULB |

| S.No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | • Plan the works on-site only during non-rainy seasons and to complete the works before rains<br>• Store leachate preferably in aboveground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide for emergency containment additionally | | |
| 5 | Soil decontamination from accumulated waste levels *(Impact on leachate, odor)* | • Decontaminate the soil / stabilized layers remaining after sieving out wastes using windrow and bio-culture of appropriate quality in line with standards / regulations or appropriate means as per CPCB Guidelines<br>• Vegetative layer using contaminant absorptive root varieties like Vetiver may be tried on soil and along the edge of the green belt or floating wetlands may be deployed in water channels nearby to maximize absorption of leachate in the soil by root-zone phytoremediation<br>• Soil and water testing shall be done and changes in contamination shall be noted. | Contractor | SPMU/DPMU/ ULB |
| 6 | Excavation of waste from the waste mound *(Health and safety impacts)* | • The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound.<br>• Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided<br>• Machinery operated for excavation should be operated by skilled operators at all times.<br>• Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on wastes.<br>• Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound<br>• In case of the waste mound and site edges are sliding or unsafe, provide engineered retention walls or string boundaries.<br>• When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection & treatment mechanism. | Contractor | SPMU/DPMU/ ULB |
| 7 | Transportation of wastes or retrieved or other material in overloaded and open vehicles | • All vehicles shall carry only approved load of weight<br>• Regular cleaning of roads & drains and removal of spills if any.<br>• All waste transport vehicles shall be covered and movement shall be during non-peak hours. | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | *(Air, Odour nuisances; spills and littering impacts on Air, Water, Land)* | • Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities.<br>• Adopt required measures as per CPCB guidelines, and site specific safety requirements. | | |
| 8 | Spreading and compaction of waste<br>*(Safety)* | • Follow technical details in line with CPCB Guidelines<br>• The active working face should be minimized as much as practical an appropriate size is about 2 to 3 times the width of the compactor vehicle.<br>• Waste should be spread and compacted in layers not greater than 0.6m [2ft.] after compaction.<br>• Compaction of the waste should be on a slope of about 20-30% as guided via the permissible levels and worked from the bottom of the slope to the top | Contractor | SPMU/DPMU/ ULB |
| 9 | Occupational health and safety impacts of the workers during the biomining & construction of support facilities:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage of chemicals/other materials, biocultures or wastes etc. by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | • Avoid direct & double handling of wastes through avoidance measures(suitable planning & equipments), engineering controls & use PPEs<br>• Work area & Labour camps shall be provided with First Aid and other related activities.<br>• Emergency Preparedness plans shall be prepared and implemented for all manpower working centers and its field extension centers.<br>• An Environment Health & Safety policy shall be prepared and implemented<br>• Adequate manpower shall be provided & manager & staff shall listen and act upon the manpower related grievances.<br>• Workers will be provided with PPE such as face mask, gloves, shoes, nose masks & goggles<br>• Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed without slip, trip, fall especially on waste, leachate or trenches<br>• Proper training will be provided regarding the maintenance of health<br>• Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks & water supply), food, and water in a hygienic environment (with proper handwash). Provide clean eating areas where workers are not exposed to contaminated, hazardous or noxious substances.<br>• First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus<br>• Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health | Contractor, ULB | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | checkups. Arrange daily health checkup for workers working on waste heaps<br>• Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals.<br>• Measures such as deferred timings and stretch break to be adopted<br>• Secure all installations from unauthorized intrusion and accident risks;<br>• Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every days start of works / activities. Key hazards would be (but not limited to) are flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and leachate from existing capped area on site, electric shocks, works with heavy machines & equipments, slips of men & material (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc.<br>• EHS specialist with adequate experience & third party supervision are important for biomining activity<br>• Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites<br>• Provide visitor orientation if visitors to the site need to gain access to areas where hazardous conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible<br>• Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;<br>• Ensure moving equipment is outfitted with audible back -up alarms & flag men with whistles or speakers;<br>• Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit.<br>• Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenance to be marked well & safe kept before activity start near those.In close proximity to this location, there is a transformer. Disallow worker exposure to | | |

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| | | noise level greater than 85 dBA for more than 8 hours a day without hearing protection<br>• All workers shall be registered as per prevalent Labour laws (including a workforce of subcontractors) and provided insurance cover & others as per existing acts/laws<br>• Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractors person/insurance agent<br>• While using heavy machinery like JCB, cranes, etc, inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle.<br>• While using heavy machinery like JCB, cranes, etc, inform communities to prevent children and others from going near operating / movement areas including roads.<br>• Flagmen shall be arranged if work is near schools, hospitals, major roads, and traffic control is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if possible<br>• A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs;<br>• No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor<br>• All work related to working at heights will be undertaken only during the daytime when sufficient sunlight is available;<br>• Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done;<br>• All excavation activities to be conducted in supervision of the site contractor;<br>• Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured.<br>• All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans prepared and implemented, as per Banks Incident Reporting Tool | | |
| 10 | Risk of fire due to conditions leading to spontaneous combustion | • Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for Implementation of SWM Rules 2016 – regdg Fire Incidents at MSW Dumpsites (https://cpcb.nic.in/openpdffile.php?id=UHVibGljYXRpb25zaWxlLzEwNDRfMTY1NTE2 | Contractor, ULB | SPMU/DPMU |

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| | *(Air environment, disturbance to communities and workers, health impacts, safety issues)* | MzkzN19tZWRpYXBobiRvMzYxMi5uc2GV=) LSGD Kerala Government GO on Fire Safety of MRF, MCFs (for the MRF on site if used for storage of wastes)and other Regulations, guidelines applicable<br>• Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3; and National/State regulations & WB EHS<br>• Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes<br>• Avoid conditions that can lead to spontaneous combustion such as:<br>○ Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard<br>○ Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.<br>• Design the facility for access by firefighting equipment, including clear aisles among waste heaps or work areas and access to adequate water supply.<br>• Ensure workers are briefed of fire hazard & its management<br>• No unauthorized entry shall be permitted to the site; including of workers during holidays, night time, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating "trespassers not allowed"<br>• The following activities should be implemented to prevent fires from occurring at the facility<br>○ adequate fire-fighting equipment should be made available on-site and stored in an accessible manner.<br>○ all operating staff should be trained and able to manage fire outbreaks at any part of the facility.<br>○ clear signage should be established to inform workers and the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area.<br>○ Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows.<br>○ all fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the blooming, storage, and processing areas.<br>○ all flammable liquids should be stored within a bund that can hold 110% of the | | |

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| | | volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating stormwater.<br>• The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the biomining activity in line with National State regulations, guidelines and international good practices<br>• Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.<br>• Contain all local smokes/small fires inside the dump asap. Fire brigade help shall e sought on all smokes/fires outside the dump asap<br>• Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured.<br>• Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers | | |
| 11 | Construction of new facilities in retrieved land | • The excavated site shall be protected from any dumping during or after the biomining activity and shall be reserved for SWM activities in line with SWM Rules 2016<br>• Any new facility under ICSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations | ULB | SPMU/DPMU |
| 12 | Pest / Vermin Control & Visual impacts<br>(Odour, flies, rodent / other pest menaces) | • Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center<br>• Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups<br>• Biopesticides / biological control shall be followed. However, biopesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials<br>• Banned pesticides/insecticides shall not be used.<br>• Workers shall be made aware of storage and use of pest control measures and PPEs to be used<br>• Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate management | Contractor, ULB | DPMU, SPMU |
| 13 | Odour nuisance | • Waste with a strong odor to be covered immediately they are emptied from vehicles.<br>• Control and manage leachate treatment to minimize odor. | Contractor, ULB | DPMU, SPMU |

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| | | • Provide buffers screens to curtail odor from reaching surrounding communities especially to North side of site.<br>• Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor. | | |
| 14 | Storage, Collection, Transport, Treatment & Disposal of wastes and rejects | • Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste<br>• Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters<br>• Waste handling shall be inline with existing regulations & guidelines & avoid health & safety impacts<br>• No material is allowed to remain on site after the contract period<br>• Adequate fire safety arrangements & awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported<br>• Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/inerts in designated or agreed area & are in line with schedule; using GPS.<br>• Given that the access road is used by the public, it is imperative to implement the required safety precautions and environmental protection measures when transporting the waste. | Contractor, ULB | DPMU, SPMU |
| 15 | Other activities | • No activity other than biomining shall take place on site & any activity shall cause no adverse impacts on the environment or people<br>• If existing MCF shall be used for sorting biomining wastes, its safety shall be ensured in terms of fire & structural safety before starting to use the facility. Further usage of the MCF after biomining works shall be after proper cleaning / washing & disposal of all rejects/inerts & tools to ensure good housekeeping & no H&S impacts<br>• If existing MCF shall be used by the ULB for storing dry wastes from Town, during biomining period, alternate access shall be arranged & workers shall be adequately protected against any health & safety impacts | | |
| 16 | Energy Efficiency & Water Use efficiency | • All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & biomining / construction techniques<br>• Landscaping & green belts to use local / indigenous plants & trees | Contractor | ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • Waste water and Leachate to be treated & recycled/reused | | |
| C | **Future Site Usage (EMP shall be updated in line with EMF & used if future site usage is proposed under KSWMP). This section is not the responsibility of the Contractor for Biomining, but of the future facility operator & ULB** | | | |
| 1 | Future use of the biomined site: Green Park, MCF, RRF, Treatment plants, landfill cell or any other, preferably for SWM | • ULB to ensure that the site will not be used for future dumping.<br>• Activities at existing MCF to be upgraded to ensure that no waste (even dry wastes) gets dumped around.<br>• ULB shall plan the future use of the site shall be in consultation with the communities.<br>• Phase 1 Environmental Assessment to be carried out. EA for existing facilities & EIA for proposed development in line with EMF in case this is proposed to be developed under KSWMP<br>• All applicable clearances, permits shall be arranged in line with applicable regulations for the proposed new use of the site, and appropriate designs/plans to be prepared & implemented | Future Facility Developer/ Operator & ULB | ULB (SPMU in case it is under KSWMP) |
| 2 | Vehicle movement for new activities: MCF, RRFs, Treatment plants, landfill cell<br><br>*(Air, water environment & nuisance to biodiversity, communities, Health impacts)* | • The movement route shall be scheduled for each vehicle.<br>• Enforce speed limits applicable and make drivers aware of this<br>• Vehicles movement shall be tracked by Health Supervisors to ensure keeping up to schedule; preferably using GPS<br>• Any adulterated fuel shall be avoided. There shall be periodic emission tests for vehicles<br>• Provision of Personal Protective Equipment such as face mask, gloves, nose masks & goggles to all workers in C&T vehicles, Maintenance yards<br>• Proper lubrication shall be provided to minimize squeaking noise due to friction<br>• Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br>• The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public<br>• Traffic will be managed at the site by providing adequate space for parking of vehicles<br>• Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design<br>• No waste or material shall be disposed in any place other than the designated area; including water bodies, courts/forests, or sensitive areas. | Future Facility operator | ULB |
| 3 | Exhaust emissions<br>*(Air impacts)* | • No idling of vehicles on site.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed | Future Facility operator | ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 4 | Plying of vehicles through kutcha / unsurfaced roads and idling<br>*(Air pollution: SPM, CO, CO2)* | • Vehicle movement shall be well planned – through topped roads. In case of necessity to move through Kutcha roads, ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Future Facility operator | ULB |
| 5 | Odor<br>*(Nuisance, Air)* | • Daily soil covers to compacted wastes to manage odors.<br>• Waste with a strong odor to be covered immediately they are emptied from delivery vehicles;<br>• Control and manage leachate treatment plant to minimize odor.<br>• Adhere to air quality regulations with quarterly air quality monitoring Maintenance of the buffer zone and protective berms<br>• Provide buffers screens to curtail odor from reaching surrounding communities | Future Facility operator | ULB |
| 6 | Impact on the ambient noise quality during the operations<br>*(Noise, nuisance to sensitive receptors, health impacts)* | • Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines;<br>• Using modern, well-maintained and regularly serviced vehicles;<br>• Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>• Provision of earmuffs and ear protection to workers and employees in high noise areas | Future Facility operator | ULB |
| 7 | Occupational health and safety impacts of the workers:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | • All OHS and CHS measures to be followed in line with applicable regulations, guidance<br>• Workers & communities shall be made aware of OHS, CHS risks and impacts & mitigation measures adopted<br>• Emergency management plan to be prepared & followed<br>• Workers shall be appropriately trained or OHS during construction & Operation of all future facilities | Future Facility operator | ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 8 | Pest / Vermin Control (Odour, flies, rodent / other pest menaces) | • Regular cleaning and approved pest control measures to be adopted<br>• Biopesticides / biological control shall be followed<br>• Banned pesticides/insecticides shall not be used.<br>• Workers shall be made aware of storage and use of pest control measures and PPEs to be used | Future Facility operator | ULB |
| 9 | Fire Safety | • The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented in line with National State regulations, guidelines and international good practices | Future Facility Operator | ULB |
| 10 | Energy Efficiency & Water Use efficiency | • All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & construction techniques<br>• Landscaping & green belts to use local / indigenous plants & trees<br>• Waste water to be treated & recycled/reused | Future Facility Operator | ULB |

**Disposal phase of By-products from Bio-mining process**

The bio-earth and coarse fraction soil recovered from dumpsite will be used for filling low lying areas. The RDF material recovered from dumpsite will be transported to nearby cement factory and recyclable material will be handed over to the authorized recycling agency. If the by-products are not removed from the site within specified time mentioned as per the bid documents, penalties will be imposed on the contractor as mentioned in bid document.

## 6.3 Emergency & Disaster Management Plan
## Hazards Associated with Dumpsite Activities

The Disaster Management Act, 2005 mandates every Government Department to prepare, review and update Disaster Management Plan

### 6.3.1 Identified Emergency Situations

*Table 18 Hazards associated with Dumpsite Activity*

| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| As per World Bank EHS Guidelines | |
| Waste Storage | Regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases |
| Waste Segregation | Regular audits of waste segregation and collection practices |
| Monitoring records for hazardous waste collected,stored, or shipped should include | **1. Material Identification:**<br>- Name and identification number of the hazardous material(s) present in the waste.<br><br>**2. Physical State:**<br>- Indicates whether the waste is in a solid, liquid, gaseous form, or a combination of these.<br><br>**3. Quantity:**<br>- Specifies the amount of hazardous waste, typically measured in kilograms or liters, or by the number of containers.<br><br>**4. Waste Shipment Tracking:**<br>- Documentation tracking details include:<br>- Quantity and type of hazardous waste.<br>- Dates of dispatch, transportation, and receipt.<br>- Records of the originator, receiver, and transporter involved in the waste shipment.<br><br>**5. Handling and Treatment:** |

| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| | - Describes the method and date of various actions taken with the hazardous waste, such as storing, repacking, treating, or disposing of it at the facility.<br>- Cross-referenced with specific manifest document numbers relevant to the hazardous waste.<br><br>**6. Location within Facility:**<br>- Specifies the specific locations within the facility where the hazardous waste is stored or processed.<br>- Includes information about the quantity of waste at each location. |
| Falls and Slips at the dumpsite<br>Slippery surfaces or uneven surfaces and poor access to work areas climbing on and off plant. | Tidy workplace by maintaining good housekeeping. Handholds wherever necessary and clear/ safe access to work areas with proper PPE to the persons working at the site. |
| Fire Hazard<br>Fire risk may occur due to the following<br>Storage of flammable liquids / Gas like LPG, Diesel<br>Any combustible materials<br>Sparks<br>Open flames<br>Absence of Fire hydrant network may lead to major fire accident | Combustible/flammable materials should be properly managed and stored/used. Fire extinguishers and Fire hydrant Network with reserve water (As per NFPA Code) should be made available. Emergency Plan in case of fire. |
| Absence of Personal Protective Equipment Lack of adequate footwear, Helmets, hearing/ eye protection, gloves & goggles may lead to injuries and death. | Proper footwear, Helmets, hearing/ eye protection, gloves & goggles should be given to the workers at the dumpsite. Proper training should be given to the workers on the use of PPE. |
| Electrical Hazard<br>Electric wires if any damaged<br>Poorly insulated<br>During temporary repairs | Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit. |

| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| Circuits overloaded may lead to major accident | |
| Ladders<br>Risk may occur due to the following<br>Not secured against dislodgement<br>Defective ladders<br>Not sufficient length<br>Incorrectly placed | Ladder risk can be mitigated by the following<br>Secured against movement or footed<br>Ladders in good condition<br>Regular inspection<br>Ladder should be extended one (1 m) meter above platform to avoid injuries |
| Excavations<br>Risk may occur due to the following<br>Trench collapse<br>Gas emission | Risk can be mitigated by the following<br>Soil stability should be known before excavation<br>No water accumulation<br>V500 mask should be used at the in order to counter the gas emission.<br>Emergency Plan |
| Defective or wrong Hand Tools<br>Wrong/defective tool may end up with injuries to the workers using the tool | Right tool for the job should be used properly and it should be in good condition |
| Accidents due to vehicular movement<br><br>Vehicle movement inside the site | Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents |
| Noise Hazard<br>Noise levels over 85 decibels would cause trouble to the people working at the site | Noise Levels should be maintained below 85 decibels and with proper protection |
| Falling Material<br>Fall during carrying/Lifting of waste and materials from overhead work areas. | Risk can be mitigated by the following<br>Use of hard hats.<br>Person operating the Jcb/machine must be provided with walkie talkie/hand signals to know about the clearance |
| Visitors Presence at site<br>Insufficient fencing may lead to attract pedestrians to enter the site. | Fencing and barricades with proper signage boards indicating pedestrians not allowed |

### 6.3.2 Proposed Organizational Structure for Disaster Management

The Organizational structure for the Disaster management contains the following team members.

**Emergency Response Team:**

A response team needs to be set in assistance with a senior executive (Site controller), Manager Safety (Incident controller), Shift in charge, and Emergency Coordinators.

Incident controller would be reporting to the Site Controller. Incident Controller organizes a team responsible for controlling the incidents with the personnel under his control.

Shift In-charge would be the reporting officer, who would bring the incidence to the notice of the Incidence Controller and Site Controller.

Emergency Coordinators would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential support services. For this purpose, security in-charge, personnel department, essential services personnel would be engaged. All these personnel would be designated as key personnel.




*Figure 6 Organizational Structure for the Disaster Management Team*

### 6.3.3 Emergency Response Facilities

Emergency Control Center – with access for emergency shutdown procedures, duties and contact details of key personnel and government agencies, emergency equipment, etc.

- Assembly Point – with minimum facilities for safety and rescue
- Emergency Power Supply – connected with diesel generator, flame proof emergency lamps, etc.
- Fire Fighting Facilities – first aid fire-fighting equipment, fire alarms, etc.
- Location of Wind Stock – located at appropriate location to indicate the direction of wind for emergency escape
- Emergency Medical Facilities – Stretchers, gas masks, general first aid, emergency control room, breathing apparatus, other emergency medical equipment, ambulance. The medical centre should display poster for treating burns and first aid. Some medicines and facilities to be kept in the medical centre are suggested.

**Health and Safety Measure for the workers**

All workmen employed in working conditions will be provided with adequate personal safety equipment as applicable to the work lies:

- Safety shoes
- Safety Helmets
- Hand gloves
- Ear muffs

**Monitoring Plan**

The considerations in an emergency planning include the following:

- Identification and assessment of hazards and risks
- Hazard consequences analysis
- Alarm and communication procedures

- Identification and equipping emergency control centre identify assembly, rescue points, medical facilities
- Emergency preparedness plan, procedure, steps to be taken before during and after emergency
- Formulation of plan and emergency sources
- Training rehearsal, evaluation and updating the plan
- Machinery should be examined regularly
- Medical examination for every employee shall be examined by doctors at least 3 months in a calendar. Health register should be maintained by the individual industry coming in the project site

**Emergency Action Plan for Fire**

In case of Fire the immediate plan of action will be "RACE" that stands:

R - Rescue: When you discover a fire, rescue people in immediate danger if you can do so without endangering yourself.

A - Alarm: Sound the alarm by pulling a fire pull station and call fire station, from a safe distance, notify security of precise location of fire

C - Confine: if possible

E - Evacuate: Evacuate the place

Immediately informed the response team. Response team moves to the point of fire and take all necessary steps to stop the fire. If the fire is not controllable and spreads then the manager in charge should inform the district authorities and call for external help. Complete an Incident/Accident Report within 24 hours.

Firefighting system is proposed to prevent and control fire outbreaks for the project. The firefighting system will consist of portable fire extinguishers, hose reel, wet riser, yard hydrant, automatic sprinkler system, and manual fire alarm system.

**Emergency Action Plan for Electric Fire**

- Disconnect the affected areas electric supply
- If fire is small scale than $NAHCO_3$ or Sand will be effective.
- Attempt to extinguish fire with the help of $CO_2$ based extinguisher

Action Plan of on-site Emergency Plan

- The action plan considered is given as follows:
- To constitute Disaster Management Committee under senior officer not below the rank of General Manager
- To identify potential hazards areas in the layout map
- To predict degree of burns and distance of the risk zone by using model
- To evacuate the area within risk zone
- To localize the emergency and if possible, eliminate it
- To minimize the effects of accidents on people and property
- To take remedial measures in the quickest possible time to contain the incident and control it with minimum damage
- To mobilize the internal resource and utilize them in the most effective way
- To get help from the local community and government official to supplement internal manpower and resources
- To minimize the damage in other sections
- To keep the required emergency equipment in stock at right places and ensure that they are in working condition
- To keep the concerned personnel fully trained in the use of emergency equipment
- To give immediate warning to the surrounding localities in case of emergency situation arising
- To mobilize transport and medical treatment of the injured
- To educate the public in the surrounding village regarding hazards
- To arrange treatment of causalities
- To safe guard the people
- To identify the causalities and communicate to persons known to them
- To render necessary help to concerned
- To rehabilitate area affected

**Urban Floods:**

Floods are extreme events, usually triggered by extreme precipitation (river/inland floods) and/or storms (coastal floods). If these rainfalls exceed the retention capacity of the basins, drainage speed and volume, it causes floods.

**Different Types of Flooding:**

1) Localized flooding due to inadequate drainage;

2) Flooding due to overflows from River, where settlements have taken place in the flood plains.

**Stakeholders in Disaster Management:**

The policy also systematizes a frame work of operation for the following set of stakeholders that play key roles in disaster management.

- Kerala State Disaster Management Authority
- State and Central Government Departments
- District Disaster Management Authorities
- Local authorities including Municipal Corporations/Municipalities, District/Block/Grama Panchayaths, Taluk/Village Officers etc.
- Voluntary and Civil Society Organizations
- Red Cross, multilateral aid agencies and U.N agencies
- Community – Village Disaster Management Committees / Task Forces
- Public sector Undertakings
- Private sector undertakings
- Army, Navy, Air Force, Coast guard, Airport Authority, National Disaster Response Force etc.

**6.4Environmental Monitoring Plan**

Monitoring at a dumpsite site is carried out in four physical zones as follows:

i. On and within the dumpsite
ii. In the unsaturated subsurface zone beneath and around the dumpsite
iii. In the groundwater (saturated) zone beneath and around the dumpsite

iv. In the atmosphere/local air above and around the dumpsite

The Environmental Monitoring Program involves the following:

- Conducting survey and sampling program.
- Analysis of samples and data / information collected, and interpretation of data and information.
- Preparation of reports for submitting to management and statutory authorities.
- Environmental monitoring is carried throughout the project operation to detect changes in the key environment quality parameters, which can be attributed to the project.

The results of the monitoring program used to evaluate the following.

- Extent and severity of the environmental impacts against the predicted impacts
- Performance of the environmental protection measures or compliance with pertinent rules and regulations.

### 6.4.1 Air Environment

The potential sources of air pollution from the dumpsite include vehicular movement, emission of dust from biomining activities & wastes retrieved and stacked, and passive leakage of landfill gas from the disposal site. Other important contributor is odour emissions from the existing legacy site disturbed. Monitoring of the air environment will be carried out during the operational phase in and around the project site.

### 6.4.2 Noise Environment

The operations shall induce noise due to operations of transport trucks (men & material), JCB loaders and other types of machinery required at the dumpsite for moving wastes, screening, stacking, turning etc, and the biomining activity per se. Monitoring of ambient noise levels and also the exposure of the workers to that environment is essential.

### 6.4.3 Water Environment

Water quality to be monitored during the operational phase. The monitoring frequency needs to be increased if higher concentrations are expected. Both groundwater regime and

surface water domain is anticipated to be most-affected, through leachate contamination. Therefore, surface water will be periodically monitored for the parameters particularly the heavy metals and the hazardous chemicals

### 6.4.4 Land Environment

The soil in the neighboring areas will be analyzed for the relevant parameters. The land environment also includes developing a green belt.

The details of Environmental Monitoring Programs are given below:

*Table 19 Environmental Monitoring Parameters*

| Environmental components | Locations | Frequency | Parameters |
|---|---|---|---|
| Ambient Air quality | Nearby habitations and downward locations | Quarterly [1 sample] | $PM_{10}$, $PM_{2.5}$, NOx, CH4, CO, Ammonia |
| Noise | Within the site | Monthly | Noise levels |
| Ground and Surface water | Ground water from the nearest well and streams or river | Quarterly | IS 10500:2012 drinking water parameter if required |
| Accidental release | Chemical, oil and fuel spills | Daily | Nil |
| Health safety Hazards | Medical records, documentation of injuries and accidents, Health and safety assessments | Monthly | Health and safety survey |
| Leachate | 1 point per leachate pond | Quarterly | • pH<br>• Biological Oxygen Demand- BOD<br>• Chemical Oxygen Demand-COD |

| Environmental components | Locations | Frequency | Parameters |
|---|---|---|---|
| | | | • Nitrogen (Ammonia, Nitrate, Nitrite)<br>• Oxidation-Reduction Potential- ORP<br>• Electrical Conductivity-EC<br>• Total Organic Carbon (TOC) Dioxins |

In case of any deviation from FR, this would be updated and mitigation monitoring measures would be revisited. Currently the location of disposal of biomined material, or type of transport of biomined material is unknown & hence, these impacts & mitigation, monitoring requirements will be updated & implemented by the Contractor. This aspect should be made a Bid condition.

### 6.5 Environmental & Social Safeguard Budget

The details of Environmental Budget for Implementation and Supervision of Environmental Management Plan (EMP) is given below:

*Table 20 Environmental & Social Safeguard Budget*

| S. No. | Description | Frequency | Unit Price | Qty | Amount in Rs |
|---|---|---|---|---|---|
| | **Environmental Safeguards** | | | | |
| 1 | Deodorizer equipment (power sprayer) | Only Once | [redacted] | [redacted] | [redacted] |
| 2 | Green Net (Approx., 280 m Length – Height – 3 m) and installation charges | Based on requirement | [redacted] | [redacted] | [redacted] |

| S. No. | Description | Frequency | Unit Price | Qty | Amount in Rs |
|---|---|---|---|---|---|
| 3 | Spillage Kit | Only Once | [redacted] | [redacted] | [redacted] |
| 4 | Monitoring of Environmental parameters [Air, Ground water, Surface water, Noise, Soil and Leachate] Actual Noise abatement, odour management, dust management measures to be included in DPR cost | Quarterly, first six months by contractor and next two years by ULB | [redacted] | [redacted] | [redacted] |
| 5 | Gas monitoring to check the gas accumulation at the dumpsite | Gas monitoring should be conducted at least twice a day for about 7 consecutive days | [redacted] | [redacted] | [redacted] |
| 6 | Personal protective equipment | Entire Process | [redacted] | [redacted] | [redacted] |
| 7 | Training on capacity building | Entire Process | [redacted] | [redacted] | [redacted] |
| 8 | Leachate Management (Full costs included in DPR. This is only for incidental mitigation of odur, leaks, spillage, flies etc.) | Entire Process | [redacted] | [redacted] | [redacted] |

| S. No. | Description | Frequency | Unit Price | Qty | Amount in Rs |
|---|---|---|---|---|---|
| 9 | Site Access Road Improvisation | One time | [redacted] | [redacted] | [redacted] |
| | **Social Safeguards** | | | | |
| 10 | Overall Budget for Social Safeguards | | [redacted] | [redacted] | [redacted] |
| **TOTAL (actual costs for works involved for mitigation measures are to be included by the contractor in DPR costs based on his work method. This is only indicative cost for incidental mitigation & management measures. EHS in Labour camp also not included here; but shall be included by the contractor based on his work plan as this is combined with multiple other dumpsite biomining works)** | | | | | [redacted] |

## 7. INSTITUTIONAL ARRANGEMENTS

### 7.1 Proposed Institutional Arrangements

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of Terms of Reference (ToR) for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation.

The Support Organization will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments. Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level.

The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances. The

PIU will submit the compliance reports on clearances, permits, and environmental and social safeguards to D-ESDU.

### 7.2 Capacity Building

Capacity building is defined as the "process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in the fast- changing world. It is a long-term, continuing process, in which all stakeholders participate.The dumpsite remediation requires the following capacity building programmes;

- Sensitize and orient different stakeholders of the project with adequate communication of benchmark standards on various project components. Ensure up gradation of awareness generation at different levels. Special focus: Health Hygiene and sanitation Sub Activity
- Training program for ULB officials includes elected representatives, municipal officials.

**Importance of Capacity Building**

Capacity building is the development of knowledge, skills and attitudes in individuals and groups of people relevant in the design, development and maintenance of institutional and operational infrastructures and processes that are locally meaningful. The main aim of capacity building under solid waste management is to build a basic understanding regarding the solid waste management project at each step of value chain (waste generation, segregation & storage at source, primary collection, secondary collection, transportation, processing and disposal) and importance of their work and develop a sense of belonging towards the work.

### 7.3 Grievance Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizen can lodge complaint either directly to ULBs, toll free number or through digital platforms (website/email – https://kswmp.org/grievances/grmkswmp@gmail.com / Toll free number-18004250238). The complaint will automatically be recorded in login of ward

level official of ULB and an escalation system is constituted according to the category of each complaint to close the complaint in time. The complainer can close the complaint through a feedback form according to their satisfaction.

A municipal level GRM committee is required to constitute during the subproject implementation. It will help to solve the issues locally. The Municipal Chairperson, Ward Councillor, Municipal Secretary, community representatives, contractor, social workers, subject expert etc are the proposed members in the committee. The municipality can include more members if required.

## 8. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

"Public Consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate.

The proposal is to remediate the existing site in order to protect the environment and human health of the nearby area. The summary of the document will be made available in the website, which will also be featured in a newspaper advertisement in Malayalam language for public disclosure.

### 8.1 Consultation Meeting

In connection with the dumpsite remediation, a consultation meeting was conducted on 03.06.2023. Stakeholders from different social entities participated in the consultation meeting followed by a transect walk. Political and local leaders, Kudumbashree members, Municipal ward councilors, HKS, officials from DPMU, ULB, PIU and TSC participated.

In the meeting, SWM Engineer explained about the proposed dumpsite remediation activities with a positive note on how the remediation activities beneficial to the local community. The local residents extended whole support from the local people for the dumpsite remediation activities. Further, a detailed description on dumpsite remediation was given by the Social and Communication expert, DPMU. Participants expressed their concerns regarding the proposed project activities and its implementation modalities. The participants were happy that the lifelong bad image of 'trenching ground' would get removed since it was highly a stigmatized usage.

### 8.2 Outcome of the meeting

A transect walk was carried out followed by the meeting with the participation of stakeholders. The participants, after the meeting and interactions, extended support for the dumpsite remediation activity. The meeting also discussed various aspects of dumpsite remediation in detail including the possible social and environmental issues that may affect their routine life as well as the free movement during the time of operation.

### 8.3 Information and Education and Communication (IEC) Plan

| IEC Plan for dumpsite remediation - Koothuparamba | | | | |
|---|---|---|---|---|
| **Programme** | **Methodology** | **Topic** | **Responsibility** | **Monitoring** |
| **Sensitization/ Awareness programme** | Meetingwithallconcernedstakeholder'swithpriornotificationtodiscussaboutheprocessandremediationmethods | Process of dumpsite remediation Developing as a Recreational Park | Contractor | TSC/DPMU /DPMC |
| **Cautionary notification boards** | About vehicle movement and the transit of waste | precautionary measures should the general public take. | Contractor | TSC/DPMU /DPMC |

**Conclusion**

The dumpsite remediation activity at Koothuparamba municipality falls under moderate social risks. However, a set of risk mitigation activities are mentioned in the scoping of social management plan to overcome the identified risks and its negative impacts. Formation and regular meeting of GRM & stakeholder's committee, awareness generation counseling for the aggrieved parties, gender sensitization, legal awareness, providing safety are the major mitigation measures. This proposal is made to reduce the social risk associated with dumpsite remediation and to minimize the negative social impacts.

**Annexure 1 – Environmental Screening**
**Environmental Screening**

**Sub Project Details**

| Name of Subproject: | Dumpsite Remediation |
|---|---|
| Sub project Components: | Dumpsite Remediation |
| Subproject Location (City / Town/ Village with ward numbers): | Koothuparambu ULB, Ward 5 Palaparamba,Kannur District. |

**Stage 1: Exclusion List**

| Sl.No | Non-permissible Activities |
|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i) any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to siting criteria as per SWM Rules 2016 (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible) |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides |
| The project does not fall under the above conditions as mentioned under exclusion list | |

**Stage 2: Environmental Screening Checklist**

| Project Details | | |
|---|---|---|
| S.No | Components | Details |
| 1 | Project Components | Dumpsite Remediation |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste management, centralized non- | • Biomining of dumpsite |

| Project Details | | |
|---|---|---|
| S.No | Components | Details |
| | biodegradable waste management facilities, centralized biodegradable waste management facilities, sanitary landfills, biomining of dumpsites, including for Linked activities / associated facilities) | |
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project; including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination) Site Survey No:/s (attach map) with ownership details, Geographical co-ordinates of the site location [including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | Latitude:11°50'10.6"N<br>Longitude:75°34'19.2"E<br>Land ownership: Koothuparamba Municipality.<br>Land use: Public and Semi Public.<br>Door no. MCF: 5/209G; RRF 5/209F; Windrow composting: 5/209E<br><br>Disaster Zone: It falls under Zone III (Moderate) |
| 4 | Land Area proposed to be used: Location wise (in sq. km / sq. m) | It is remediation of land and hence no land required |
| 5 | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | Operational phase – 0.5 KL/day |
| 6 | Power Required and Source of Power | Demand load for the proposed equipment during the remediation process will be made available by DG sets |

**Baseline Environmental Conditions**

| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| 1<br><br>(i) | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers) | | No | The project site is not located near any Critically Vulnerable Coastal Areas (CVCAs), Eco sensitive Areas (ESAs) |

| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| | Critically Vulnerable Coastal Areas (CVCAs), Eco sensitive Areas (ESAs) | | | |
| (ii) | Cultural Heritage site, protected monuments - listed by ASI/State | | No | The project site is not located near any cultural Heritage or protected monuments as listed by ASI/state |
| (iii) | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensitive area, with any schedule 1 species? If yes, which is the area? | | No | The project site is not located near Natural Forests / Protected Areas / Bio-Reserves |
| (iv) | Other Wetlands/ Mangrove/ Estuarine Region | | No | The project site is not located near any Wetlands/ Mangrove/ Estuarine Region |
| (v) | Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves | | No | The project site is not located near any Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves<br>There is a river Anjarakandy which is located at an Aerial distance of 3.5 km away from the site |
| (vi) | Other Sensitive Environmental Components listed in EMF | | No | No other sensitive environmental components listed in EMF exist nearby the project site |
| (vii) | Drinking water source, upstream and downstream uses of rivers, etc | | No | No river source is resorted for drinking water use |
| (viii) | Low-lying areas/areas of Tidal Influence (provide CRZ details) | | No | The sea is located 13 km (Aerial Distance) from the project site |
| (ix) | Sensitive Receptors – a) Habitations / Households / Hostels, other special areas, etc. b) School c) Religious Places d) Tourist Areas | Yes | | a. **Nearest Habitation-** 20 Houses are located within 200 m radius of the dumpsite<br>b. **Religious Place-** Temple (Noonjiyil Bhagavathi Sthanam) is located at an |

| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| | | | | aerial distance of 170 m away from unit<br>c. **School** – Koothuparamba High School is located at an aerial distance of 730 m<br>d. **Hospital** – Cimhans Hospital is located at an aerial distance of 750 m<br>e. **Tourist Places** – Areekkal waterfalls is located at an aerial distance of 10.5 km<br>f. **Airport** – Kannur International Airport is located at an aerial distance of 9.5 km |
| 2 | Is the site in Critical / Over Exploited Ground Water Block. Provide the level of the groundwater table | | No | Site falls under semi-critical block |
| 3 | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other (specify) | | No | The site does not fall under major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion<br>There may be chance of fire due to the following<br>1. Fire breaking due to high temperature<br>2. Electrical short circuit due to poor maintenance.<br>3. Smoking in the premises near the waste storage.<br>4. Burning of the waste by unauthorized persons<br>5. Keeping highly flammable materials like, cooking gas, kerosene, match boxes, etc. |

| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| | | | | 6. Not having provision for proper fire/smoke detecting system. |
| 4 | Describe the type of soil and vegetation on site | Yes | | Laterite and red soil is predominantly available and few trees are present inside the site |
| 5 | Is the site present in the flood plains as recorded in the last 100 years. Provide the HFL level of the site/region | | No | The sea is located 13 km (Aerial Distance) from the project site |
| 6 | Existing pollution/contamination or degradation on site | Yes | | Dumpsite located in Koothuparamba ULB is the existing contaminationand detailed under section 3.11 |
| 7 | Any other remark on baseline condition | | No | There is no other remark on baseline condition |

**Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology, and Soils**

| S.No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Total extend of land to be covered/built | Yes | | 0.98 acres where waste is dumped |
| 2 | Total extend of land where the waste will bedumped openly / or expected to get contaminated by waste or leachate/material storage | | No | Nil |
| 3 | Extend of Land to be remediated | Yes | | 0.98 acres where waste is dumped |
| 4 | Extend of land expected to be under green belt | Yes | | Will be under the scope of contractor |
| | Proposed project cause the following on Land / Soil: | | | |
| (i) | Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains | | No | There will be no major impact other than the operational phase as this project is remediation project. During operational phase the anticipated impacts are |

| | | | | |
|---|---|---|---|---|
| | | | | identified and mitigation measures are provided |
| (ii) | Substantial removal of Top Soil (mention area in sqm) | | No | NA |
| (iii) | Any degradation of land / eco-systems expected due to the project? | | No | There will be no Land degradation instead it will be a remediation of land from further contamination |
| (iv) | Loss or impacts on Cultural/heritage areas/properties | | No | There will be no loss or impacts on Cultural/heritage areas /properties |
| (v) | Does the project activity involve cutting and filling/ blasting etc? | | No | The project does not involve cutting and filling/ blasting as the building is existing. |
| (vi) | Will the project cause physical changes in the project area (e.g., changes to the topography) due to excavation, earthwork, or any other activity? | Yes | | The project will have physical change in a positive way by clearing the waste dumped into vacant land |
| (vii) | Will the project involve any quarrying/ mining etc.? | | No | The project does not involve any quarrying/ mining |
| (viii) | Will the project / any of its component contaminate or pollute the Land? | | No | Presently there is contamination and due to the project activity, the further contamination shall be eliminated and natural system shall be restored |
| (ix) | Will the project contribute to any long term significant adverse (negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | No | There will be no negative impact due to the proposed project |
| (x) | Will the Project or related activities cause negative impacts on the land in combination with other anticipated / existing projects in the region? | | No | There will be no negative impact due to the proposed project |

| S.No | Impacts on Air and Noise Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the project cause or increase air pollution due to dust and / or vehicle emissions? | Yes | | It will be minimal and adequate mitigation measures will be taken to reduce the impact. |
| 2 | Will the project cause or increase pollution due to GHG emissions? | | No | Nil |
| 3 | Will the project cause or increase odour nuisance? | Yes | | The Biomining project will be create odour nuisance but it is temporary and once the process is completed there will be no odour nuisance. |
| 4 | Is there a potential for release of toxic gases or accident risks (eg: potential fire outbreaks) | Yes | | There may be chance for any release of toxic gases or potential fire outbreaks which will be mitigated through proper mitigation plan. |
| 5 | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | Yes | | The Biomining project will create increase in noise level but it is temporary and once the process is completed there will be no noise |

| Sl.No | Impacts on Water Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the activities proposed at the site(s) impact water quality (surface or ground) – leachate, runoff, wastes deposition, erosion? | | No | The leachate generated will be properly collected in leachate collection tank and thus avoiding the impact with the surface or ground water |
| 2 | Will the activities proposed at the site(s) impact water resource availability and use - leachate, runoff, wastes deposition, erosion? | | No | The leachate generated will be properly collected in leachate collection tank and thus avoiding the impact |

| | | | | |
|---|---|---|---|---|
| | | | | with the surface or ground water |
| 3 | Chances of Pollution of Water bodies / groundwater wells, nearby or downstream | | No | There will not be any chance of pollution of water bodies / groundwater wells, nearby or downstream |
| 4 | Will the activities proposed at the site(s) hinder natural drainage | | No | The activities proposed at the site will not hinder natural drainage and the proposed activity will improve the natural pathway without any obstacles. |
| 5 | Will the activities proposed at the site(s) decrease permeability /rainwater percolation | | No | The activities proposed at the site will not decrease permeability /rainwater percolation |

| S.No | Impacts on Bio diversity & Host Communities | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the project necessitates cutting of Trees /Loss of Vegetation | | No | There will be no cutting of trees /no loss of vegetation due to this project |
| 2 | Will the project necessitate substantial removal of Top Soil (mention area in sqm) | | No | There will be no Substantial removal of Top Soil.<br>During the excavation of waste there is a slight chance of the top soil to get removed and the same will be mitigated with byproduct (bio earth) of this activity |
| 3 | Any degradation of land / eco-systems expected due to the project? | | No | There will be no degradation of land / eco-systems expected due to the project activity. Also, the proposed activity will |

| | | | | |
|---|---|---|---|---|
| | | | | protect the land from further contamination |
| 4 | Will the project result in Health & Safety Risks in the neighborhood including the release of toxic gases, leachate, accident risks | | No | There may be chance of accidental risks due to leachate and toxic gases, which will mitigated by proper lined leachate drain and PPE kits |
| 5 | Potential Noise, Light Pollution/movements causing disturbance to nearby habitats/communities | | Yes | There will be no major impact. During operational phase there will be noise pollution due to movement of vehicles which will be curtailed by adopting mitigation measures. |
| 6 | Potential disruption to common property,accessibility, traffic disruptions, conflicts, or disruption to the local community within the subproject area? | | Yes | There will be no major impact. During operational phase there will be slight increase in traffic due to movement of vehicles which will be mitigated by adopting movement of vehicles during off peak hours. |

**Project Categorization and Need for Safeguards Instruments**

| **Project category** | E1 ☐ E2 E ✓ ☐ |
|---|---|
| **Key Reasons** | During screening, it has found that the proposed subproject is moderately causing impact to the base line environment, land/ soil / water /noise environment, biodiversity or to the community. Hence it is categorized as E2. |
| **Safeguards Instruments Required** | a) E1: Project-specific EIA (impact assessment considering the project details & location) by Independent Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities) |

| | |
|---|---|
| | b) E2: Project-specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>c) E3: signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities |

| Status | Agency / Official | Name, Signature with Date and Seal |
|---|---|---|
| **Prepared by** | PIU or ULB (project in charge) | |
| | Environmental Engineer | |
| **Checked, categorised as __ (E1, E2, E3) & ToR issued by:** | DESDU / SESDU | |
| | Environmental Specialist | |

**Annexure 2 – Fire and Risk Assessment**

A fire and risk assessment is a systematic evaluation of potential fire hazards and associated risks within a particular environment or premises. The assessment aims to identify potential fire hazards, assess the level of risk they pose, and recommend measures to mitigate or manage those risks effectively. Fire and risk assessments are essential for ensuring the safety of the workers, protecting property, and complying with fire safety regulations.

The existing legacy waste dumpsite, occupying about 0.98 acres in ward 5 Palaparamba, aims to fully reclaim the land for future development. Bio-mining, a technique chosen after careful evaluation will be used to recover the land and ensure sustainable and environmentally friendly treatment of the waste. The process will yield various by-products, which require immediate attention to prevent fire hazards.

The by-products and their intended use are as follows:

1. The bio earth & Coarse fraction (8774 tons) waste will be utilized for the development of the reclaimed legacy waste dumpsite as a green park/facility.
2. Refused derived fuel (RDF) of 3396 tonswill be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the process.
3. Recyclables of 445 tons will be sold to authorized recyclers

The RDF by-product& recyclables, totaling around 3841 tons, poses a potential fire risk and requires proper handling. To mitigate the risk, a storage and disposal process spanning 3 to 4 months has been devised. During this period, the contractor will implement various protective measures to prevent the possibility of a fire outbreak.These following measures are important for preventing fires, ensuring the safety of workers and nearby communities, and minimizing risks to the environment and property.

**Pre-Construction/Planning Stage:**

1. Fire Safety and Emergency Plan: Develop a comprehensive fire safety plan and emergency response plan to address potential fire incidents.
2. Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard.

3. Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.
4. Fire Equipment: Ensure that the site is equipped with fire extinguishers.

**Storage of Waste & RDF:**

**Fire Standards and Facilities:** Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.

Below equipment and their required quantities should be strategically positioned according to the site's specifications.

- Fire extinguisher (A, B, C powder): It will be used to immediately put off fire caused by wood, Paper and textiles, flammable liquids and flammable gases. Commonly can be placed anywhere inside the site
- Fire extinguisher (Foam spray): Mainly used to put off the fire caused by flammable liquids. It should be placed in diesel storage area, lubricant storage area and DG sets.
- Fire extinguisher ($Co_2$): Mainly used to put off the fire caused by Electrical short circuit. It should be placed near the control panel room/operation room.
- Fire bucket filled with sand: It should be placed near the diesel storage area

To ensure rapid response in case of a fire, it's essential to have a water tanker filled with water, equipped with a fire-fighting hose, readily accessible along with the portable motor. The presence of this equipped water tanker ensures timely and effective action during fire emergencies.

The following points to be considered for assessing the fire risk and procedure to mitigate it.

1. Identification of Fire Hazards: The first step involves identifying potential fire hazards in the premises. These hazards could include sources of ignition (e.g., electrical equipment), combustible materials (e.g., flammable liquids, paper, cardboard), and other factors that could contribute to the outbreak of a fire.

2. Assessment of Risk: Once the hazards are identified, the next step is to assess the level of risk associated with each hazard. This involves evaluating the likelihood of a fire occurring and the potential consequences if a fire were to break out.
3. Escape Routes: Since operational phase occurs in an open environment, the need for conventional escape routes in the event of a fire emergency may not be required.
4. Fire Safety Measures: The assessment reviews existing fire safety measures in place, such as fire alarms, fire fighting equipment, and fire suppression systems. Proper assembly point is required in case of fire break out
5. Emergency Procedures: The assessment evaluates the effectiveness of emergency procedures and evacuation plans in the event of a fire, ensuring that workers can safely evacuate the premises.
6. Fire Training and Awareness: The assessment considers the level of fire safety training provided to workers and the awareness of fire hazards and evacuation procedures.
7. Record-Keeping: Detailed records of the assessment process, findings, and recommended actions are maintained for future reference and regulatory compliance.
8. Recommendations: Based on the assessment, the fire risk assessor provides recommendations for improving fire safety, which may include installing additional fire safety equipment, conducting training programmes, or implementing any changes to reduce fire risks.
9. Review and Updates: Fire and risk assessments should be regularly reviewed and updated to account for any changes in the premises or regulations.

Fire and risk assessments play a crucial role in preventing fires and minimizing their impact if they occur. They are particularly important for dumpsites and other places with a higher risk of fire hazards to ensure the safety and well-being of workers.

NOTE : The major assessments had been referred based on the EMF Vol-II Part A – Indicative EMP

**Annexure 3 –Checklist for screening of dumpsites for potential landfill/ processing facility**

| Name of the contact person from ULB-Phone number and email Address | Koothuparamba |
|---|---|

| S.No. | Item | Norm | Information |
|---|---|---|---|
| 1 | Land ownership (including that required for approach road) (inline with revenue records)(supporting data to be provided as annex) | | Koothuparamba, Municipality |
| 2 | Name of the location of site and Map of the site (include as an annex) | | Palaparamba,Koothuparamba |
| 3 | GPS coordinates of site | | Latitude: 11°50'10.6"N<br>Longitude: 75°34'19.2"E |
| 4 | Is there a Pollution Control Board permit for dumping /SWM activity? | | Yes |
| 5 | Is there a notified no development zone or buffer or green belt around the dump? | | No |
| 6 | Possible area to be kept as buffer green belt around (within /outside the site for purchase) | | Not available |
| | **Site Selection Criteria - give distances, wherever applicable** | | |
| 7 | Groundwater (m below liner bottom) | 2m | No |
| 8 | Private water sources (well etc.)- distance from site boundary (to beadjudged based on approx. distances during screening exercise) | 100 m (river) | No |
| | | 200 m (Pond) | No |
| | | 30 m (Local Canal) | No |

| | | | |
|---|---|---|---|
| 9 | Env. Sensitive Areas/ Wetlands | Not Permitted | No |
| 10 | Site having Rare and Endangered Species | Not Permitted | No |
| 11 | Site should not be within Protected/Reserve Forests | Not Permitted | Site is Not within the Protected/ Reserve Forests |
| 12 | Residential Development within prescribed buffer zone of 200 m | Not Permitted | Yes. Local Residents nearby Dumpsite within 200 m |
| 13 | Perennial Stream within site | Not Permitted | No |
| 14 | Airport | 20 Km | Yes. Airport is located an aerial distance of 9.5 km |

| S.No | Item | Norm | Information |
|---|---|---|---|
| 15 | Distance to the nearest village in the predominant wind (m)direction | | Palaparamba |
| 16 | Flood prone site | | No |
| 17 | Accessibility - Road access for heavy vehicles | | No |
| | i. Starting point of the access road | | No |
| | ii. length and width of the access road | | No |
| | iii. Current condition of the access road (visual assessment) | | No |

| S.No. | Site Description | | |
|---|---|---|---|
| 18 | Is the site that/stopping to nearby uses | | High Land |
| 19 | Soil base-soft soil/murum,soft rock etc | | Hard Laterite & red soil |
| 20 | Direction of Leachate flow out of the site, if any | | All the existing waste are caped on 2012 |

| | | | |
|---|---|---|---|
| 21 | Other uses within the dumpsite(recycling yard, compost pad etc) | | Existing MCF,RRF, Composting building and new windrow provision available |
| 22 | Boundary conditions-walls/fence/what land uses along boundary | | Compound wall |
| 23 | Year since the dump site is existing | | 1973 |
| 24 | Is the dumping Operation Ongoing | | Still waste is dumping at dumpsite. |
| 25 | Any underground utilty/gas line etc near the site | | No |
| 26 | Existing power supply,water supply,electric poles going through/over/in the site etc. | | Yes. Bore well is inside the compound wall. |
| 27 | Are there pools of leachate ,rat and fly infestations, domestic animals roaming freely, odours, dust, vermin and birds, waste being burnt at dumpsites or families of scavangers picking through the wastes | | No |

| Geography and Climatic aspects | | | |
|---|---|---|---|
| 28 | Average annual rain fall | | 3471 mm |
| 29 | Duration of rainfall | | May to August |
| 30 | Whether any incidents of flooding reported at site/other hazards | | |
| | i. No | | |
| | ii. Very Rare | | Very Rare |

| | | | |
|---|---|---|---|
| | iii. Some times | | |
| | iv. Frequent | | |
| 31 | Any geological fault | | No |
| Waste Characteristics | | | |
| 32 | Characteristics of the dumps, such as the height and area, characteristics of solid waste based on visual inspection and degree of compaction (subjective), and any details of variability of wastes within the site | | The dumpsite began its waste disposal operations in 1973, and in 2012, the waste was capped. Currently, they are depositing waste in a nearby separate pit. |
| 33 | Type of waste (MSW/HW) (subjective assessment based on visual inspection) | | MSW |
| | i. 100% MSW | | |
| | ii. 75% MSW +25% (domestic and/ or biomedical/ HW/EW) | | Yes |
| | iii. 50% MSW +50% (domestic and/ or biomedical /HW/EW) | | |
| | iv. > 50% (domestic and/ or biomedical /HW/EW) | | |
| 34 | Expected waste contamination (visual check of ground water, littering, dust pollution, Smell/odour, Is the ground water being used for drinking purpose) | | Ground water not used for drinking. |

| | | | |
|---|---|---|---|
| 35 | How much quantum of fresh waste is dumped everyday? | | No |

| General Information | | | |
|---|---|---|---|
| 36 | Any reported Environmental and health impacts of existing dump (from ULB eg-media report or complaint) | | No |
| 37 | Any ongoing litigation or disputes related to site usage | | No |
| 38 | Potential for mining decomposed organic materials (compost from the existing dumps (By visual inspection) | | No |
| 39 | Presence of ragpickers and approx.how many? Male/Female and age group | | Not available as on visit time. But as per SWM data file 12rag pickers |
| 40 | Number of sensitive receptors close to dumpsite (approx.200 m which is buffer zone criteria) (mention distance to closest residence, social profile of the people, school, religious structure, wetland, forest, river, canal, Eco sensitive area, well, lake/pond) | | Nearby river within 3.5 km. Govt HS School within 730 m. |
| 41 | Available open / clean space in the dump yard which can used to develop a treatment facility till such time the dump is cleaned, and land is recovered (percentage of land available for use) | | Yes |

| | | | |
|---|---|---|---|
| 42 | Space / covered shed (which may be renovated to house segregation & storage facility) | | No |
| 43 | Estimated time for dumpsite capping/ mining/ remediation. Does it fall within the project lifetime? | | 100 days |
| 44 | Possible Range of solutions: rehabilitate existing open dumps through landfill mining where the resource recovery might serve as a source of energy, recycle and reuse of metals, plastic and glass ware, use of compost as fertilizer for agriculture and as a cover material for future landfills, etc. | | RDF materials can be processed and used for cement kilns. |
| 45 | Is dumpsite remediation likely to benefit in regaining a suitable site for an engineered landfill cell or for setting up any other waste management facility? If yes, what could be set up? | | There is a demand for the establishment of new MRF. |
| 46 | Likely area of the site which can be salvaged for future use More than 70%, 50-70%, 30-50%, Less than 30% | | 50 %. |

| Upstream Linkages required | | | |
|---|---|---|---|
| 47 | Stop the waste coming to the site or delineate a separate area for proper processing of waste. | | Dumping of waste to be stopped |
| 48 | Intention of anchor ULB (where the site is located) to allow the facility to be used as a regional facility, with | | After thorough stakeholder consultation, the |

| | | | |
|---|---|---|---|
| | other ULBs falling in the cluster, on a cost sharing basis. | | recommendation is to process the waste at a standalone site. |
| Downstream Linkages required | | | |
| 49 | Off-take of all the products coming out of the biomining - Plastic & RDF - cement factories, soil/bio-earth - farmers or gardens, inert - SLF/closure | | Forward linkage for the RDF yet to be finalized |
| 50 | Any wastewater treatment facility whether available within 10 km where leachate can be transported for treatment. | | No |
| Other Information | | | |

## Annexure 4 Occupational Health and Safety

Occupational Health and Safety Risk Assessment for Dumpsite Remediation is as follows

### 1. Introduction:

The purpose of this Occupational Health and Safety (OHS) Risk Assessment is to identify, assess, and mitigate potential hazards and risks associated with the implementation of a Biomining project for dumpsite remediation. Biomining is a sustainable and environmentally friendly method used for the disposal of dumped waste and reclamation of land.

### 2. Scope:

This risk assessment focuses on the occupational health and safety aspects of the Biomining process for dumpsite remediation. It covers the potential hazards and risks that workers may encounter during site preparation, Biomining operations, and waste disposal activities. The assessment will also outline control measures to minimize or eliminate these risks.

### 3. Hazard Identification:

Biomining process identifies potential hazards, which include but are not limited to:

a. Chemical Hazards: Exposure to hazardous chemicals present in the dumpsite waste and chemicals used in the Biomining process.

b. Biological Hazards: Potential health risks associated with the presence of pathogens, disease-causing microorganisms, and vectors within the waste. These hazards can arise from the decomposition of organic matter, the presence of infectious materials, and the attraction of disease-carrying organisms such as rodents, insects, and other vermin.

c. Physical Hazards: Potential for slips, trips, and falls on uneven terrain or during equipment operation.

d. Mechanical Hazards: Risks associated with operating and maintaining heavy machinery.

e. Ergonomic Hazards: Strain and injuries related to improper handling of equipment or materials.

f. Environmental Hazards: Adverse effects on air and water quality during the Biomining process.

**4. Risk Assessment:** The risk assessment will categorize the identified hazards based on their severity and likelihood of occurrence. Each hazard will be evaluated using a risk matrix to determine the level of risk and priority for mitigation.

### 5. Risk Mitigation Measures:

To ensure the safety of personnel involved in the Biomining project, the following risk mitigation measures will be implemented:

a. Engineering Controls:

- Regular maintenance and inspection of machinery to prevent mechanical failures.

- Providing appropriate personal protective equipment (PPE) to workers.

b. Administrative Controls:

- Developing standard operating procedures (SOPs) for Biomining operations.

- Implementing a comprehensive training program for all personnel involved in the project.

- Scheduling regular breaks and rotation of tasks to minimize fatigue.

c. Environmental Monitoring:

- Regular monitoring of air and water quality to ensure compliance with safety standards.

- Establishing emergency response protocols in case of any unexpected environmental events.

d. Emergency Preparedness:

- Developing and practicing emergency response plans for potential accidents or incidents.

- Providing workers with first-aid training and easily accessible medical facilities.

e. Personal Protective Equipment (PPE):

- Mandating the use of appropriate PPE, such as respirators, gloves, safety goggles, and protective clothing.

**6. Worker Health Surveillance:**

Implementing a health surveillance program to regularly monitor the health of workers involved in the Biomining project. This may include medical examinations and assessments to detect any health issues related to exposure during the remediation process.

The work site to be equipped with first aid and the contractor must have tie-up with nearest primary health center/ medical facility for the welfare of the Labours.

**7. Training and Education:**

Conducting comprehensive training and educational programs for workers and supervisors to raise awareness of potential hazards, proper handling of equipment, and the correct use of PPE.

## 8. Conclusion:

By proactively identifying potential hazards, assessing risks, and implementing appropriate control measures, this Occupational Health and Safety Risk Assessment aims to ensure the safe and successful execution of the dumpsite remediation Project through Biomining. Continuous monitoring and improvement will be essential throughout the project to maintain a safe work environment.

KSWMP

FEASIBILITY REPORT

# DUMPSITE BIOMINING AND BIOREMEDIATION, PALAPARAMBA, KOOTHUPARAMBA MUNICIPALITY














November 2023

KSWMP | LSGD | LSGD

State Project Management Unit

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## EXECUTIVE SUMMARY

Koothuparamba Municipality is one of the rapidly developing urban local bodies in Kannur district. Even though the ULB has an excellent practice of waste management, the primary environmental issue currently faced by municipal authorities revolves around a longstanding existing legacy waste dumpsite. Despite discontinuing the dumping activities, these dumpsites remain as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Consequently, these sites pose significant environmental, social, and economic challenges for the communities and ecosystems surrounding them. The SWM Rules 2016 directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the project for the remediation of legacy waste dumpsites in all the ULBs. As part of the project, the existing dumpsite at Koothuparamba, ward 05, Palaparamba was proposed for remediation.

The Koothuparamba municipality has an area of 16.76 sq.km with 28 wards. The municipality, with the financial and technical support of KSWMP, has taken up steps to remediate the existing legacy waste dumpsite located in around 0.986 acres of land inward 05, Palaparamba and to recover land for future developmental activities. The Palaparamba dumpsite was used for dumping municipal solid waste from the year 1973. The local residents are demanding to remediate the legacy dumpsite and to utilize the remediated land for social cause. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes.

To assess the quantity & composition of legacy waste & also evaluate the environmental baseline of the dumpsite, samples from representative locations were collected and analyzed for various parameters viz., physical and chemical analysis of Legacy waste, Soil, Air, Noise, leachate, Groundwater and Surface Water. As part of the study, detailed site investigations were carried out for; – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical and Environmental Analysis by M/s Poluchem Laboratories. From the results of the investigations, it was found that the waste was seen upto a depth of 5.5m. The total estimated quantity of legacy waste is around 15102 $m^3$ considering the density of the material to be 0.836 tons/cum the total quantity of waste disposed before conducting the survey is estimated as (12625.27 tons).

As per the SWM Rules 2016, selection of an applicable method/type or technique for dumpsite remediation needs to be arrived from the Feasibility study carried out, and based on the results, remediation can be done by a) Capping without land recovery, b) Bio-mining – reclamation/recovery of land and c) capping with partial land recovery. The selection of technology shall also depend on the available resources viz., manpower, machineries, money, and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for land recovery and forward linkages/utilization of processed aggregates/by- products. Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite.

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Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by-products as per the requirements of the utilization/forward linkage. Based on the detailed assessment of the selection parameters, mobile/compact screening machineries shall be optimum for processing the legacy waste of 15102 $m^3$ within the stipulated timeline of 31st March 2024.

Environmental & Social safeguards: The project attracts E2 Environmental category based on the project activities and status of the environment baseline. The project attracts moderate social risks based on the social mapping, transect walk and consultation with the people living around the proposed project site to assess the problems associated with the legacy waste dumpsite and the impact during the execution of the project.

By-products utilization/forward linkages/Usage

1. The approximate quantity of bio earth (7173.43$m^3$) & C&D (3322.44$m^3$) waste will be utilized for the development of the reclaimed legacy waste dumpsite as a Recreational Park/facility.
2. Refused derived fuel (RDF) of 4062.44 $m^3$ will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the process.
3. Recyclables of 543.67 $m^3$ will be sold to authorized recyclers.

The activities of bio-mining will be commenced from Dec 2023 and are expected to end by Mar 2024. An area of 0.986 acres (0.399 Ha) will be reclaimed and will be developed into a recreational park based on the ULB decision for public use. Total cost of the project is [redacted]/-. The cost per $m^3$ for processing and disposal of the legacy waste is [redacted]/-.

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## 1. INTRODUCTION

Koothuparamba Municipality stands as a swiftly advancing urban local body within the Kannur district. Even though the ULB has an excellent practice of waste management, the primary environmental issue currently faced by the municipal authorities revolves around a longstanding existing legacy waste dumpsite. It has a long history of more than three decades of continuous dumping of both bio- and non-biodegradable wastes. Though the waste dumping activity has been stopped, the dumpsite remains as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Improper management of such sites pose significant environmental, social, and economic challenges for the communities and ecosystems in the vicinity.

In view of the environmental and social issues connected with dumpsites, the SWM Rules 2016, directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the remediation projects of legacy waste dumpsites in all the ULBs. As part of the project, the existing dumpsite of Koothuparamba, ward 05, Palaparamba was proposed for remediation.

For arriving at a methodology for remediating the legacy waste in the dumpsites, as per the Project Implementation Manual, a feasibility study outlining the technical, economic, and socio-environmental factors has been carried out. As a result of the feasibility study that involved detailed field investigations & assessment, and market sounding, the method proposed for remediation of legacy waste dumpsite is biomining, which will ensure long-term sustainability and environmentally sound treatment, which is found technically feasible, economically viable, and socially acceptable. The details of various steps involved in the feasibility study are described in the following sections. `

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## 2. GENERAL DESCRIPTION ABOUT PROJECT

Koothuparamba municipality has an area of 16.76 sq.km with 28 wards. Solid waste generated from 9602 households and 1758 institutions including commercial establishments is 13.21 TPD. The municipality intends to strengthen and enhance the existing treatment facilities of the biodegradable & non-biodegradable waste system at household, institutional and community level for effective management of the solid waste generated, and also remediation of existing legacy waste dumpsite.

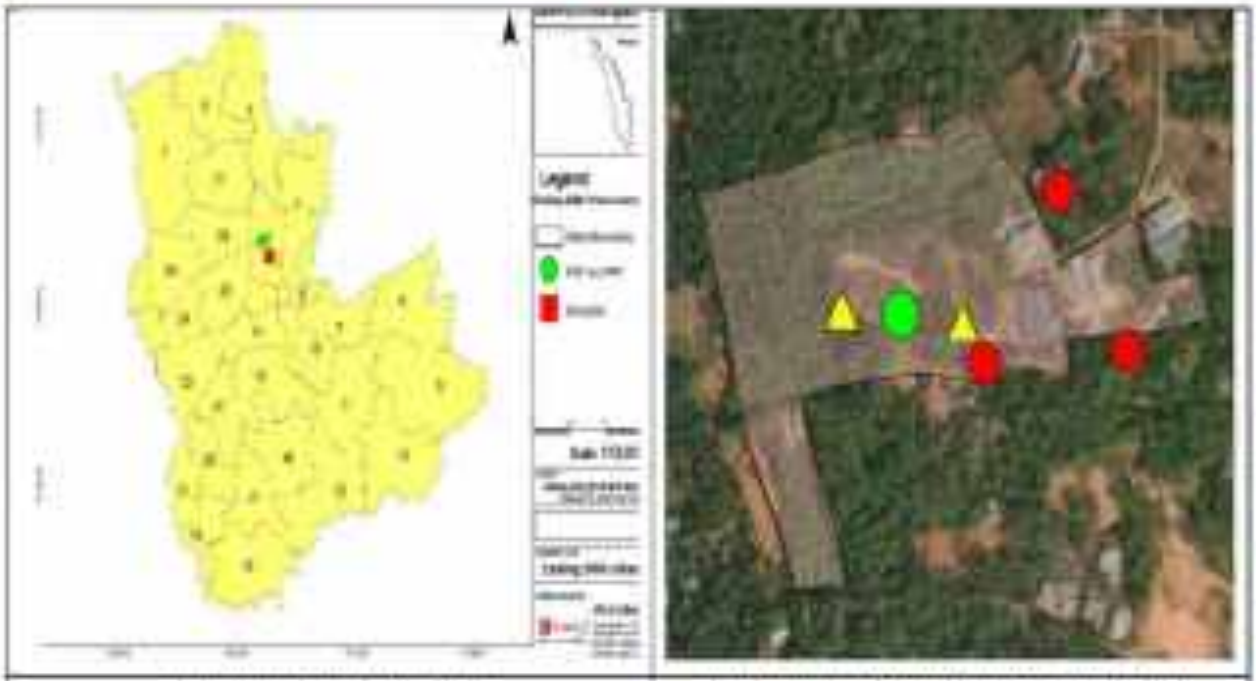
The Palaparamba dumpsite was used for dumping of solid waste from the year 1973. The local residents are in demand for remediating the legacy dumpsite and to utilize the remediated land for social cause.

The legacy waste is spread over an area of 0.986 acres with an average height of 4.5 m. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes. The municipality intends to remediate the existing legacy waste dumpsite for the recovery of land and develop the same into a recreational park for the public use after assessed the suitability of the soil as per applicable standards. The details of the legacy waste dumpsite are provided below:

*Table 1 Dumpsite Details*

| Name of ULB | Koothuparamba |
|---|---|
| District | Kannur |
| Taluk | Thalassery |
| Location | Ward 05, Palaparamba,Koothuparamba. |
| GPS Co-ordinate of the Site | Lat: 11° 50' 10.14''N, Long: 75° 34' 18.959" E |
| Total dumpsite area (in acres) | 4 Acre 81.69 Cents |
| Legacy waste spread (in acres) | 0.986 |

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Dumpsite Location in ULB | Environmental Sampling Location in ULB



Waste Spread in Dumpsite

*Figure 1 Koothuparamba Dumpsite Location*

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# 3. LOCATION, DEMOGRAPHY, ACCESS, LAND-USE, WATER TABLE AND CLIMATE OF THE ULB

## 3.1 LOCATION

Koothuparamba municipality lies at 11°50'10.14''N, 75°34'18.959''E, located in Thalaserry Taluk of Kannur District with an area of 16.76 km$^2$, comprising 28 (Nos) administrative wards. The dumpsite located in the ward 05, Koothuparamba. It is situated about 68 km to the north of Kozhikode City and approximately 22 km to the south of Kannur City. Koothuparamba is surrounded by mattanur on the North, Panoor on the South, Iritty on the East, and Arabian Sea on the West. Location map of Koothuparamba is given below.




*Figure 2 Location of Koothuparamba Dumpsite*

## 3.2 POPULATION, DENSITY AND LITERACY RATE

As of the 2011 Census of India, Koothuparamba had a population of 34,501 with a decadal growth rate of 6.12 % with males constituting 16,560 (48%) of the population and females 17,940 (52%). The population of ULB in 2021 was 34,501, considering the decadal growth rate of 6.12 %. The

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density is around 1800 persons/sq.km. The sex ratio is 1054 females for 1000 males against the state average of 1084.

The literacy rate of Koothuparamba city is 96.76 %, which is higher than the state average of 94.00 %. In Koothuparamba, the male literacy rate is around 98.1 % while female literacy rate is 95.6%.

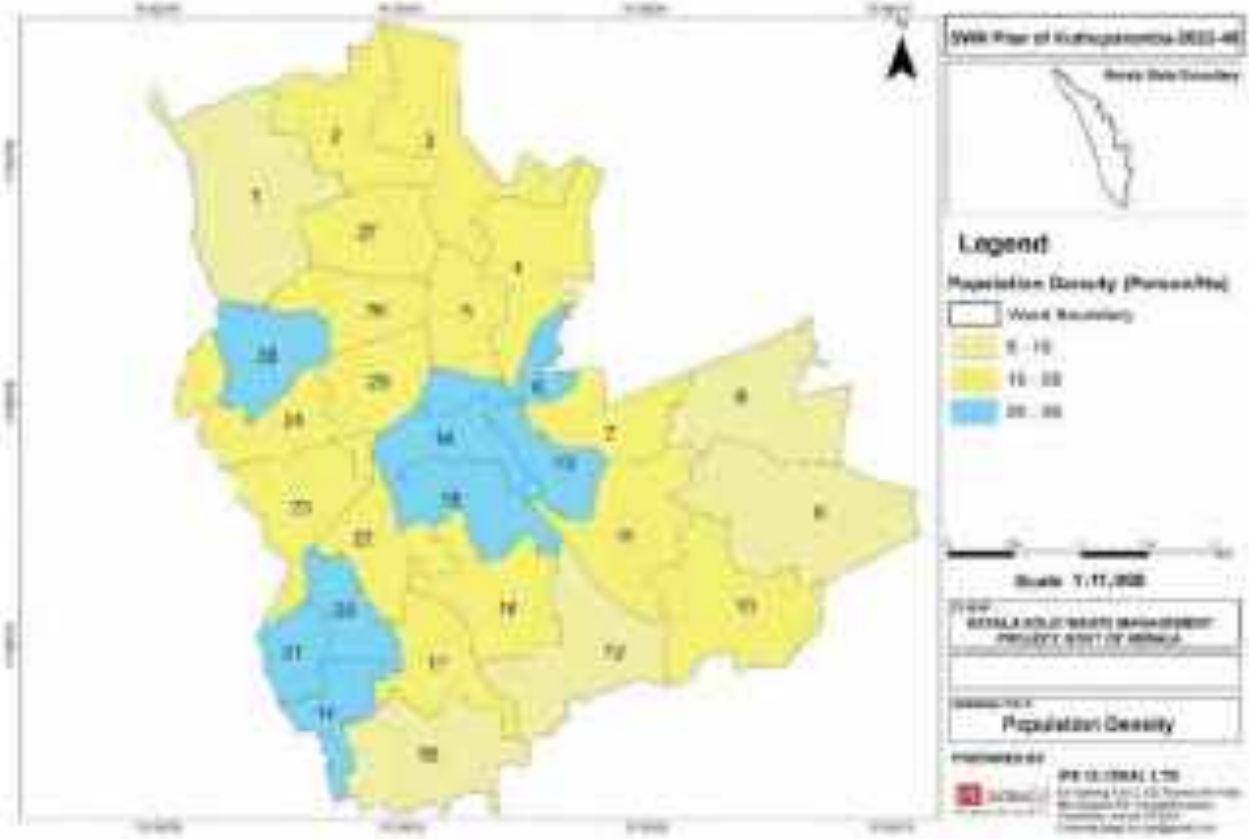



*Figure 3 Ward Wise Population Density (Person/ha)*

## 3.3 LAND USE

The Koothuparamba municipality has a total area of 16.76 Sq. km. The study area's land use has been assessed through satellite data interpretation and confirmed during on-site visits. The primary findings regarding the Koothuparamba

The land use indices of Koothuparamba municipality are shown in below figure.

*Table 2 Land Use Indices*

| Description | Area (in sq.km.) | Land Use % |
|---|---|---|
| Residential | 10.66 | 64 |
| Institutional | 0.54 | 3 |
| Agricultural | 4.51 | 27 |
| Recreational and Open Space | 0.02 | 0 |

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| | | |
|---|---|---|
| Transportation | 0.7 | 4 |
| Water Bodies | 0.11 | 1 |
| Other (Commercial, Sacred groves, Hazardous Zone, Quarry Laterite and Granite) | 0.23 | 1 |
| **Total** | **16.76** | **100** |

Source: Master Plan for Koothuparamba town 2031(draft)

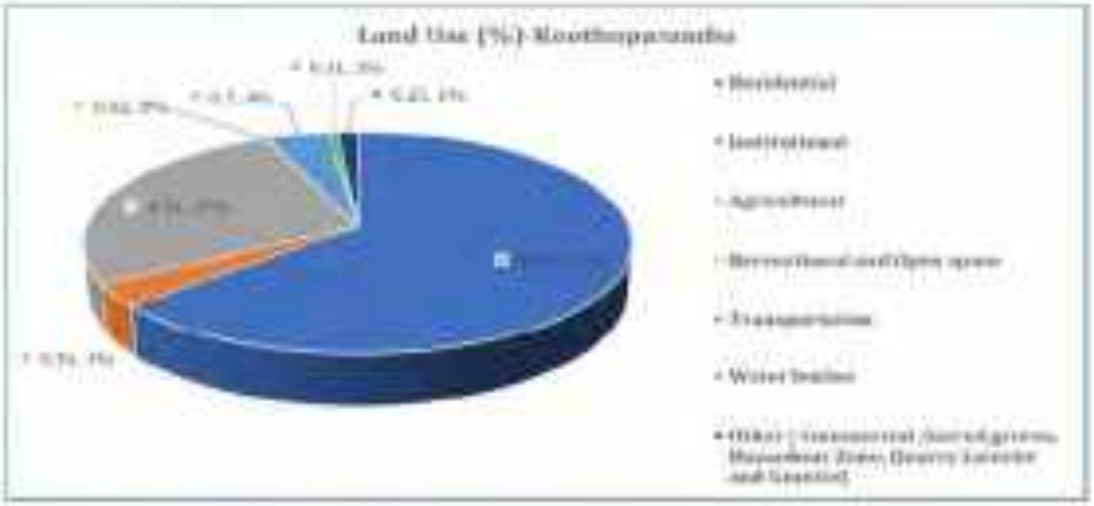



*Figure 4 Land Use Plan of Koothuparamba Dumpsite*

## 3.4 TRANSPORTATION CORRIDOR

*Table 3 Transportation corridor details*

| Mode | Details |
|---|---|
| Road | Koothuparamba town is a major junction connected by two state highways and a major district road to Wayanad. There are two state highways passing through the town, namely SH-30 (Thalassery – Coorg inter-state highway) and SH-38 (Kannur – Kozhikode road). These two roads act as major corridors of the town and possess good connectivity. Considerable volume of traffic from Karnataka passes through the town. In addition to this, other district roads and municipal roads exist within the town. |
| Train | There is no railway line, with the nearest railway stations is Thalaserry (14 Km from Koothuparamba). |
| Air | The nearest international airports are situated at Kannur (15 km away). |

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### 3.5 TOPOGRAPHY

Based on altitude, the terrain is classified into three; low land, midland and highland.

*Table 4 Topographical Land Details*

| Altitude | Details |
|---|---|
| Low land | The Land lying between 0 to 7.5m from MSL is treated as low land. The lowland is the coastal land of Koothuparamba. |
| Midland | Land lying between 7.5m to 75m from MSL is treated as midland. Majority of the land area in Koothuparamba is midland. |
| Highland | There is no high land region in Koothuparamba |

The average elevation of the Koothuparamba is 38 m and falls under the midland category which can be seen from the figure below.




*Figure 5 Topographic Map*

Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope. This steep slope on southeast direction possesses a potential risk of leachate runoff, which could result in the contamination of surface water on thatside of the site.

### 3.6 CLIMATIC CONDITION

#### 3.6.1 TEMPERATURE & RAINFALL

Koothuparamba Municipality falls in the tropical to sub- tropical climatic region and dominant feature is the monsoon. The maximum temperature varies between 26.4°C and 31.50°C and minimum temperature varies from 21°C to 25°C. The maximum monthly rainfall is 1031 mm and the annual rainfall is 3586 mm.

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### Table 5 Temperature & Rainfall Data

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average high °C | 30 | 30.9 | 31.5 | 30.9 | 29.7 | 27 | 26.4 | 26.6 | 27.6 | 28 | 28.8 | 29.3 | 28.8 |
| Average low °C | 21.2 | 22.2 | 23.9 | 25 | 24.9 | 23.8 | 23.2 | 23.1 | 23.1 | 23.2 | 22.7 | 21.5 | 23.1 |
| Average precipitation mm | 7 | 6 | 26 | 109 | 264 | 695 | 640 | 427 | 249 | 279 | 121 | 33 | 2868 |

*Source: Climate-Data.org*

According to the Rainfall Data, the most favorable working period spans from December to March due to the lower precipitation levels.

## 3.7 FLOOD ZONE

According to the 2022 Flood Probability Report published by the Kerala State Disaster Management Authority, the Koothuparamba municipality has an area of 0.31 square kilometers (1.85% of the total area of 16.76 square kilometers) that is susceptible to flooding, with a peak elevation of 1.48 meters.

## 3.8 EARTHQUAKE ZONE

The Bureau of Indian Standards (BIS) has grouped the country into four seismic zones viz. zones II, III, IV and V as detailed in the Map below. The Kerala state falls under Seismic Zone 3.

## 3.9 COASTAL REGULATION ZONE

As per the Coastal Regulation Zone (CRZ) notification 2011 and further amendment in CRZ notification 2019, the Koothuparamba legacy dumpsite does not fall under the CRZ zone.

## 3.10 GROUND WATER LEVEL

The details of groundwater level during pre-monsoon and post-monsoon, and the average fluctuation is provided in the table below.

### Table 6 Details of Ground Water level

| Pre-monsoon (m) | Post-monsoon (m) | Avg. Fluctuation (m) |
|---|---|---|
| 7.15 | 5.60 | 1.55 |

*Source: Ground Water Information Booklet of Kannur District, Kerala State, CGWB*

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# 4. DETAILED DESCRIPTION OF THE DUMPSITE

## 4.1 PHYSICAL FEATURE OF THE SITE

The total expanse of the dumpsite measures approximately 4.81 acres, with a portion of 0.98 acres being occupied by legacy waste. The average elevation of this legacy dumpsite is 5.5 meters. This historical waste repository is situated at geographical coordinates Lat: 11° 50'10.14'' N, Long: 75°34'18.959'' E in the region known as Palapparamba (ward-5), within the Koothuparamba district of Kannur.

At present, the Municipality's solitary dumpsite is located within the Palaparamba Area of Koothaparamba. Specifically positioned within ward No. 5, this site encompasses the Recycling and Recovery Facility (RRF) spanning 276 sqm, the Material Collection Facility (MCF) covering 276 sqm, the Windrow Composting Unit spanning 612.57sqm, and the Vermi-compost Unit 228.68 sqm. The Solid Waste Management Plan for Koothuparamba also outlines the proposed inclusion of an additional Material Collection Facility (MCF) of area 138.56 sqm.

The dumpsite is enclosed by a well-constructed compound wall, ensuring clear demarcation from the adjacent MRF, RRF, Windrow Composting Unit, and Vermi-compost Unit.

## 4.2 INFORMATION ON SITE MANAGEMENT

The Palapparamba dumpsite has served as a repository for solid waste disposal since 1973, spanning a period of over 50 years. This site remains operational and actively receives waste deposits. On a daily basis, it accumulates approximately 1.5 tons of mixed waste. The site is organized into three trenches, and over time, four capping procedures have been conducted to cover and secure waste deposits. The most recent capping operation was carried out in 2013.

## 4.3 SITE HISTORY INCLUDING PUBLIC PROTEST

In 2008, a protest emerged in response to the disposal of human excreta at a designated dumpsite. The situation gained further prominence in 2011 when leachate from the dumpsite infiltrated wells located in proximity to the adjacent residential areas, consequently intensifying the ongoing protests. By 2013, the municipality decided to address the issue by implementing waste capping measures.

## 4.4 DIRECTIONS FROM AUTHORITIES LIKE NGT, PCB, ETC.

### 4.4.1 NGT DIRECTIONS & ORDERS

The National Green Tribunal (NGT) has set norms and guidelines (O.A. No. 606/2018) to address legacy waste accumulated at long-operating dumpsites, to mitigate environmental and health hazards. The norms focus on closure and remediation of dumpsites, waste segregation and treatment using appropriate technologies, conducting Environmental Impact Assessments (EIAs), implementing land use planning and zoning regulations, monitoring and compliance measures, and promoting public participation and awareness regarding legacy waste management. These guidelines aim to stabilize dumpsites, prevent further pollution, and involve communities in decision-making and risk education.

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### 4.4.2 LOCAL SELF GOVERNMENT DEPARTMENT - GUIDELINES

The remediation of dumpsites is further directed by Honorable NGT in its order OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. Remediation of Legacy Waste Dumpsites through Bioremediation - G.O.(Rt)No.2629/2022/LSGD Dated, Thiruvananthapuram, 29-10- 2022

### 4.4.3 KSPCB - GUIDELINES FOR DUMPSITE REMEDIATION

The Kerala State Pollution Control Board (KSPCB) has established guidelines (PCB/HO/SEE2/Model City/Kozhikode corporation/2019 dated 09/09/2021) for dumpsite remediation to address the environmental and health impacts of waste disposal. The recommended steps include conducting a site assessment, developing a remediation plan based on risk assessment, selecting appropriate remediation technologies, implementing remediation activities under supervision, verifying the success of remediation, and ensuring long-term management and monitoring of the site. By following these guidelines, the KSPCB aims to mitigate the adverse effects of waste disposal, protect the environment, and safeguard public health.

### 4.4.4 CPCB GUIDELINES

Hon'ble NGT warned that due to incremental growth of Municipal Solid Waste (MSW), these MSW dumps are converting into virtual mountains. Hon'ble NGT further directed that every city/town should adhere to clause 'J' of Schedule–I (capping is not the first option for environmentally safe legacy waste management) of SWM Rules, 2016. Finally, Hon'ble NGT directed CPCB to propose Standard Operating Procedure (SOP) for implementation of Bio-mining and Bioremediation of legacy solid waste.

### 4.4.5 SWACHH BHARAT MISSION (SBM) ADVISORY

The advisory on dumpsite bioremediation addresses the challenges of legacy waste and promotes sustainable waste management practices and emphasizes the importance of dumpsite bioremediation as a sustainable solution for managing legacy waste. By adopting these guidelines, municipalities can address the environmental and health risks associated with dumpsites and promote a cleaner and healthier living environment for communities.

### 4.4.6 CENTRAL PUBLIC HEALTH AND ENVIRONMENTAL ENGINEERING ORGANIZATION (CPHEEO) GUIDELINES

The guidelines aim to provide a comprehensive approach to remediate dumpsites in a safe and environmentally sustainable manner. Key points from the guidelines include conducting site assessments, segregating waste, and implementing engineering and biological measures to control contamination, treating leachate to prevent groundwater contamination, and conducting post-remediation monitoring. These guidelines are crucial to ensure effective and environmentally sound dumpsite remediation that protects public health and the environment.

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# 5 SCOPE OF WORK

Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at Koothuparamba includes the following steps.

- Conducting detailed field investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical, and Environmental Baseline Analysis by M/s Poluchem Laboratories.
- Assessment & Analysis of detailed investigation report submitted by the Laboratories.
- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.
- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the By-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation (land recovery – Biomining, Capping partially Biomining & Capping), Methods/Technologies (Stationary & Mobile- compact), Implementation mode, Forward linkages (Utilization/Management of By-products) and Environmental & Social categorization as per the Environmental Management Framework – Vol II Part A.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Baseline assessment, impact & risk assessment, mitigations measures and Environmental Management & monitoring plan and its budget.
- Social Safeguards - Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.
- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport, Environmental and social monitoring costs, Revenue from the project, Funding for project
- Project Implementation plan –contractual models and timelines.

## 5.1 OBJECTIVES:

- To remediate the legacy waste dumpsite of approximately 12,625 Tons by 31st March 2024.
- To reclaim the legacy waste dump area and to develop recreational park facilities, thereby eliminating the chances of dump fires, leachate generation, and foul odor.
- To reduce greenhouse gas emissions, soil pollution, and groundwater contamination.
- To increase nearby real estate/social value and benefit the citizens.

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# 6 COMPOSITION, CHARACTERISTICS OF LEGACY WASTE AND ITS IMPACTS

## 6.1 DETAILED INVESTIGATION STRATEGY

To understand the nature and composition of the legacy waste and the existing baseline environmental conditions, samples from waste, surface and groundwater, leachate, soil, air, and noise were collected as per the requirements given in the Project Implementation Manual, considering the state and national guidelines. Samples were collected as mentioned below;

- ✓ Bore hole upto a depth of 9 m and collection of 3 (nos) samples from the soil at interval of 1.5 m
- ✓ Waste analysis viz., leachate sample from 1 (nos) locations and physical analysis from 2 (nos) location, and chemical analysis from 1 (nos) location.
- ✓ Environmental baseline analysis surface water 1 (nos) location and ground water samples from 3 (nos) location (Well Water Samples -1 up gradient, 2 down gradient) and Air sampling from 2 (nos) locations and noise sampling from 1 (nos) location

## 6.2 DETAILED INVESTIGATIONS

The detailed investigations carried out for the legacy waste dumpsite is given in the table below:

*Table 7 Investigation details*

| S.No | Parameters | Sampling Nos. |
|---|---|---|
| 1 | Geotechnical Investigation | |
| A | Boreholes up to 10m depth (as per CPHEEO Manual) | 1 |
| B | Permeability test- (as per CPHEEO Manual) standard penetration test SPT and collection of undisturbed samples - Soil Investigation - Classification, gradation, Atterberg's limit, Bulk density, dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, strength, compressibility (vertically-3 samples per borehole) | 1 |
| 2 | Waste & Environmental Analysis | |
| A | Leachate Analysis (TCLP usepa 1311) (SCHEDULE II of SWM rules, 2016), Suspended solids, Dissolved solids (inorganic),pH, Ammonical nitrogen (as N), Total Kjeldahl nitrogen (as N), BOD, COD, Arsenic (as As), Mercury, Lead, Cadmium, Copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds | 1 |
| B | Physical Analysis of waste (As per CPHEEO manual) including Density, Bulk Density, Moisture Content, Size of waste Constituents, Calorific Value | 2 |
| C | Chemical Analysis of waste/soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), total Carbon, C/N ratio, calorific value, Bio-chemical - biodegradable factor | 1 |
| D | Ground Water (Well Water Samples -1 up gradient, 2 down gradient) - (shallow and deep wells): pH, Colour, EC, Turbidity, SS, TDS, TOC, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, | 3 |

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| | | |
|---|---|---|
| | TKN, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total Coliforms (IS 10500 – 2012) | |
| E | Surface Water (pH, Colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, TKN, Total Alkalinity, Total hardness, Ecoli and Total Coliforms (IS 10500 – 2012) | 1 |
| F | Ambient Air Quality (Sulphur Dioxide (So2), Nitrogen Dioxide (No2), Particulate Matter 2.5, Particulate Matter 10, Ozone (O3), Lead (Pb), Carbon Monoxide (CO), Ammonia (NH3), Benzene (C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | 2 |
| G | Ambient Noise Level (E(p)Rules) for 24 hours | 1 |
| Note: Detailed Technical Investigations conducted as per PIM | | |

## 6.3 METHODOLOGY OF SAMPLING

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed sampling methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat/Long) were considered. The following table shows the strategic location details of samples selected for the detailed investigation.

*Table 8 Details of sampling location*

| S.No | Description | Sampling location | Justification |
|---|---|---|---|
| 1 | Air sampling (2 Locations) | Within the dumpsite | As per the wind rose diagram, the direction and speed of the wind are determined and based on the existing wind-rose data the air sampling location fixed at two locations |
| | | Dumpsite entry point | |
| 2 | Noise (1 Location) | Within the dumpsite | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. |
| 3 | Surface water (1 Location) | Surface water near to the dumpsite (stream) | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope. This steep slope on northeast direction possesses a potential risk of leachate runoff, which could result in the contamination of surface water on that particular side of the site. So, the location of surface water is taken on the northeast direction. |
| 4 | Ground water (3 Locations) | 3 wells identified near the dumpsite area | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope (SE). The |

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| | | | |
|---|---|---|---|
| | | | infiltration of leachate which could result in the contamination of ground water.<br>Based on the possible infiltration and slope direction, two ground water samples are collected in the east direction and one of the west direction |
| 5 | Bore Hole (1 Location) | Within the dumpsite area | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. |
| 6 | Legacy Waste | Within the dumpsite area | Not Applicable |

### *Table 9 Direction and Distance of the sampling location*

| S.No. | Description | Direction | From Dumpsite (m) | From Boundary (m) |
|---|---|---|---|---|
| 1 | Surface Water | Southeast | 450 | 180 |
| 2 | Ground water-1 | Centre | Within the boundary | |
| 3 | Ground water-2 | Northeast | 158 | 20 |
| 4 | Ground water-3 | Southeast | 200 | 7 |
| Note: Air and Noise Monitoring are monitored inside the dumpsite | | | | |

### *Table 10 Quantity of sampling & location*

| S. No | Items | Quantity of sample collected | Location |
|---|---|---|---|
| 1 | Solid Waste | 25 kg | Location -1: N- 11.8361316° E -75.57723916°<br>Location -2: 11.836167 ° °E -75.571933 ° |
| 2 | Surface Water | 1.5 Litres | Location -1:N- 11.835573° E -75.575786° |
| 3 | Ground Water | 1.5 litres | Location -1: N- 11.835923° E -75.57255°<br>Location -2: N- 11.835988° E -75.573558°<br>Locations -3:N- 11.836860° E -75.5730799° |
| 4 | Leachate | 1.5 litres | Location -1: N- 11.836348 ° E -75.571850 ° |
| 5 | Ambient Air Quality | 2 Nos | Location -1: N- 11.8361316° E -75.57723916°<br>Location -2: N- 11.836215 ° E -75.571515 ° |
| 6 | Ambient Noise Quality | 1 Nos | Location -1: N- 11.836167 °E -75.571933 ° |

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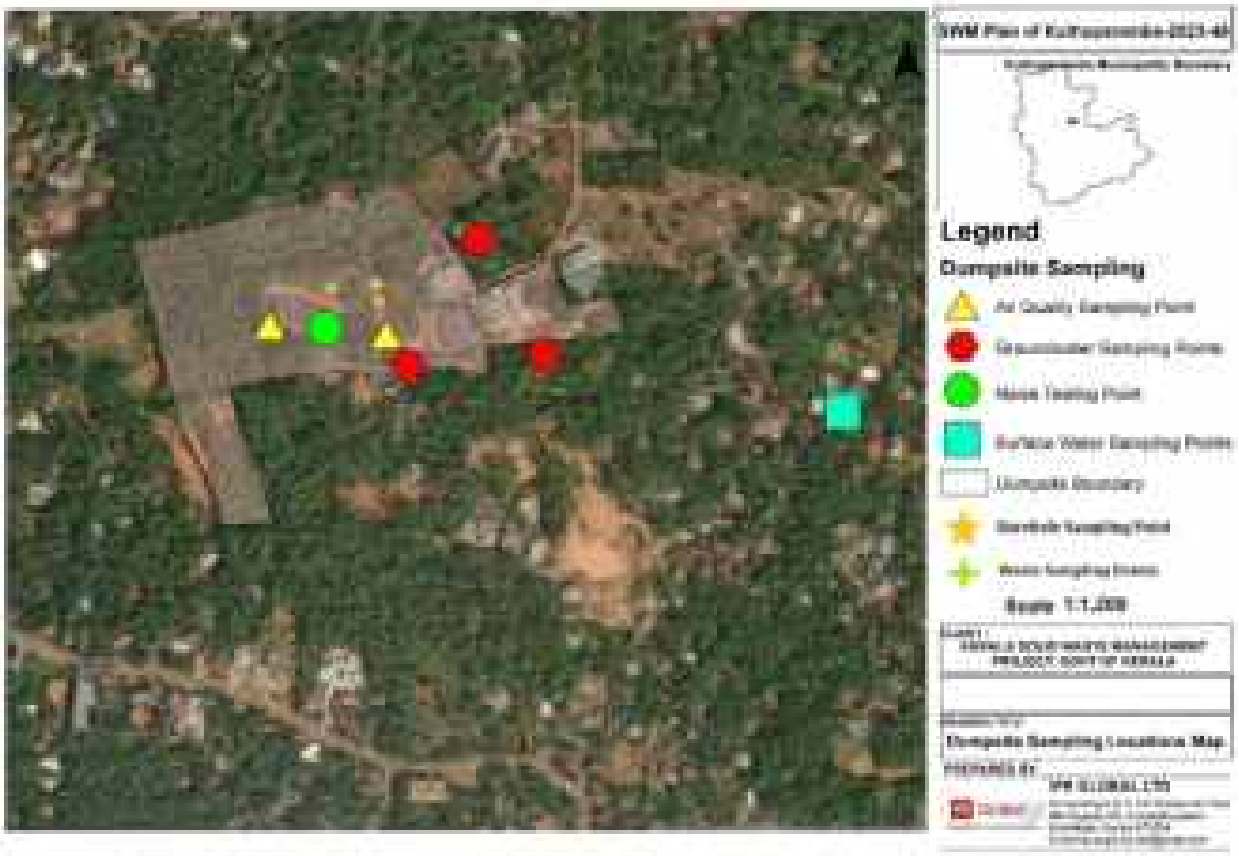



*Figure 6 Sampling Location at Dumpsite Location*

### 6.4 ANALYSIS AND INTERPRETATION OF EXPLORATORY DATA

As part of the feasibility study, Technical Support Consultants (IPE Global Ltd) has entrusted the geotechnical investigation & Environmental baseline assessment to M/s Matter Material Testing & Research Laboratory (P) Ltd and M/s Polluchem Laboratories (P) Ltd respectively.

The initial site visit was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd on 16th May 2023 along with the experts of TSC and PIUs. Field Geotechnical investigation to collect the soil samples after drilling through the legacy waste was started on 17th May 2023 and was completed on 23rd May 2023. Positioning of Air samplers & Noise monitoring equipment, sampling of surface/groundwater, leachate, and legacy waste were done on 06th June 2023 by M/s Polluchem Laboratories (P) Ltd. The lab analysis reports were submitted by the investigation agencies to TSC. The lab analysis reports are provided in Annexures – A & B

#### 6.4.1 GEOTECHNICAL EXPLORATORY DETAILS

For assessing the depth of legacy waste and contamination of the soil below the legacy waste, bore hole samples were collected using rotary drill. The exploratory data of the bore hole revealed a maximum depth of 5.5 m of waste followed by 3.50m of soil. Lateritic rock was encountered below the soil stratum. The Geotechnical investigation was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. The details of the exploratory data of the bore hole is provided below.

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*Table 11 Exploratory Data of Bore Log*

| S. No | Borehole location | Total Depth of the Borehole (m) | Depth of Soil (m) | Depth of Legacy Waste (m) | Remarks |
|---|---|---|---|---|---|
| 1 | N- 11.83609 °<br>E -75.572326 ° | 9 | 3.5 | 5.5 | Lab Analysis Report provided in Annexure A |

Note: Bore hole terminated at the depth of 9.0m below ground level due to Laterite rock

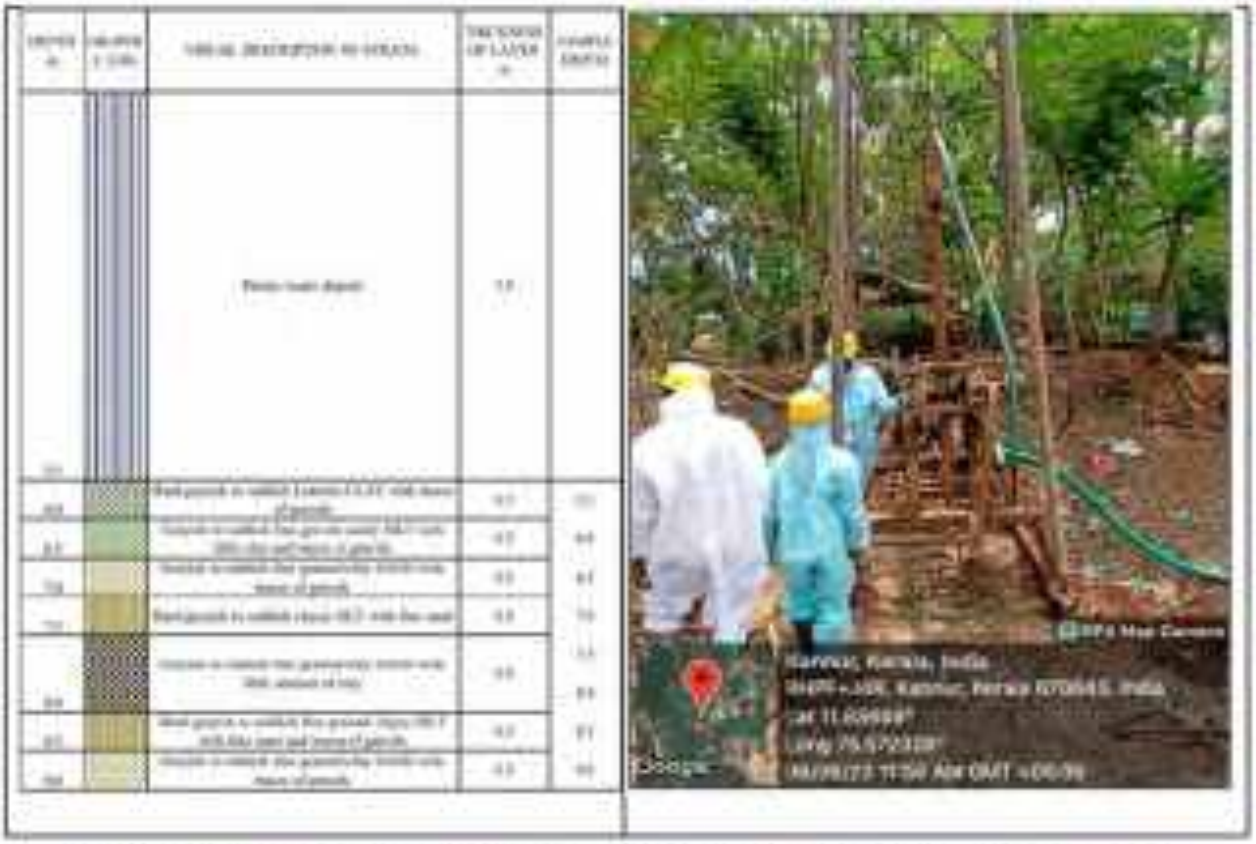


*Figure 7 Dumpsite Legacy Waste Depth Indication and Surveying*

### 6.4.2 ESTIMATED TOTAL QUANTITY OF WASTE

The total quantity of waste is estimated based on the contour/topography survey profile of the waste over the ground level and exploratory data of the bore log (Geotechnical investigations). The details of the estimated total quantity of waste are provided below:

*Table 12 Quantity of waste above and below the ground level*

| Level | Volume of Legacy Waste (m3) | Density of Waste (t/m³) | Total Quantity of Waste (T) | Remarks |
|---|---|---|---|---|
| Above and Below the Ground | 15302 | 0.826 | 12625.27 | *As per the Contour Survey Report by IILM |

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*Table 13 Estimated total quantity of waste*

| Estimated total quantity of waste | |
|---|---|
| Total Quantity of Legacy Waste ($m^3$) | 15,102 |
| Total Quantity of Legacy Waste (T) | 12,625.27 |
| Total Quantity of Legacy Waste (T) Approximately | 12625 |

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### 6.4.3 LEGACY WASTE CHARACTERIZATION

The characteristics of the legacy waste were assessed by collecting 2 samples of 25 kg from 2 (nos) locations within the dumpsite. The legacy waste samples were collected on 06th June 2023 by M/s Polluchem Laboratories (P) Ltd. The assessment of waste characteristics was done based on the results of the analysis. The details of the characteristics viz., composition, physical & chemical characteristics, heavy metals, and estimated quantity of by-products are provided in the tables below:

| S. No | Items | Quantity of sample collected | Location |
|---|---|---|---|
| 1 | Solid Waste | 25 kg | Location -1: N- 11.836111°, E -75.577233°<br>Location -2: 11.836167°, E -75.571933° |

**Physical Composition:**

*Table 14 Physical Composition for Location- 1, 2 & Average*

| Sl. No | Total Quantity of legacy waste (cu.m) | Parameters | Location - I | | Location - II | | Average | |
|---|---|---|---|---|---|---|---|---|
| | | | Avg. Percentage(%) | Quantity (cu.m) | Avg. Percentage (%) | Quantity (cu.m) | Avg. Percentage (%) | Quantity (cu.m) |
| 1 | 15,102 | Bio Earth (-4.75mm) | 31 | 4681.62 | 32 | 4832.64 | 31.5 | 4757.13 |
| | | Bio Earth (+4.75 to 8 mm) | 16 | 2416.32 | 16 | 2416.32 | 16 | 2416.32 |
| 2 | | C&D (+8mm) | 21 | 3171.42 | 23 | 3473.46 | 22 | 3322.44 |
| 3 | | Plastics | 20 | 3020.4 | 18 | 2718.36 | 19 | 2869.38 |
| 4 | | Paper | 4 | 604.08 | 3.5 | 528.57 | 3.75 | 566.325 |
| 5 | | Cloths | 3.66 | 552.7332 | 3.6 | 543.672 | 3.63 | 548.2026 |
| 6 | | Glass | 1.8 | 271.836 | 1.5 | 226.53 | 1.65 | 249.183 |

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| Sl. NO | Total Quantity of legacy waste (cu.m) | Parameters | Location - I | | Location - II | | Average | |
|---|---|---|---|---|---|---|---|---|
| | | | Avg. Percentage(%) | Quantity (cu.m) | Avg. Percentage (%) | Quantity (cu.m) | Avg. Percentage (%) | Quantity (cu.m) |
| 7 | | Metals | 2 | 302.04 | 1.86 | 286.930 | 1.93 | 294.489 |
| 8 | | Rubber | 0.5 | 75.51 | 0.5 | 75.51 | 0.5 | 75.51 |
| 9 | | Other | 0.01 | 1.5102 | 0.02 | 3.02 | 0.015 | 2.27 |
| 10 | | Leather | 0.01 | 1.5102 | 0.02 | 3.02 | 0.015 | 2.27 |

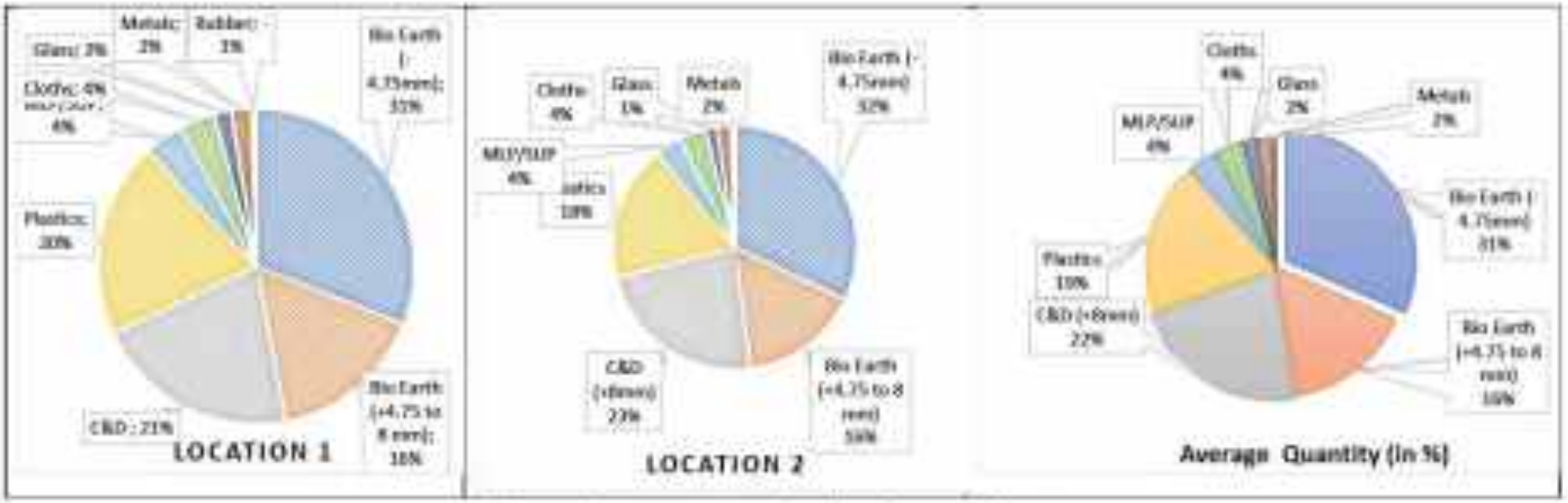



*Figure 8 percentage Indication of Wastes*

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**Physical Analysis:**

*Table 15 Physical Analysis*

| S. No | Parameters | | | Test Method | Unit | Location 1 | Location 2 | Avg. | Limit as per FCO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Moisture@105°C | | | ASTM D 2216 | % | 36.5 | 24.3 | 30.4 | 15.0-25.0 |
| 2 | Bulk Density | | | USEPA | kg/m³ | 1047 | 1086 | 1066.5 | |
| 3 | Density | | | USEPA | g/cm³ | 0.913 | 0.859 | 0.886 | <1 |
| 4 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 647 | 720 | 683.5 | – |
| 5 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | Retained | Retained | Retained | |
| | | 75 | – | | | 0 | 0 | 0 | |
| | | 40 | – | | | 8.6 | 0 | 4.3 | |
| | | 20 | – | | | 12.4 | 8.8 | 10.6 | |
| | | 8 | – | | | 17.6 | 22.4 | 20 | |
| | | 4.75 | 4 | | | 16.3 | 22.8 | 19.55 | |
| | | 2.36 | 8 | | | 17.5 | 15.5 | 16.5 | |
| | | 1.18 | 16 | | | 16.4 | 18.6 | 17.5 | |
| | | 0.6 | 30 | | | 4.4 | 11.9 | 8.15 | |
| | | 0.3 | 50 | | | 6.8 | 0 | 3.4 | |
| | | 0.15 | 100 | | | 0.3 | 0 | 0.15 | |
| | | 0.09 | 170 | | | 0 | 0 | 0 | |
| | | 0.075 | 200 | | | 0 | 0 | 0 | |
| | | 0.045 | 325 | | | 0 | 0 | 0 | |
| Lat/Long: Location -1: 8° 11.836161316" E -75.57722016" Location -2: 8° 11.836167 " E - 75.571911 " | | | | | | | | | |

**Chemical Analysis:**

*Table 16 Chemical Analysis*

| S. No | Parameters | Test Method | Unit | Location -1 |
|---|---|---|---|---|
| 1 | pH@25°C | USEPA | - | 8.30 |
| 2 | Biodegradable Factor | USEPA | % | 2.0 |
| 3 | Total carbon | USEPA 9060A | % | 4.1 |

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| S. No | Parameters | Test Method | Unit | Location -1 |
|---|---|---|---|---|
| 6 | Phosphorus(P) | USEPA | % | 0.018 |
| 7 | Nitrogen(N) | USEPA | % | 0.24 |
| 7 | Potassium(K) | USEPA | % | 0.046 |
| 8 | C/N Ratio | USEPA | - | 17.01 |
| 9 | Calorific Value | ASTM D-5865 | Kcal/kg | 720 |

**Heavy Metal Analysis:**

*Table 17 Heavy Metal Analysis*

| S No | Parameters | Test Method | Unit | Location - 1 | Limit as per Organic Compost (FCO 2009) |
|---|---|---|---|---|---|
| 1 | Iron (Fe) | USEPA 3050 | % | 3.24 | – |
| 2 | Arsenic (As) | USEPA 3050 | mg/kg | <0.1 | 10 |
| 3 | Selenium (Se) | USEPA 3050 | mg/kg | <0.1 | – |
| 4 | Nickel (Ni) | USEPA 3050 | mg/kg | 19.08 | 50 |
| 5 | Zinc (Zn) | USEPA 3050 | mg/kg | 261 | 1000 |
| 6 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 | 5 |
| 7 | Copper (Cu) | USEPA 3050 | mg/kg | 58.15 | 300 |
| 8 | Chromium (Cr) | USEPA 3050 | mg/kg | 6.3 | 50 |
| 9 | Lead (Pb) | USEPA 3050 | mg/kg | 90.17 | 100 |
| 10 | Mercury (Hg) | USEPA 3050 | mg/kg | <0.1 | .15 |
| 11 | Manganese (Mn) | USEPA 3050 | mg/kg | 258.5 | – |

**By-Products:**

*Table 18 By Product*

| By-Products | Bio Earth | C&D Waste | RDF | Recyclable |
|---|---|---|---|---|
| Percentage (%) | 47.5% | 22% | 26.9% | 3.6 % |
| Quantity (tons) | 7173.45 | 3322.44 | 4062.44 | 543.67 |

6.4.4 ENVIRONMENTAL BASELINE

The environmental baseline was assessed from the analytical results of air, surface &groundwater, noise and leachate from the location as mentioned in the section 6.3. The samples were collected

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on 06th June 2023 by M/s Polluchem Laboratories (P) Ltd. The Environmental baseline was analyzed with reference to the lab analysis reports. The details of analysis & inferences are provided in the tables below:

**Surface Water Analysis:**

*Table 19 Surface Water Analysis*

| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 – 1983RA2017 | 6.12 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 6 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 1.1 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 134 µS/cm | ---- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 81 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1mg/l) | ---- | -- |
| Total Hardness as CaCO3 | IS 3025 (P) 21 – 1983RA2014 | 38 mg/l | 200 mg/l | -- |
| Total Alkalinity as CaCO3 | IS 3025 (P) 23 – 1986RA2014 | 21.3 mg/l | -- | -- |
| Chloride as Cl- | IS 3025 (P) 32 – 1988RA2014 | 25.4 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as SO4 | IS 3025 (P) 24 – 1986RA2014 | 12.4 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 – 1989RA2014 | 4.2mg/l | 6 mg/l | 4 mg/l |
| B.O.D ( 3 days at 27° C ) | IS 3025 (P) 44 - 1993RA2014 | 3.2 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 - 2006RA2017 | 8 mg/l | ---- | -- |

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| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| TOC | APHA5310 | BDL(MDL-0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL-1mg/l) | --- | -- |
| Nitrate as NO3 | IS 3025 (P)34 – 1988RA2014 | 1.2 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 - 2008RA2014 | BDL(MDL-0.1mg/l) | 1.5 mg/l | 1.5 mg/l |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL-0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL-0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL-0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL-0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL-0.01mg/l) | 0.5 mg/l | --- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL-0.001mg/l) | 0.001 mg/l | --- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL-0.01mg/l) | 15 mg/l | 15 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.18 mg/l | 0.3 mg/l | 0.5 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL-0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL-0.01mg/l) | 0.05 mg/l | 0.2 mg/l |
| Location | **Inference** | | | |
| 1 | The analysis reveals that all the parameters are within the acceptable limit except that it is slightly acidic, and the dissolved oxygen content is less than permissible limit of class A, just crossing the permissible limits of class C. | | | |

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| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| | likewise, BoD is greater than the allowable limit, indicating the presence of organic matter. | | | |

**Note:** The sampling location and its respective distance from the dumpsite have been incorporated into Table 10. The stream is not use for any public use.

**Ground Water Analysis:**

*Table 20 Ground Analysis*

| Parameter | Test Method | Location -1 | Location -2 | Location -3 | Acceptable Limit As per IS-10500-2012 |
|---|---|---|---|---|---|
| pH | IS 3025 (P) 11 – 1983RA2017 | 6.84 | 5.51 | 6.5 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 4 Hazen Unit | 4 Hazen Unit | 7 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | BDL(MDL-0.1 NTU) | BDL(MDL-0.1 NTU) | 1.9 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 390 µS/cm | 50 µS/cm | 160 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 119 mg/l | 36 mg/l | 98 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL- 1 mg/l) | BDL(MDL- 1 mg/l) | 4 mg/l | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 128 mg/l | 8 mg/l | 36 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 124 mg/l | 6 mg/l | 25.87 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 24.7 mg/l | 19 mg/l | 29.56 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 1.08 mg/l | 6.12 mg/l | 3.87 mg/l | 200 mg/l |
| COD | IS 3025 (P) 58 - 2006RA2017 | 8 mg/l | 4 mg/l | 4 mg/l | --- |

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| Parameter | Test Method | Location -1 | Location -2 | Location -3 | Acceptable Limit As per IS-10500-2012 |
|---|---|---|---|---|---|
| TDC | APHA5310 | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | ---- |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 2.49 mg/l | 1.71 mg/l | BDL(MDL-1mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 - 2008RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.25 mg/l | 1.0 mg/l |
| Nickel as Ni | IS 3025(P) 54- 2003RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41- 1992RA2014 | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47- 1994RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42- 1992RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59- 2006RA2017 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 5.0 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.21 mg/l | 1.0 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37- 1988RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.01 mg/l |
| Lat/Long: Location -1: [N- 11°50'09.324", E -75°34'21.18"], Location -2 [N- 11°50'09.557", E -75°34'24.809"], Location -3 [N- 11°50'12.696", E -75°34'23.087"] | | | | | |
| Location | Inference | | | | |

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| Parameter | Test Method | Location -1 | Location -2 | Location -3 | Acceptable Limit As per IS-10500-2012 |
|---|---|---|---|---|---|
| 1 | The analysis reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The pH of the sample analysis is 6.84 which is in a slightly acidic range, and may have influence in the industrial processes as it is corrosive. | | | | |
| 2 | The analysis reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The PH of the sample is 5.51, which is in the acidic range, making the water not fit for any industrial purpose as it is more corrosive. | | | | |
| 3 | The analysis reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The PH of the sample analysis is 6.5 which is also in a slightly acidic range. | | | | |

**Note :** The sampling location and its respective distance from the dumpsite have been incorporated into Table 10.

**Ambient Air Quality:**

*Table 21 Ambient Air Quality*

| Parameters | Test Method | Location -1 | Location -2 | Limits as per NAAQS |
|---|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 68.5 µg/m3 | 54.3 µg/m3 | 100 µg/m³ |
| Particulate Matter ($PM_{25}$) | CPCB | 24.2µg/m3 | 21.7 µg/m3 | 60 µg/m³ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 4.3 µg/m3 | 3.8 µg/m3 | 80 µg/m³ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 7.2 µg/m3 | 6.2 µg/m3 | 80 µg/m³ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 1.1 mg/m3 | 1.0 mg/m3 | 4 mg/m³ |
| Ammonia ( $NH_3$) | CPCB | < 1 µg/m3 | < 1 µg/m3 | 400 µg/m³ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m3 | < 0.1 µg/m3 | 1 µg/m³ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m3 | <0.1 ng/m3 | 6 ng/m³ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m3 | <0.1 ng/m3 | 20 ng/m³ |

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| | | | | |
|---|---|---|---|---|
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m3 | < 1 µg/m3 | 180 µg/m³ |
| Benzene ($C_6H_6$) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m3 | < 0.1 µg/m3 | 5 µg/m³ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m3 | < 0.1 ng/m3 | 1 ng/m³ |
| Lat/Long: Location -1 [N- 11 °50'10.14", E -75°34'18.959"], Location -2 [N- 11 °50'10.14", E -75°34'17.454"] | | | | |

| Location | Inference |
|---|---|
| 1 | Within permissible limits |
| 2 | Within permissible limits |
| NOTE: The contractor is required to implement all necessary protective measures during the biomining process to ensure that air quality levels are maintained within permissible limits. | |

**Note :** The sampling location and its respective distance from the dumpsite have been incorporated into Table 10.

**Ambient Noise Level:**

*Table 22 Ambient Noise Level*

| Date | Hourly Interval | Unit | Result | Limits in dB(A) Leq |
|---|---|---|---|---|
| 08.06.2023 | 15.00 Hrs | dB (A) | 59.1 | Residential Area: Day time -55 dB(A) Leq Night time -45 dB(A) Leq |
| | 16.00 Hrs | dB (A) | 59.5 | |
| | 17.00 Hrs | dB (A) | 59.4 | |
| | 18.00 Hrs | dB (A) | 61.6 | |
| | 19.00 Hrs | dB (A) | 57.7 | |
| | 20.00 Hrs | dB (A) | 58.3 | |
| | 21.00 Hrs | dB (A) | 62.1 | |
| | 22.00 Hrs | dB (A) | 63.7 | |
| | 23.00 Hrs | dB (A) | 56.0 | |
| 06.06.2023 | 00.00 Hrs | dB (A) | 64.0 | |
| | 01.00 Hrs | dB (A) | 60.7 | |
| | 02.00 Hrs | dB (A) | 67.1 | |
| | 03.00 Hrs | dB (A) | 59.4 | |

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| | | | | |
|---|---|---|---|---|
| | 04.00 Hrs | dB (A) | 62.1 | |
| | 05.00 Hrs | dB (A) | 58.5 | |
| | 06.00 Hrs | dB (A) | 62.4 | |
| | 07.00 Hrs | dB (A) | 57.4 | |
| | 08.00 Hrs | dB (A) | 67.2 | |
| | 09.00 Hrs | dB (A) | 60.3 | |
| | 10.00 Hrs | dB (A) | 65.8 | |
| | 11.00 Hrs | dB (A) | 64.8 | |
| | 12.00 Hrs | dB (A) | 66.3 | |
| | 13.00 Hrs | dB (A) | 65.8 | |
| | 14.00 Hrs | dB (A) | 61.3 | |
| Avg. Leq Day – 69.1 dB (A) | | | | |
| Avg. Leq Night 61.0 dB (A) | | | | |

| Location | Inference |
|---|---|
| 1 | The assessment indicates that the noise levels exceed permissible limits, necessitating the implementation of measures to alleviate the noise pollution. |

**Leachate Analysis:**

*Table 23 Leachate Analysis*

| Parameters | Test Method | L1 | Limits as per SWM Rules 2016 |
|---|---|---|---|
| pH | IS 3025 (P) 11-1983 RA2017 | 5.97 | 5.5 to 9.0 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16-1984 RA2017 | 847 mg/l | 2100 mg/l |
| Total Suspended Solids | IS 3025 (P) 15-1984 RA2017 | 56 mg/l | 100 mg/l |
| Chloride as Cl | IS 3025 (P) 32-1988 RA2014 | 187.6 mg/l | 1000 mg/l |
| COD | IS 3025 (P) 58-2006 RA2017 | 156 mg/l | 250 mg/l |
| BOD(3 days at 27 deg cel) | IS 3025 (P) 44-1988 RA2014 | 63.5 mg/l | 30 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34-1988 RA2014 | 21.3 mg/l | 100 mg/l |

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| Parameters | Test Method | L1 | Limits as per SWM Rules 2016 |
|---|---|---|---|
| Ammonical Nitrogen as N | IS 3025 (P) 34-1988 RA2014 | 14.3 mg/l | 50 mg/l |
| Phenolic Compound as C6H5OH | IS 3025 (P) 43-1992RA2014 | 0.41 mg/l | 1 mg/l |
| Fluoride asF | IS 3025 (P) 60-2008RA2014 | 0.23 mg/l | 2 mg/l |
| Cynadie as CN | IS 3025 (P) 27-1986 RA2014 | BDL(MDL-0.01 mg/l) | 0.2 mg/l |
| Nickel as Ni | IS 3025 (P) 54-2003 RA2014 | BDL(MDL-0.01 mg/l) | 3 mg/l |
| Cadmium as Cd | IS 3025 (P) 41-1992 RA2014 | BDL(MDL-0.001 mg/l) | 2 mg/l |
| Lead as Pb | IS 3025 (P) 47-1994 RA2014 | BDL(MDL-0.01 mg/l) | 0.1 mg/l |
| Copper as Cu | IS 3025 (P) 42-1992 RA2014 | BDL(MDL-0.01 mg/l) | 3 mg/l |
| Mercury as Hg | IS 3025 (P) 48-1994 RA2014 | BDL(MDL-0.001 mg/l) | 0.01 mg/l |
| Zinc as ZN | IS 3025 (P) 49-1994 RA2014 | BDL(MDL-0.01 mg/l) | 5 mg/l |
| Total Arsenic as As | IS 3025 (P) 37-1988 RA2014 | BDL(MDL-0.01 mg/l) | 0.2 mg/l |

| Location | Inference |
|---|---|
| 1 | The analysis reveals that all the parameters fall within the acceptable limit except BoD, which is higher than the allowable limit, indicating that the leachate is containing biological contents. |

## 6.5 RISK ASSESSMENT

**Surface Water:** Dumpsites can release pollutants into nearby surface water bodies through leachate, which is generated when rainwater or other liquids come into contact with the waste. Leachate can contain various contaminants such as heavy metals, organic compounds, and pathogens. Proper containment and management of leachate are essential to prevent water pollution.

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The analysis of surface water reveals that all the parameters are within the acceptable limit, except it is slightly acidic and the dissolved oxygen content is less than prescribed limit, so also the BoD is greater than the allowable limit. Indicating that the water is contains organic load.

### *Table 24 Risk Assessment - Surface Water*

| Risk Assessment | |
|---|---|
| Source | Legacy Waste Dumpsite |
| Pollutant | Leachate from Dumpsite – BoD higher than the acceptable limits |
| Pathway | Water / Run off |
| Receptor | Humans, Animals, Aquatic life and flora & fauna |
| Risk | High BoD indicates the water is highly polluted and it is harmful to ecosystems as fish and other aquatic life may suffocate in oxygen-depleted waters. Also, it will contain more pathogens and make the water unfit for human and animals. |

**Groundwater**: Pollutants from dumpsites can infiltrate into the underlying groundwater, if waste disposal practices have caused contamination of the soil. Once pollutants enter the groundwater, they can spread over a wide area, affecting drinking water sources and ecosystems. Remediation techniques often focus on preventing or minimizing further groundwater contamination.

The analysis of ground water samples at three different locations reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The pH of the sample analysis is 6.84 @ G-1, 5.51 @ G-2 and 6.50 @ G-3 location which is in acidic range and harmful to health also make the water not fit for any industrial purpose as it is more corrosive.

*Table 25 Risk Assessment - Ground water*

### *Table 25 Risk Assessment- Ground Water*

| Risk Assessment | |
|---|---|
| Source | Legacy Waste Dumpsite |
| Pollutant | Leachate from Dumpsite – pH is acidic in nature |
| Pathway | Water, Soil |
| Receptor | Humans, Animals and flora & fauna |
| Risk | **Possible risks to Human health**<br>• diarrhoea<br>• Nausea and Vomiting<br>• Abdominal Pain<br>• Weakness<br>• Shortness of Breath<br><br>**Possible risks to Animals**<br>Animals when intake waters with pH acidic in nature it affect the health of the animals.<br><br>**Possible risks to flora** |

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| Risk Assessment | |
|---|---|
| | It can decrease the availability of plant nutrients, such as phosphorus and molybdenum, and increases the availability of some elements to toxic levels, particularly aluminium and manganese. |

**Air:** Dumpsites may emit pollutants into the air through processes such as open burning of waste or the release of gases from decomposing organic materials. Airborne pollutants can include particulate matter, volatile organic compounds (VOCs), dioxins, and other hazardous substances. These pollutants can have adverse effects on air quality and human health. Measures to control and mitigate air pollution during dumpsite remediation include covering waste, implementing proper waste management practices viz., dust containment screens etc.

### *Table 26 Risk Assessment - Air*

| Risk Assessment | |
|---|---|
| Source | Legacy Waste Dumpsite |
| Pollutant | Within the limits |
| Pathway | Air |
| Receptor | Humans, Animals and flora & fauna |
| Risk | No anticipated Risks |

**Soil:** Dumpsites can contaminate the surrounding soil with a wide range of pollutants. Hazardous chemicals, heavy metals, and organic compounds can leach from the waste and accumulate in the soil, potentially posing risks to plants, animals, and humans.

### *Table 27 Risk Assessment – Soil*

| Risk Assessment | |
|---|---|
| Source | Legacy Waste Dumpsite |
| Pollutant | Heavy metals etc. |
| Pathway | Soil |
| Receptor | Humans, Animals and flora & fauna |
| Risk | **Possible risks to Human health**<br>Soils if contain substances such as heavy metals, which may be toxic to humans, can pass those substances on to humans through crop uptake, leading to unsafe foods.<br>**Possible risks to Animals**<br>When farm animals consume the plants grown from contaminated soil it affects the health of animals in later stage.<br>**Possible risks to flora**<br>Soil pollution may alter plant metabolism and reduce crop yields and cause trees and plants that may absorb soil contaminants to pass them up the food chain. |

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**Bioaccumulation in Biota:** Pollutants from dumpsites can enter the food chain and bioaccumulate in plants and animals. Contaminated soil or water can be taken up by plants, and these plants may then be consumed by animals. As pollutants move up the food chain, their concentrations can increase, leading to potential health risks for humans and wildlife. Remediation efforts include restoring the ecological balance and minimizing the exposure of organisms to contaminated environments.

*Table 28 Risk Assessment – Bio-accumulation in Biota*

| Risk Assessment | |
|---|---|
| Source | Legacy Waste Dumpsite |
| Pollutant | Leachate and gas emission from Dumpsite |
| Pathway | Air, water and soil |
| Receptor | Humans, Animals and flora & fauna |
| Risk | Possible risks to Human health, Animals and flora & fauna:<br>Accumulation of contaminants in plants and animals indirectly through food chain affects human health. |

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# 7 EVALUATION OF REMEDIATION TECHNIQUES

Although the term "legacy waste" has not been defined in any official government document in India, it typically refers to aged municipal solid waste in landfills or dumpsites. There is no information on how old waste must be in order to qualify tobe called legacy waste. These legacy dumpsites are creating various irreversible environmental/health/livelihood hazards. The major sources of pollution are:

- ✓ Puddles of leachate flowing through the adjacent area and reaching the water table long-term issues of greenhouse gas emissions
- ✓ Surface water and groundwater pollution due to erosion and seepage
- ✓ Dumpsite fires
- ✓ Due to the faster urban development and increased waste generation per capita and mismanagement of generated waste.

The dumpsites have emerged as pollution hubs, especially those situated in human settlements, as cities have grown over the decades. It has, therefore, become a necessity for the city authorities to remediate the existing dumpsites in an environmentally sound and economically viable manner.

**Remediation of legacy waste dumpsite**

Remediation is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

1. Uplift of the environment- reduction in greenhouse gas emissions, soil pollution, ground water contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.
2. Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in growth of nearby city
3. Land - Dumpsite land becomes available for public use or for setting up SWM facility on the reclaimed land.
4. Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled, or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels.

For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- ✓ A total station survey for assessment of volumetric quantity of legacy waste above the ground level.
- ✓ Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- ✓ History of the site, Physical features of site, as –is/current situation and compositional analysis of waste.

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- ✓ Baseline study of heavy metals in surface;
- ✓ water, rainfall, soil type, surface hydrology, topography, wind directionetc. shall be studied before and after bioremediation.
- ✓ Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area.

The details of the remediation techniques for the remediation of the legacy waste dumpsite remediation are as follows

## 7.1 BIO-MINING – RECLAMATION/RECOVERY OF LAND

Bio- mining is the scientific technique to extract materials of economic interest from legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) and followed by sustainable management through recycling, co-processing, road construction etc.

*Table 29 Phase of Bio-minning*

| Phases of Bio-mining | |
|---|---|
| Phase 1: Stabilization | The legacy waste is formed into equal-sized windrows, and which are turned frequently, bio-culture is added and de-odourizer (an odour-controlling agent) sprayed. This phase removes stench, reduces moisture and eliminates pathogens. |
| Phase 2: Sorting & Segregation | In this phase, stabilized legacy waste is sorted/segregated into bio earth, recyclables, refused derived fuel (RDF) and C&D through series of various sizes of Trommels/circular rotatory sieves and manpower. |
| Phase 3: Disposal & Utilization | In this phase, the non-combustible fractions such as soil and stones are disposed of for further processing into finer aggregates or for earth filling. The combustible fractions are called refuse-derived fuel (RDF) are sent for co-processing in cement industries. |
| Salient Aspects | land recovery, increase in value of land and available for public use/habitation with immediate effect.<br>Ensures long-term sustainability and environmentally sound treatment of legacy waste and present lucrative revenue-generating opportunities.<br>Bio products/aggregates generated from the process can be used as alternative construction material, fuel and recyclables.<br>Compliance to SWM Rules and NGT orders.<br>Improvement in aesthetics and quality of life & health. |
| Applicability | The ownership is well defined.<br>Working space is available in the dumpsite.<br>Linkage for utilization by-products is available |

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## 7.2 CAPPING WITHOUT LAND RECOVERY

Capping is a scientific process of profiling legacy waste and covering with barrier layers consisting of soil, high density polyethylene (HDPE) liner, gas collection system surface drainage system, and a vegetative cover to minimize the percolation of rainwater into the legacy waste.

| | |
|---|---|
| Salient Aspects | The capped area becomes a green space and can be developed into parks/recreational areas.<br>Capped area will be equipped with environmental monitoring systems for post-closure maintenance to monitor pollution levels in groundwater and surface-water sources and air (especially methane emissions) atleast 15 years.<br>Capped area needs to be inspected periodically for settlement due to physical, chemical and biological transformation, leachate generation, erosion and naturally occurring invasion by deep-rooted vegetation. Recurring expenditure will be incurred for regular maintenance.<br>On July 17, 2019, the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested bio-mining as environmentally safe and the most preferable approaches to dumpsite remediation<br>SWM rules do not permit habitation over it for at least 15 years because of the danger posed by toxic gases release by the waste. |
| Applicability | Capping could be a solution for legacy waste where bio-mining is not possible because of steep terrain, inaccessible ravines and narrow valleys.<br>Lack of linkage for utilization/ disposal of segregated components<br>Lack of working space & resources |

## 7.3 CAPPING WITH PARTIAL LAND RECOVERY

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can be linked to relevant buyers and the inert material will be capped to prevent further degradation of the environment.

| | |
|---|---|
| Salient Aspects | The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.<br>Ensures short -term sustainability and environmentally sound treatment of legacy waste.<br>Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area |
| Applicability | Legacy waste dumpsite area partial of steep terrain, inaccessible ravines and narrow valleys.<br>Lack of linkage for disposal of inert<br>Recovery land for public use is not a priority |

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## 7.4 SELECTION OF REMEDIATION OPTION

Selection of the applicable method/type or technique is based on the factors like., salient aspects & applicability of remediation types viz., Capping without land recovery, Bio-mining – reclamation/recovery of land & capping with partial land recovery and also available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for land recovery and forward linkages/utilization of processed aggregates/by-products.

Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. It may be noted that the bio-earth and C&D material which will be recovered by remediation is proposed to be used for development of the reclaimed legacy waste dumpsite as recreational park/facility (for site development work/ profiling). The bio-earth and C&D material recovered will be subjected to bi-weekly sampling and conform to the parameters mentioned in Schedule II of SWM Rules 2016 before using the material. Considering the same, there won't be any leachate generation using this material. There won't be any capping done and hence the question of erosion etc. doesn't arise.

**Salient parameters for opting the Bio-mining – reclamation/recovery of land.**

1. Based on the assessment from the chemical analysis report from the M/s. Polluchem, all the heavy metals are within the permissible limits as prescribed by the regulatory authorities Soil is free of contamination viz., heavy metals, chemical and other toxic substances.
2. Land recovery, increase in value of land and available for public use/setting of SWM facility with immediate effect. An area of 0.98 acres will be reclaimed through bio-mining
3. Adequate downstream linkages for the management/disposal waste viz., Bio-earth and C&D waste will be utilized for development of the reclaimed legacy dumpsite as recreational park/facility, recyclables will be sold to the authorized recyclers & will be collected from the project site and RDF will be sent to Cement industries for co-processing viz., as supplement to the conventional fuel.
4. By products/aggregates generated from the process can be used as alternative construction material (after processing), fuel and recyclables.
5. The Solid Waste Management Rules, 2016 and several National Green Tribunal (NGT) directives have mandated that urban local bodies opt for bio-mining over capping.

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# 8 TECHNICAL DESCRIPTION OF THE SELECTED OPTION

## 8.1 METHODOLOGY

The legacy waste dumpsite reclamation through bio-mining with recovery of land involves Phase 1: stabilization, Phase 2: sorting & segregation and Phase 3: disposal & utilization

The type of machinery, capacity and type of screens to stabilize of the legacy waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) will depend on the physical site conditions including quantity & characteristics of legacy waste and utilization of the aggregates/by-products/recovered material.

The type machinery available for the bio mining are as follows:

1. Stationary screening machinery
2. Mobile/compact machinery.




### 8.1.1 STATIONARY SCREENING MACHINERY

A Stationary trommel is a specialized piece of equipment used in legacy waste bioremediation processes to separate and classify solid waste materials. It is designed to efficiently screen and sort different components of the waste based on size and other characteristics. Technical description of a Stationary Trommel used in legacy waste bioremediation are as follows:

- ✓ Structure: The Stationary trommel consists of a frame made of steel or other durable materials. It is designed to withstand the harsh conditions of waste treatment facilities. The frame supports a cylindrical drum that is inclined at an angle for optimal material flow.
- ✓ Drum: The drum is the main component of the Stationary Trommel and is typically made of perforated metal or mesh. It is cylindrical in shape and rotates on its axis using a motorized drive system. The drum's 3- 5 mtr diameter and 10 mtr length can vary depending on the specific requirements of the waste treatment process.
- ✓ Motor and Drive System: The Stationary Trommel is equipped with a motor and drive system that powers the rotation of the drum. The motor is typically electrically powered and is connected to the drum through a gearbox or direct drive mechanism. The rotational speed of the drum can be adjusted to optimize the screening process.

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- ✓ Inlet and Outlet: The Stationary Trommel has an inlet where the legacy waste is fed into the drum for processing. The waste material enters the drum at one end, typically assisted by a conveyor or loader. The screened waste material is discharged from the opposite end of the drum through an outlet.
- ✓ Screening Mechanism: As the drum rotates, the legacy waste inside it is subjected to a combination of tumbling and rolling actions. The perforated drum allows smaller-sized particles and materials to pass through, while larger items such as bulky waste, debris, and contaminants are retained inside the drum. The drum's perforation size can be customized to achieve the desired separation efficiency.
- ✓ Waste Sorting: The Stationary Trommel facilitates the separation of different components within the legacy waste. It effectively segregates organic waste, inert materials, recyclables, and other categories based on their size and physical properties. This sorting process prepares the waste for further treatment or disposal.



Source: DCC Infra., Gurugram Site

Salient Features of Stationary Screening Machinery:

- Land requirement high for setting of machinery and processing area.
- Erection, Installation and Commissioning is time consuming
- Cost Intensive – CAPEX & OPEX high
- Electrical Power Intensive and Consumption is high
- Breakdown of the Machinery is high, onsite technicians should be available.
- Manpower – skilled & unskilled Intensive
- Suitable for quantity more than 2,00,000 ton of legacy waste.
- Less suitability for reuse of the machinery/screenings for more than one site/location.

### 8.1.2 MOBILE/COMPACT SCREENING MACHINERY

The Mobile Trommel is a technical apparatus utilized in legacy waste bioremediation processes. Its primary function is to separate and sort various types of waste materials, such as solid waste and organic matter, for effective bioremediation.

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**Structure:** The trommel consists of a cylindrical drum, typically made of heavy-duty metal, which is inclined at a slight angle. The drum is supported by a framework and set in motion by a motor or engine, causing it to rotate slowly. The rotation of the drum allows the waste materials to be fed into the trommel at one end, while simultaneously moving the materials along its length. Large screening area (9.5 sq m). Helps in good quality segregation & high productivity.

**Screening Mechanism:** The Mobile Trommel incorporates various mechanical features to facilitate waste separation. As the waste enters the drum, it encounters a series of screens or perforations arranged along the length of the drum. These screens have different mesh sizes, which allow for the separation of different-sized particles. The smaller particles, such as sand or fine soil, pass through the screens and fall through openings at the bottom of the trommel, while larger materials, such as plastics or larger debris, are retained and carried along by the rotation of the drum.

**Separation System:** Additionally, the Mobile Trommel may be equipped with paddles or lifters mounted inside the drum. These paddles help to agitate and tumble the waste materials, assisting in the separation process by ensuring proper contact between the waste and the screens. They also help to break up clumps or aggregates, aiding in the release of trapped organic matter. Four different screen inclination angles for operations between 20°-35° are available for selection provides flexibility.

**Treatment Process:**In the context of legacy waste bioremediation, the Mobile Trommel plays a crucial role in preparing the waste for subsequent treatment steps. By separating the waste into different fractions based on particle size, it allows for targeted bioremediation processes. For example, the fine fraction may be subjected to aerobic or anaerobic composting, while the larger fraction can undergo mechanical or physical treatments.

**Transport:** Quick and easy folding of conveyor helps in quick setup time.

**Discharge height:** Wider conveyor and higher discharge heights help in making bigger stockpile and eliminates the frequent loader usages.



*Figure 9 Compact Screening Machinery*

*Source: Kleemann Mobile Screens (Piranna, Ahamadabad Site)*

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**Salient Features of Mobile/Compact Screening Machinery:**

- Full Mobility: Plants are fully mobile like excavator. Plants can be moved across the most difficult of surfaces and terrain and can accommodate the most inaccessible locations.
- Quick Set up time: Track-Mobile plants can normally be set-up within 1 hour, as it normally does not require additional conveyors, feed hopper to link separate machines, thus increasing machine utilization.
- Versatility: Track-Mobile plants can be operated independently or in combination of two or three stage screening depending upon user requirements.
- No Civil works required: Plants do not require any civil works, can be erected & shifted quickly. Thus offer quicker return on investment.
- Manpower requirement is less.

## 8.2 SELECTION OF MACHINERIES

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by- products as per the requirements of the utilization/forward linkage.

Based on the detailed assessment of the selection parameters listed above, the site conditions, legacy waste characteristics, statutory requirements etc, mobile / compact screening shall be the optimum screening machinery for the Koothuparamba Dumpsite. The 12,625.27 tons legacy waste can be remediated within the stipulated time by NGT i.e. 31st March 2024

**Salient parameters for opting the Mobile/Compact screeners.**

1. Sorting/segregation of the stabilized legacy waste of 15,102 $m^3$/ 12,625.27 Tons within the stipulated timeline of 31st March 2024.
2. The remediation process will be guided by National, State Regulations & EIA/EMP in line with KSWMP ESMF.
3. Salient Features of Mobile/Compact Screening Machinery – details are in the section 8.1.2

## 8.3 SYSTEM REQUIREMENTS

### 8.3.1 CAPACITY SIZING OF MOBILE COMPACT SCREENER

The capacity of the Mobile compact screener is assessed as **100 TPH** considering the physical site conditions including quantity & characteristics of legacy waste and stipulated timeline for optimum land reclamation by **31st March 2024.** The calculation shown is only indicative and the contractor is required to propose own design and capacity to complete the works in the stipulated time and standards. The details of plant capacity sizing are provided in the table below:

*Table 30 Capacity Sizing of Mobile Compact Screener*

| Description | Quantity |
|---|---|
| Quantity of waste (Tons) | 12625.27 |
| Mobilization and site preparation (days) | 60 |

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| Description | Quantity |
|---|---|
| Weekends & Holidays | 20 |
| Rainy Days | 20 |
| Break downs (Days) | 15 |
| No of days (Dec 2023 - Mar 2024) | 75 |
| Effective processing days | 25 |
| Processing per day (Tons) | 505 |
| Capacity of the Plant - Considering working 8 hrs/day | 94 |
| Proposed Capacity of plant TPH | 100 |

### 8.3.2 MACHINERIES & VEHICLES

Detailed assessment of quantity (nos) of machinery, vehicles, auxiliary items required for effective processing of the legacy waste are provided in the Annexure – E. The summary of machineries and vehicles requirements are provided in the table below:

*Table 31 Machineries and Vehicles*

| S. No. | Description | Quantity(Nos) | Remarks |
|---|---|---|---|
| 1 | Mobile Trommel @ 100 TPH | 1 | Detailed Specifications are provided at Annexure –F |
| 2 | Baling Machine @ 50 TPD | 1 | |
| 3 | Ballistic Separator @ 30 TPH | 1 | |
| 4 | Magnetic Separator | 1 | |
| 5 | Front End Loader @ Bucket Capacity 1Cum | 2 | |
| 6 | Chain Mounted Excavator @ Bucket Capacity 1.1 Cum | 2 | |
| 7 | Weighing bridge - 40 Ton | 1 | |
| 8 | Tipper @ 8 Cum | 5 | |
| 9 | Tractor - Trolley shift of Materials | 1 | |
| 10 | Tractor -Trolley Water Tanker | 1 | |
| 12 | Mechanical Sprayer | 2 | |
| 13 | Office - Portable cabin (1 Nos.) | 1 | |
| 14 | GPS (5 Nos.) & Tracking System (1 Nos.) | 5 | |
| 15 | CCTV System (Cameras 5 Nos.) | 5 | |
| 16 | Fire Safety System - Fire Extinguisher ABC type 4 Kg/cm2 | 10 | |

Note: Considering the size of the site, it is required that the contractor liaisons with the Fire Department and deploys a fire tender at the site during the period of the contract works to manage any fire incident as part of Fire Safety Plan.

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## 8.4 OPERATIONS AND MAINTENANCE

### 8.4.1 MANPOWER:

Detailed assessment manpower required for effective processing of the legacy waste are provided in the Annexure – I. The summary of manpower required are provided in the table below:

*Table 32 Manpower Details*

| S. No | Manpower | Nos. |
|---|---|---|
| 1 | Site In-charge/Head | 1 |
| 2 | Environmental, Social and Health & Safety (ESHS) Officer | 1 |
| 3 | Security (3 X 8 Hrs) | 3 |
| 4 | Operations Supervisor & Accountant | 2 |
| 5 | Machine Operator, Mechanic & Electrician | 2 |
| 6 | Labors for stone removal | 2 |
| 7 | Labors for spraying Bio culture | 2 |
| 8 | Labors near Screening machinery | 4 |
| 9 | Labors at Baling facility | 2 |
| 10 | Drivers for tipper trucks, excavators, backhoe loaders and tractors | 11 |

### 8.4.2 ELECTRICAL POWER:

*Table 33 Electrical Power Details*

| Machineries | Required Electrical Load (KW) | Working Hr. | Total Units (KW-Hr) |
|---|---|---|---|
| Baling Machine | 5 | 4 | 20 |
| Ballistic Separator | 15 | 6 | 90 |
| Magnetic Separator | 5 | 6 | 30 |
| Weigh bridge | 5 | 6 | 30 |
| Total | 30 | | 170 |

### 8.4.3 FUEL/DIESEL FOR VEHICLES:

*Table 34 Fuel/Diesel for Vehicle*

| Description | Liters per Day |
|---|---|
| Fuel - Diesel Mobile Trommel (12 liters/hour) | 96 |

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### 8.4.4 WATER REQUIREMENTS:

The Water requirement in site will be fulfilled by the piped water supply and storage of water tank of 5000 liters capacity is already available at the dumpsite.

*Table 35 Water Requirement at Dumpsite*

| Description | Liters per Day |
|---|---|
| Water required for workers and other uses. | 5000 Liters Per Day |
| (Source – Municipality water Supply) | |

***Note:** The calculation shown above is only indicative and the contractor is required to propose own design and capacity to complete the works in the stipulated time and guidelines as per tender. The responsibility of availing necessary power and water connection shall be with the contractor as condition precedent before starting the work.*

*Further, considering the size of the site, it is required that the contractor liaisons with the Fire Department and deploys a fire tender team at the site during the period of the contract works to manage any fire incident as part of Fire Safety Plan. Alternatively, general SOPs for fire safety detailed herewith are to be followed:*

a) *Fire Fighting System including fire hydrant, pressure pumps, 5000 Ltr (min) water storage, adequate hose reel and fire extinguishers to be provided at site.*
b) *Alternate source of power (DG)*
c) *Manual Fire Alarm System with evacuation plan*
d) *Regular check, maintenance of equipment's for firefighting (before initiating work and then at interval of 1 months thereof)*
e) *Training to all men. (Before initiating work and then at interval of 3 months thereof).*
f) *Maintaining fire line while storage of material (RDF). RDF to not exceed 10% of total estimated waste at site at any given time.*
g) *Any other requirement in consultation with local Fire & Rescue Services office.*

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# 9 SCOPE OF DISPOSAL INCLUDING LOCATION OF DISPOSAL FOR RDF, BIO SOILS, C & D WASTE, AND OTHERS AS PER LOCAL DEMANDS

## 9.1 UTILIZATION OF BY PRODUCTS

The details of the utilization of aggregates/by-products screened out by processing of the stabilized legacy waste are provided in the table below

*Table 36 Utilization RDF, Bio-soils, C&D Waste*

| S.No | Component | Quantity (Cu.m) | Utilization/Linkage/Usage |
|---|---|---|---|
| 1 | Bio earth and C&D Waste | 10496 | The bio earth and C&D and quantity 15102.00 cu.m waste will be utilized for development of the reclaimed legacy waste dumpsite as recreational park/facility. |
| 2 | RDF | 4062.44 | RDF will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel. Currently theindicativenearest location for the RDF disposal is atDalmia Cements, Trichy which has the necessary infrastructure for co-processing of RDF. |
| 3 | Recyclables & others | 543.67 | Recyclables will be sold to CKCL/recyclers authorized by KSPCB/CPCB. |
| Note: The contractors engaged in bio-mining will be responsible for ensuring this disposal of Bio Earth, RDF, recyclables, and others. | | | |

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## 10 ESTIMATED PROJECT COST

The details of the estimated cost for bio-mining - recovery of land by remediating legacy waste dumpsite is provided in the table below:

*Table 37 Details of Estimated Project Cost*

| Estimate for Dumpsite remediation considering Forward Linkage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Activity | Details | Rate/ m3 | Cost Index @ 1.35 * A | COP @ 1.15 * B | Round off (INR) | Qty (m3) | Amount (Rs) |
| | | | A | B | C | | | |
| 1 | Remediation/ Biomining | Rate adopted from Calculation from Suchitwa Mission (DSR 2018 including baling) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 2 | Transportation of RDF | The average distance to cement factories works out to be 400 km. [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 3 | Disposal of recyclable | Considering that the recyclable will be sold at [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 4 | Disposal of Inert | Considering the disposal cost of [redacted] (market rate) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 5 | Disposal of Compost / Soil enricher | Considering the disposal cost of [redacted] (market rate) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| | | | | | | | | [redacted] |
| | Environmental & Social Safeguard estimated amount for the implementation and monitoring | | | | | | | [redacted] |
| | Grand Total | | | | | | | [redacted] |
| | | | | | | | | |

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| NOTE | |
|---|---|
| 1 | [redacted] |
| 2 | [redacted] |
| 3 | [redacted] |
| 4 | The estimate is based on the information available. The actual cost may vary from site to site based on results of dumpsite investigations report and contractors forward linkages |

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## 10.1 REVENUE FROM THE PROJECT

The anticipated sources of revenue from the processing of the legacy waste dumpsite viz., by sale Bio earth & C&D waste, organic compost, RDF and recyclables. But due to the following reasons mentioned below no revenue from the project is considered

- Bio earth & C&D waste will be utilized within the remediated dumpsite as filler material for development of recreational park.
- RDF is utilized as fuel (co – processing) in the cement industries, presently most cement industries are only accepting the RDF at no cost whereas transportation cost is required to be borne by the contractor sending the RDF to the cement factory/ WtE facility.
- The uncertainty of quantity and quality of the recyclables from legacy dumpsite due to burnt or crushed or disintegrated, rusted and additional money is required for cleaning of the recyclables for saleable.

## 10.2 FUNDING FOR PROJECT

The estimated cost of [redacted]/- for the project Dumpsite Remediation which equals to [redacted]/- per $m^3$. The sources and funding pattern is given below:

*Table 38 Funding for the Project*

| Item | External (70%) Rs. | State Govt. (30%) Rs. | Total cost Rs |
|---|---|---|---|
| **Bioremediation** | [redacted] | [redacted] | [redacted] |

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# 11 PROJECT IMPLEMENTATION PLAN

## 11.1 PROPOSED OPERATIONAL PLAN

The bioremediation of Koothuparamba dumpsite will be done with the land recovery and will be executed through an outsourcing model. The proposed operational plan is provided at the Annexure - I

## 11.2 TIMELINE

In compliance with the National Green Tribunal (NGT) orders, it is mandatory to remediate all dumpsites in Kerala by March 2024. To ensure timely completion and compliance with the deadline, timeline for the implementation of project is provided below.

| S No | Description | Time frame |
|---|---|---|
| 1 | Start date | 01/12/2023 |
| 2 | End date | 31/03/2024 |



## 11.3 CONTRACT MODEL

**Execution Method:**

- Item Rate Contract and disposal/Management of by-products/aggregates with land recovery and redevelopment of the site with inert/ soil enricher. The work shall be carried out in compliance with SWM Rules 2016 and CPCB Guidelines for the disposal of legacy waste 2019.

**Working Model:**

- 100% work to outsourced to selected private contractor
- TSC will assess the quantity of waste and the ULB will hand over the land for setting up the plant to the Contractor.
- Cost of Electricity connection to be provided by ULB for the plant.
- Electricity charges for the usage of the plant to be paid by contractor
- Contractor is responsible for disposal of RDF, recyclables, and aggregates

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## 12 BENEFITS OF THE PROJECT

Remediation of legacy waste dumpsite in the Koothuparamba leads to the following anticipated benefits:

- **Reclamation of Land**: An area of 0.986 acres will be reclaimed and can be developed into a recreational park for public use or utilized as SWM facilities. A contamination assessment is to be carried out before any public use project is taken up at the location.
- **Environmental Protection**: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By cleaning up contaminated sites, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity. The project shall arrest GHG emissions from the legacy dumpsite.
- **Health Improvement**: Remediation projects reduce these risks, leading to improved public health outcomes and a reduction in waterborne and airborne diseases.
- **Enhanced Water Quality**: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to the safe drinking water.
- **Aesthetic and Social Benefits**: Remediation of legacy waste dumpsite can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents. Uncontrolled waste dumping will be stopped.
- **Operational & Life cycle Aspects**

Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through bio-mining process.

- **Employment**

During remediation& post- remediation period, requirement of un-skilled labor will be fulfilled by s local sourcing.

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# 13 CONCLUSION

- The activities of the bio-mining will be commenced from Dec 2023 to Mar 2024. An area of 0.986 acres will be reclaimed and will be developed into a recreational park for public use after contamination assessment.
- Through the process of bio mining the dumpsite, complete land reclamation and recovery, while prioritizing environmental safeguards. This means that the land will be reclaimed and put to use.
- Considering site conditions and quantum, screening of the 15102 $m^3$ of legacy waste, mobile / compact screening machinery will be preferred.
- Favorable site conditions for bio-mining:
    1. Optimum width of the road is available for movement of the vehicles.
    2. Electrical power infrastructure viz., power lines & electrical transformer is available adjacent to the boundary of the dumpsite.
    3. Piped water supply and storage of water tank 5000 liters are available at the dumpsite.
    4. At the dumpsite plot, a vacant land parcel of approx. 0.20 acres is available for the installation of auxiliary infrastructures, supporting conditions movement of processing machinery and vehicles.
- The project activity requires to obtained "Site Authorization, Consent to Establish and Consent to Operate" from KSPCB
- By-products utilization/forward linkages/Usage
    1. The bio earth & C&D quantity of 7173.45 $m^3$& 3322.44 $m^3$respectively is proposed to be utilized after testing for the contamination for development of the reclaimed land as recreational park/facility. The contraction shall level the site in consultation with the PIU/TSC/DPMU.
    2. Refused derived fuel (RDF) of 4062.44 $m^3$ will be to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the processes. The indicative location of cement plant is Dalmia Cements, Trichy.
    3. Recyclables of 543.67 $m^3$ will be sold to CKCL /Private recyclers authorized by KSPCB/CPCB
- The implementation/execution of the project activities shall be conforming to SWM Rules 2016, NGT orders, KSPCB norms, CPCB guidelines and KSWMP ESMF and other regulatory rules & norms.
- Environmental & Social safeguards:
    1. The project attracts E2 Environmental category based on the Environmental Screening and Exclusions mentioned in the Environmental and Social Framework Guidelines.
    2. Site specific Environmental Assessment and Environmental Management Plan has been developed.
    3. The project attracts moderate risk social category based on the social mapping & transect walk to understand the settlements/habitations/establishments etc., and consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.
- Total cost of the project is [redacted]/- (INR [redacted]). The cost per $m^3$ for processing and disposal of the legacy waste is Rs. [redacted]/- per $m^3$.

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ANNEXURES

*Table 39 List of Annexures*

| Annexures | Description |
|---|---|
| Annexure A | GEOTECHNICAL TEST REPORT |
| Annexure B | ENVIRONMENTAL TEST REPORT |
| Annexure C | PHOTOGRAPHS –SAMPLING |
| Annexure D | VOLUMETRIC ANALYSIS |
| Annexure E | SITE PLAN |
| Annexure F | SURVEY CONTOUR PLAN |
| Annexure G | REQUIREMENT OF VEHICLE & MACHINERY |
| Annexure H | SPECIFICATION OF MACHINERIES & VEHICLES |
| Annexure I | PROPOSED OPERATIONAL PLAN |
| Annexure J | LSGD GUIDELINES FOR REMEDIATION OFLEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION |

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# Annexure A

# Geotechnical Test Report

MatterLab
Where Quality Matters

Report Number: **ML/GT/2231/243/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE D OF KSWMP AT PALLAPARAMBA, KOOTHUPARAMBA, KANNUR DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | Project Manager, IPE Global Ltd. |
| Address | : | 2nd Floor, 16/3878-3879, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact Person | : | - |
| Project No | : | GT-236 |
| Project Name | : | Geotechnical examination of dumpsite under package D of KSWMP at Pallaparamba, Koothuparamba, Kannur District. |
| Owner | : | KSWMP |
| Project Location | : | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Fax No | : | - |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 19-07-2023 | 1st Submission | Dr. Gautham Adapa | |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Dr. Jimmy Thomas | Geotechnical Expert, Consultant, MatterLab | |
| Approved by: | Freddy Soman | General Manager, MatterLab | |

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2 SCOPE OF WORK ..... 3

3 OBSERVATIONS FROM SITE VISIT ..... 3

4 GEOTECHNICAL INVESTIGATIONS ..... 4

5 LABORATORY ANALYSIS ..... 6

6 SUMMARY ..... 7

## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results

# 1 INTRODUCTION

Matter Material Testing and Research Laboratory Pvt. Ltd has been set-up as a result of increased demand locally from various industries for a multidisciplinary testing, materials consultancy & investigation facility in alignment with global standards and technology advancements. MatterLab is an independent professional and technical services provider to all who are concerned with quality and performance of materials & products.

IPE Global Ltd. which provides technical support consultancy services to the Urban local bodies in different municipalities for the Kerala State Waste Management Project (KSWMP) has entrusted the geotechnical investigative works as part of their DPR study for the remediation of dumpsite in Pallaparamba, Koothuparamba, Kannur district to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was bored using a rotary drill. The initial site visit was done on 19th May 2023. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 06th June 2023 and was completed on 07th June 2023. Standard Penetration test (SPT) was conducted within the borehole as required. Representative and undisturbed soil samples were collected to conduct relevant laboratory tests to acquire the necessary parameters. This report presents results of the geotechnical investigation of the ground encountered after drilling through the waste at the dumpsite.

# 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil samples and performing necessary laboratory tests on the collected samples to obtain the desired parameters of the ground profile.
- Preparation of report with laboratory test results.

# 3 OBSERVATIONS FROM SITE VISIT

Matterlab has deputed a team from our geotechnical department along with Mr. Kamal Kishore Jha of IPE Global during the third week of May 2023, in order to collect the information regarding the site prior to mobilising the equipment for drilling, .




**Figure 1** : Location of the borehole drilled at the dumpsite

## 4 GEOTECHNICAL INVESTIGATIONS

### 4.1 Rotary drilling

Rotary drilling technique was adopted for advancing and clearing out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste at the dumpsite.

### 4.2 Drilling equipment

Mechanical rigs of rotary drilling machine were used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The borehole of 150mm diameter was formed using a drag bit (Soil Cutter) in soil. The drag bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by drilling mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

### 4.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as representative samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log the commencement and completion date, location of borehole, elevation of top and bottom of boring, ground water table, boundaries of each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelog is attached as **Appendix-I.**

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant Standard Codes. A summary of laboratory tests carried out is shown below in **Table 1** and the complete results of laboratory testing are presented in **Appendix II**.

**Table 1: Details of various laboratory tests and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 1 | Soil | Grain-Size Analysis | IS: 2720(Part-4)-1985 |
| 2 | | Atterberg's Limit | IS: 2720(Part-5)-1976 |
| 3 | | MDD\OMC(Light Compaction) | IS:2720(Part-7)-1980 |
| 4 | | Moisture Content | IS 2720(Part 2)-1973 |
| 5 | | Bulk Density & Dry Density | BS:1377-(Part-2)-1990 |
| 6 | | Permeability | IS :2720 (Part-17)-1986 |
| 7 | | Unconfined compressive strength | IS:2720(Part-10)-1991(R2015) |



(a)



(b)



(c)



(d)

**Figure 2 :** Laboratory tests performed at MatterLab.

## 6 SUMMARY

The geotechnical examination on the soil samples collected after boring through the waste at the dumpsite at Pallaparamba, Koothuparamba, Kannur was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a single borehole was bored using a rotary drilling method. The maximum depth of investigation was 9.0 m (5.5 m in waste and 3.5 m in the ground). SPT and collection of undisturbed samples were carried out at regular intervals. Various laboratory tests were carried out on the SPT and undisturbed soil samples.

Based on the investigations carried out, it was observed that the original ground below the waste comprises of a Lateritic soil with SPT N-value of 37 at 5.5 m, 35 at 7.0 m and refusal at 8.5 m from the start of the borehole. The tests mentioned in the above table were performed on the samples in the laboratory following the respective codes to obtain the necessary parameters. The laboratory results on samples obtained from the site are appended in **Appendix II**.

# APPENDIX-I

# BORELOGS

Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT** | **: Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba.** | **SHEET NO.** | **: 1 of 1`** | **START DATE** | **: 06/06/2023** |
| **CLIENT** | **: Project Manager, IPE Global.** | **BORE DIAMETER (mm)** | **: 150** | **END DATE** | **: 07/06/2023** |
| **Proposed Structure** | **: Dumpsite remediation** | **BORING TYPE** | **: Rotary** | **REDUCED LEVEL (m)** | **: -** |
| **LOCATION** | **: Pallaparamba, Koothuparamba, Kannur District.** | **TERMINATION DEPTH (m)** | **: 9.0** | **EASTING (m)** | **: -** |
| **BOREHOLE NO.** | **: BH-01** | **WATER LEVEL** | **:** | **NORTHING (m)** | **: -** |

| DEPTH m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM N1 | BLOW COUNT/15CM N2 | BLOW COUNT/15CM N3 | SPT N VAL | DEPTH V/S N VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.5 | | Plastic waste deposit | 5.5 | | | | | | | | |
| 6.0 | | Hard greyish to reddish Lateritic CLAY with traces of gravels | 0.5 | 5.5 | SPT-1 | 8 | 17 | 20 | 37 | | |
| 6.5 | | Geryish to reddish fine gravels sandy SILT with little clay and traces of gravels | 0.5 | 6.0 | UDS-1 | | | | | | |
| 7.0 | | Greyish to reddish fine grained silty SAND with traces of gravels | 0.5 | 6.5 | UDS-2 | | | | | | |
| 7.5 | | Hard greyish to reddish clayey SILT with fine sand | 0.5 | 7.0 | SPT-2 | 13 | 15 | 20 | 35 | | |
| 8.0 | | Greyish to reddish fine grained silty SAND with little amount of clay | 0.5 | 7.5<br>8.0 | UDS-3<br>UDS-4 | | | | | | |
| 8.5 | | Hard greyish to reddish fine grained clayey SILT with fine sand and traces of gravels | 0.5 | 8.5 | SPT-3 | 7 | 50 | > | >50 | | Balance-20cm |
| 9.0 | | Greyish to reddish fine granied silty SAND with traces of gravels | 0.5 | 9.0 | UDS-5 | | | | | | |
| | | **Bore hole terminated at the depth of 9.00 m below top of waste (3.5 m below original ground)** | | | | | | | | | |

Abbreviations
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
CR- Core Recovery, RQD- Rock Quality Designation

Sd/-
Site Supervisor

# APPENDIX-II

# LABORATORY TEST RESULTS

# SUMMARY OF LABORATORY TEST RESULTS

**Report Number : ML23/R-02243 Report Date:05/07/2023**

**Project : Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba**

**Borehole ID : BH-01**

| N value | MatterLab ref | Depth (m) | Type of sample (SPT/UDS/RC) | Soil description | IS Classification | Atterberg Limit | | | Grain size distribution | | | | | | | Water content (w), % | Maximum dry density, gm/cc | Optimum moisture content, % | Bulk Density, gm/cc | Permeability, cm/s | Unconfined Compressive Strength (UCS), kPa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit,% | Plastic Limit,% | Plasticity Index | Coarse Gravel,% | Fine Gravel,% | Coarse Sand,% | Medium Sand,% | Fine Sand,% | Silt,% | Clay,% | | | | | | |
| 37 | ML23/W-02242/S1 | 5 5 | SPT | Gravelly clay of high plasticity with sand | CH | 60 | 25 | 35 | | 21 | 5 | 4 | 10 | 33 | 27 | | | | | | |
| | ML23/W-02242/S2 | 6 0 | UDS | | | | | | | | | | | | | 31 | | | 1 54 | | 73 |
| | ML23/W-02242/S3 | 6 5 | UDS | | | | | | | | | | | | | | 1 81 | 14 | | 8 10 E-06 | |
| 35 | ML23/W-02242/S5 | 7 0 | SPT | Sandy clay of intermediate plasticity | CI | 42 | 21 | 21 | | 6 | 2 | 2 | 21 | 41 | 28 | | | | | | |
| | ML23/W-02242/S6 | 7 5 | UDS | | | | | | | | | | | | | 12 | | | 1 91 | | 203 |
| | ML23/W-02242/S7 | 8 0 | UDS | | | | | | | | | | | | | | 1 81 | 16 | | 3 91 E-07 | |
| >50 | ML23/W-02242/S8 | 8 5 | SPT | Clay of low plasticity with sand | CI | 41 | 21 | 20 | | 3 | 2 | 3 | 13 | 52 | 27 | | | | | | |
| | ML23/W-02242/S9 | 9 0 | UDS | | | | | | | | | | | | | 17 | | | 1 73 | | 163 |

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## Water Content of Soil Test Report

Report No: ML23/R-02243
Issue No : 1
Report Date: 05/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 18/3878 - 3879, Kavanatt Building, Kanagamoor Village, Kakkanad, Ernakulam, Kerala-628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

ULR-TC107423000000457F

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*): | Soil (UDS-1), BH 01, Depth 6.00m |
| Work Order ID: | ML23/W-02243 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02243/S2 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 06/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Pallaparamba, Koothuparamba, Kannur District | Date Tested : | 28/06/2023 - 29/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 6.00m |
| Tested By: | GK | Client Sample Desc.*): | Soil (UDS-1), BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

### Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 31 | - |

For and on behalf of Matter Lab

Comments:
*Information provided by client

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TC-10744

## Water Content of Soil Test Report

Report No: ML23/R-02243(2)
Issue No: 1
Report Date: 29/07/2023

| | |
|---|---|
| **Client:** | Project Mangal, IPE Global |
| **Address:** | 2nd Floor, 16/3676 - 3679, Kavanatt Building, Kaniyanoor Village, Kakkanad, Ernakulam, Kerala-628030 |
| **Contact:** | - |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Pallaparamba, Koothuparamba, Kannur District |
| **Tst / Email:** | - |

ULR-TC287432300004658F

### Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 27/06/2023 | **Client Sample Ref.*:** | Soil (UDS-3), BH 01, Depth 7.65m |
| **Work Order ID:** | ML23/W-02243 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02243/06 | **Source*:** | BH 01, Depth 7.50m |
| **Date Sampled:** | 06/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2132 - 1986 | **Sample Size(kg):** | 5 Approx |
| **Sample Location*:** | Pallaparamba, Koothuparamba, Kannur District | **Date Tested :** | 28/06/2023 - 29/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil (UDS-3), BH 01, Depth 7.50m |
| **Tested By:** | GK | **Client Sample Desc.*:** | Soil (UDS-3), BH 01, Depth 7.50m |
| **Test Location:** | MatterLab - Kozhikode | | |

### Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 12 | - |

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# Water Content of Soil Test Report

Report No: ML23/R-023403
Issue No: 1
Report Date:09/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 18/3878 - 3879, Kavanatt Building, Karagamoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

UR-TC107423000000465 9F

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Work Order ID: | ML23/W-02243 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02243/08 | Source*: | BH 01, Depth 9.00m |
| Date Sampled: | 26/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx. |
| Sample Location*: | Pallaparamba, Koothuparamba, Kannur District | Date Tested : | 28/06/2023 - 29/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-5), BH 01, Depth 9.00m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (wc) % | 17 | - |

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# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23R-022434
Issue No : 1
Report Date: 05/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 16/3878 - 3879, Kavarati Building, Kaniyanoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 5.50m |
| Work Order ID: | ML23/W-02243 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02243/S1 | Source*: | BH 01, Depth 5.50m |
| Date Sampled: | 06/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Pallaparamba, Koothuparamba, Kannur District | Date Tested : | 29/06/2023 - 01/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 5.50m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 5.50m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3: Mechanical Method | Liquid Limit,% | 60 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 25 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 35 | - |

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# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-002439
Issue No : 1
Report Date: 05/07/2023

| | |
|---|---|
| **Client:** | Project Manger, IRE Global |
| **Address:** | 2nd Floor, 18/3875 - 3875, Kavenatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| **Contact:** | - |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Pallaparamba, Koothuparamba, Kannur District |
| **Tel / Email:** | - |

IIRA-TC/0743 2 3 0 6 0 0 4 8 6 1 F

## Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 27/06/2023 | **Client Sample Ref.*:** | Soil, BH 01, Depth 7.00m |
| **Work Order ID:** | ML23/W-02243 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02243/54 | **Source*:** | BH 01, Depth 7.00m |
| **Date Sampled:** | 08/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2131 - 1981 | **Sample Size(kg):** | 5 Approx |
| **Sample Location*:** | Pallaparamba, Koothuparamba, Kannur District | **Date Tested :** | 29/06/2023 - 01/07/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil, BH 01, Depth 7.00m |
| **Tested By:** | VY | **Client Sample Desc*.:** | Soil, BH 01, Depth 7.00m |
| **Condition of Soil:** | Natural | **Period of Soaking:** | 24 Hrs |
| **Test Location:** | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3 Mechanical Method | Liquid Limit % | 42 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit % | 21 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 21 | - |

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# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-022626
Issue No : 1
Report Date: 05/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 18/3878 - 3879, Kavanatt Building, Kanayannour Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Duricrete in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

UR-TC197023000048627F

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 8.50m |
| Work Order ID: | ML23/W-02243 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02243/87 | Source*: | BH 01, Depth 8.50m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Pallaparamba, Koothuparamba, Kannur District | Date Tested : | 29/06/2023 - 01/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 8.50m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 8.50m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3 Mechanical Method | Liquid Limit % | 41 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit % | 21 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 20 | - |

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TC-19743

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/W-02243/T
Issue No : 1
Report Date: 08/07/2023

| | |
|---|---|
| Client: | Project Manger, IFE Globe |
| Address: | 3rd Floor, 16/3878 - 3879, Kavanad Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

IR-TCIW02300000485GB

## Sample Details

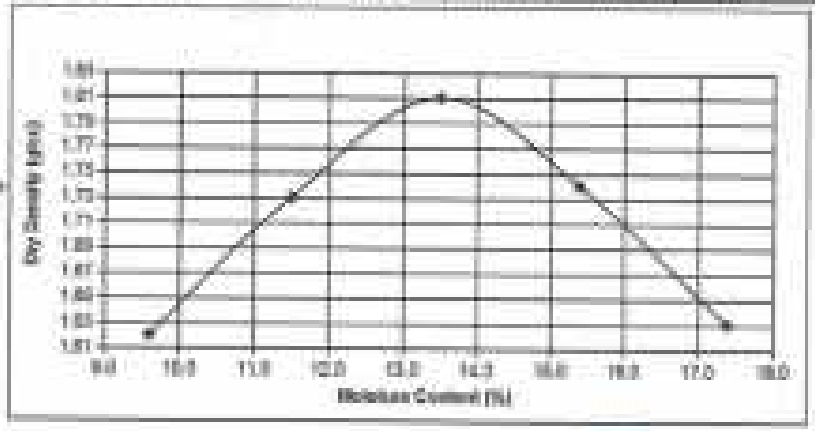
| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil (UDS-2), BH 01, Depth 6.00m |
| Work Order ID: | ML23/W-02243 | Sample Submitted By.*: | Geotechnical Division |
| Sample ID: | ML23/W-02243/03 | Source*: | BH 01, Depth 6.50m |
| Date Sampled: | 08/06/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Pallaparamba, Koothuparamba, Kannur District. | Date Tested : | 29/06/2023 - 30/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 6.50m |
| Tested By: | GK/RR | Client Sample Desc.: | Soil (UDS-2), BH 01, Depth 6.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Mould volume | $V_m$ (cm³) | Mould | | | | |
|---|---|---|---|---|---|---|
| Test No. | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | $W_m$ (g) | 4053 | | | | |
| Mass of mould + compacted sample | $W_2$ (g) | 5839 | 5969 | 6109 | 6069 | 5969 |
| Mass of sample | | 1778 | 1926 | 2048 | 2008 | 1908 |
| Wet density | $(W-W_m)/V_m$ $\rho_w$ (Mg/m³) | 1.78 | 1.90 | 2.05 | 2.01 | 1.91 |
| Mass of wet sample | $W_2$ (g) | 422.8 | 435.2 | 492.5 | 428.6 | 447.1 |
| Mass of dry sample | $W_d$ (g) | 385.8 | 390.3 | 426.7 | 371.8 | 380.8 |
| Moisture content | $((W_2-W_d)/W_d)\times100$ w (%) | 9.6 | 11.6 | 13.6 | 15.4 | 17.4 |
| Dry density | $\rho_w/(1+w/100)$ $\rho_d$ (Mg/m³) | 1.62 | 1.75 | 1.81 | 1.74 | 1.63 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, gm/c | 1.81 |
| Optimum moisture content, % | 14 |
| Material retained on 20mm,% | 0 |
| Sample used | Single |
| Size of mould | 1000cm³ |
| Weight of rammer | 2.6 kg |




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Comments

*Information provided by client

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Kozhikode, Kerala, 673020.

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/R-023639
Issue No: 1
Report Date: 05/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 16/3878 - 3879, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

ULR-TC747423023060046546F

## Sample Details

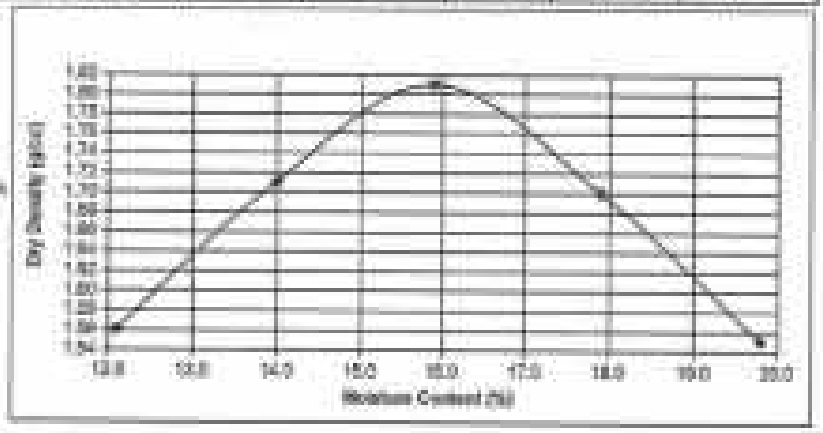
| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*): | Soil (UDS-4), BH 01, Depth 8.00m |
| Work Order ID: | ML23/W-02243 | Sample Submitted By.*): | Geotechnical Division |
| Sample ID: | ML23/W-02243/08 | Source*): | BH 01, Depth 8.00m |
| Date Sampled: | 09/06/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(Kg): | 5 Approx |
| Sample Location*: | Pallaparamba, Koothuparamba, Kannur District | Date Tested : | 29/06/2023 - 30/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-4), BH 01, Depth 8.00m |
| Tested By: | GKRR | Client Sample Desc.: | Soil (UDS-4), BH 01, Depth 8.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ (cm³) | 998 | | | | |
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4083 | | | | |
| Mass of mould + compacted sample | | W (g) | 5810 | 6009 | 6139 | 6059 | 5919 |
| Mass of sample | | | 1747 | 1946 | 2096 | 1996 | 1856 |
| Wet density | $(W-W_m)/V_m$ | $\rho_b$ (Mg/m³) | 1.75 | 1.95 | 2.10 | 2.00 | 1.86 |
| Mass of wet sample | | W (g) | 426.0 | 436.9 | 428.1 | 460.4 | 460.0 |
| Mass of dry sample | | W (g) | 379.1 | 383.2 | 369.4 | 390.5 | 400.7 |
| Moisture content | $[(W_2-W_3)/W_3]x100$ | m (%) | 12.1 | 14.0 | 15.9 | 17.9 | 19.9 |
| Dry density | $\rho_b/(1+m/100)$ | $\rho_d$ (Mg/m³) | 1.56 | 1.71 | 1.81 | 1.70 | 1.55 |

Method: IS 2720 | Part 7 | 1980

| | |
|---|---|
| Maximum dry density, g/cc: | 1.81 |
| Optimum moisture content, %: | 16 |
| Material retained on 20mm,%: | 0 |
| Sample used | Single |
| Size of mould | 1000cm³ |
| Weight of rammer: | 2.6 kg |




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## Comments

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Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

# Permeability of Soil Test Report

Report No: ML23/W-02343/S3
Issue No : 1
Report Date:09/07/2023

| | |
|---|---|
| Client: | Project Manger, IRE Global |
| Address: | 2nd Floor, 16/3875 - 3876, Kavarati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil (UDS-2), BH 01, Depth 6.50m |
| Work Order ID: | ML23/W-02343 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02343/S3 | Source*: | BH 01, Depth 6.50m |
| Date Sampled: | 06/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Pallaparamba, Koothuparamba, Kannur District | Date Tested : | 01/07/2023 - 02/07/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 6.50m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS-2), BH 01, Depth 6.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 8.10 E-08 | - |

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**Comments**

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Thiruvannur, Kozhikode, Kerala, 673028

# Permeability of Soil Test Report

Report No: ML23IN-00243/01
Issue No : 1
Report Date: 05/07/2023

| | |
|---|---|
| Client: | Project Manger, IRE Global |
| Address: | 2nd Floor, 16/3875 - 3879, Kavanatt Building, Kaneyannoor Village, Kakkanad, Ernakulam, Kerala-628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil (UDS-4), BH 01, Depth 8.00m |
| Work Order ID: | ML23IW-00243 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23IW-00243/04 | Source*: | BH 01, Depth 8.00m |
| Date Sampled: | 26/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size/kg: | 5 Approx |
| Sample Location*: | Pallaparamba, Koothuparamba, Kannur District | Date Tested : | 30/06/2023 - 01/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-4), BH 01, Depth 8.00m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS-4), BH 01, Depth 8.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 3.91 E-07 | - |

SREELESH TV
Head-QM Laboratory

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Thiruvannur, Kozhikode, Kerala, 673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-03243/01
Issue No : 1
Report Date:28/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 1503/78 - 3079, Ravanatt Building, Kanayancoor Village, Kakkanad, Ernakulam, Kerala-629030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Work Order ID: | ML23/WI-03243 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/WI-03243/02 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Pallaparamba, Koothuparamba, Kannur District | Date Tested : | 28/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 6.00m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377| Part 2| 1990 | Bulk Density of Soil, g/ml | 1.54 | - |

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# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-02343/SS
Issue No: 1
Report Date: 03/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 19/3815 - 3819, Kavarati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala-629030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*): | Soil (UDS-3), BH 01, Depth 7.50m |
| Work Order ID: | ML23/W-02343 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02343/SS | Source*): | BH 01, Depth 7.50m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx. |
| Sample Location: | Pallaparamba, Koothuparamba, Kannur District | Date Tested : | 28/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc : | Soil (UDS-3), BH 01, Depth 7.50m |
| Tested By: | GK | Client Sample Desc.*): | Soil (UDS-3), BH 01, Depth 7.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 1.81 | - |

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**Comments**

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# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/T-0234/01
Issue No : 0
Report Date:09/07/2023

| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 1933/5 - 3/5, Kavanad Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-629030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Work Order ID: | ML23/W-02245 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02243/08 | Source*: | BH 01, Depth 9.00m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS 2132 : 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Pallaparamba, Koothuparamba, Kannur District | Date Tested : | 28/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-5), BH 01, Depth 9.00m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/cc | 1.73 | - |

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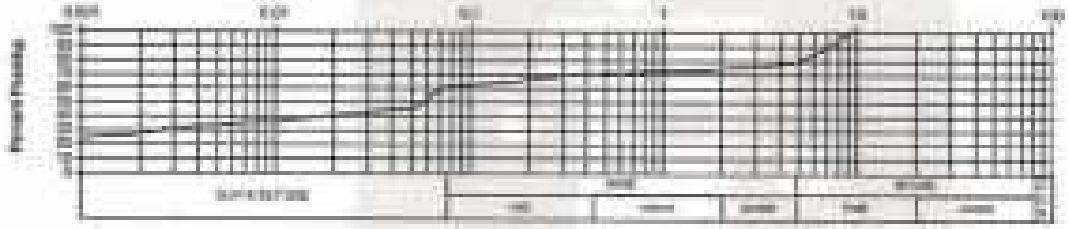
# Hydrometer Analysis Test Report

| | | | |
|---|---|---|---|
| Client: | Project Manger, PIC Global | Consultant: | - |
| Address: | 2nd Floor, 16/3870 - 3870, Kavarath Building, Kanjiramoo Village, Kakkanad, Ernakulam, Kerala-682030 | Owner: | KSWMP |
| Contact: | - | Contractor: | - |
| Project No: | - | Project Location: | Pallipparamba, Koothuparamba, Kannur District |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallipparamba, Koothuparamba | Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 27/09/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 6.00m |
| Work Order ID: | MLSWR-02349 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | MLSWR-S2349/01 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 09/09/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Pallipparamba, Koothuparamba, Kannur District | Date Tested : | 01/07/2023 - 03/07/2023 |
| Sample Cert. No: | - | Test Method Variations: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 6.00m |
| Tested By: | RH | Client Sample Desc.*: | Soil, BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4)-1985, CI 9.3




| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 79 |
| 2.000 | 74 |
| 0.850 | 72 |
| 0.600 | 71 |
| 0.425 | 70 |
| 0.300 | 68 |
| 0.150 | 64 |
| 0.075 | 60 |
| 0.047 | 46 |
| 0.033 | 44 |
| 0.024 | 42 |
| 0.015 | 40 |
| 0.014 | 38 |
| 0.010 | 36 |
| 0.007 | 35 |
| 0.005 | 33 |
| 0.003 | 31 |
| 0.002 | 27 |
| 0.001 | 24 |

| | |
|---|---|
| Gravel % | 21 |
| Sand % | 19 |
| Silt % | 33 |
| Clay % | 27 |

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**Comments**

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# Hydrometer Analysis Test Report

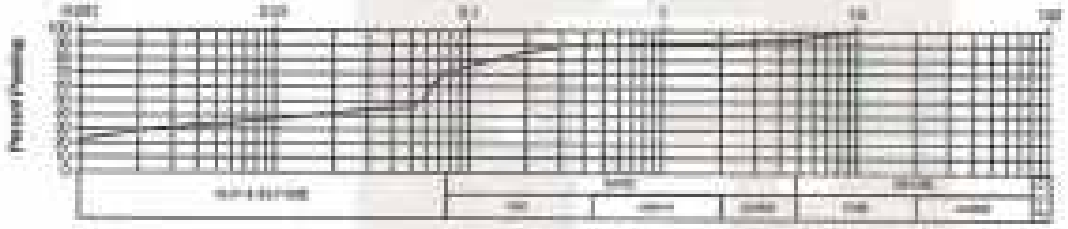
| | | | |
|---|---|---|---|
| Client: | Project Manger, PE Global | Consultant: | - |
| Address: | 2nd Floor, 18/5878 - 5879, Kavarati Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-682030 | Owner: | KSWMP |
| Contact: | - | Contractor: | - |
| Project No: | - | Project Location: | Pallipparamba, Kunhipparamba, Kannur District |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallipparamba, Kunhipparamba | Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/08/2025 | Client Sample Ref.*: | Soil, BH 01, Depth 7.00m |
| Work Order ID: | ML25WV-02343 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML25WV-02343/04 | Source*: | BH 01, Depth 7.00m |
| Date Sampled: | 09/08/2025 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Weight: | 0 Approx |
| Sample Location*: | Pallipparamba, Kunhipparamba, Kannur District | Date Tested : | 01/09/2025 - 03/09/2025 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 7.00m . |
| Tested By: | SH | Client Sample Desc.*: | Soil, BH 01, Depth 7.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution

Method: IS: 2720 (Part 4) 1985, CL 8.3




Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 99 |
| 2.000 | 97 |
| 0.850 | 91 |
| 0.600 | 90 |
| 0.425 | 90 |
| 0.300 | 89 |
| 0.150 | 81 |
| 0.075 | 66 |
| 0.053 | 46 |
| 0.037 | 42 |
| 0.026 | 42 |
| 0.019 | 41 |
| 0.014 | 36 |
| 0.010 | 37 |
| 0.007 | 36 |
| 0.005 | 35 |
| 0.003 | 31 |
| 0.002 | 28 |
| 0.001 | 22 |

| | |
|---|---|
| Gravel,% | 5 |
| Sand,% | 29 |
| Silt,% | 41 |
| Clay,% | 25 |

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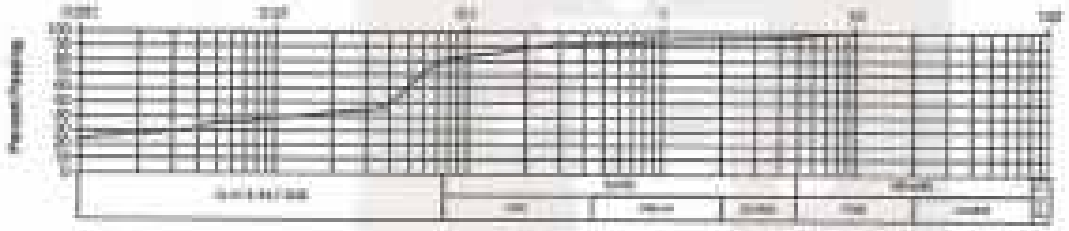
# Hydrometer Analysis Test Report

| | | | |
|---|---|---|---|
| Client: | Project Manger, PIC Dsitrict | Consultant: | - |
| Address: | 2nd Floor, 19/3876 - 3878, Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala-682030 | Owner: | KSWMP |
| Contact: | - | Contractor: | - |
| Project No: | - | Project Location: | Pallipparambu, Koothuparambu, Kannur District |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallipparambu, Koothuparambu | Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 27/08/2025 | Client Sample Ref.*: | Soil, BH 01, Depth 6.00m |
| Work Order ID: | ML23/W-02048 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02048/07 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 26/08/2025 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Shape(s): | 6 Approx |
| Sample Location*: | Pallipparambu, Koothuparambu, Kannur District | Date Tested : | 01/09/2025 - 03/09/2025 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 6.00m |
| Tested By: | SH | Client Sample Desc.*: | Soil, BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4): 1985, Cl. 9.5




| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 97 |
| 2.000 | 90 |
| 0.850 | 84 |
| 0.425 | 82 |
| 0.300 | 82 |
| 0.150 | 80 |
| 0.075 | 79 |
| 0.037 | 68 |
| 0.027 | 64 |
| 0.019 | 62 |
| 0.014 | 60 |
| 0.010 | 58 |
| 0.007 | 56 |
| 0.005 | 55 |
| 0.004 | 52 |
| 0.003 | 29 |
| 0.001 | 24 |

| | |
|---|---|
| Gravel % | 3 |
| Sand % | 18 |
| Silt % | 62 |
| Clay % | 17 |

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**Comments**

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# UNCONFINED COMPRESSIVE STRENGTH(UCS) OF SOIL TEST REPORT

Report No: ML23/W-02343/T
Issue No: 1
Report Date: 05/07/2023

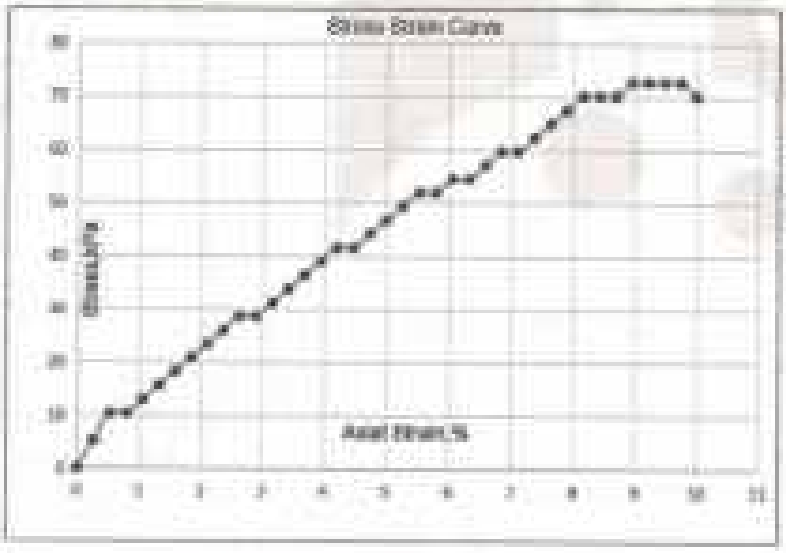
| | |
|---|---|
| Client: | Project Manger, IRC Global |
| Address: | 3rd Floor, 16/3879 - 3879, Kavanatt Building, Kanapparoor Village, Kakkanad, Ernakulam, Kerala-628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Work Order ID: | ML23/W-02343 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02343/02 | Source: | BH 01, Depth 6.00m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 6 Approx |
| Sample Location: | Pallaparamba, Koothuparamba, Kannur District | Date Tested: | 28/06/2023 - 29/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | Matterlab, Kozhikode | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 6.00m |
| Tested By: | GK/CK | Client Sample Desc.: | Soil (UDS-1), BH 01, Depth 6.00m |

## Test Results

Method: IS: 2720 (Part 10)-1991 (R2019)




| | |
|---|---|
| Unconfined Compressive Strength,kPa | 70 |
| Specimen Height (mm) | 76 |
| Specimen Diameter | 38 |
| Specimen Density(g/cc) | 1.54 |
| Moisture Content(%) | 31 |
| Type of specimen | Undisturbed |
| Specimen Condition | - |

For and on behalf of Matter Lab

Comments:
*Information provided by client

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Where Quality Matters

Matter Material Testing & Research Laboratory (P) Ltd,
Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673028

## UNCONFINED COMPRESSIVE STRENGTH(UCS) OF SOIL TEST REPORT

Report No: ML/SW-02243/SS
Issue No : 1
Report Date: 28/07/2023

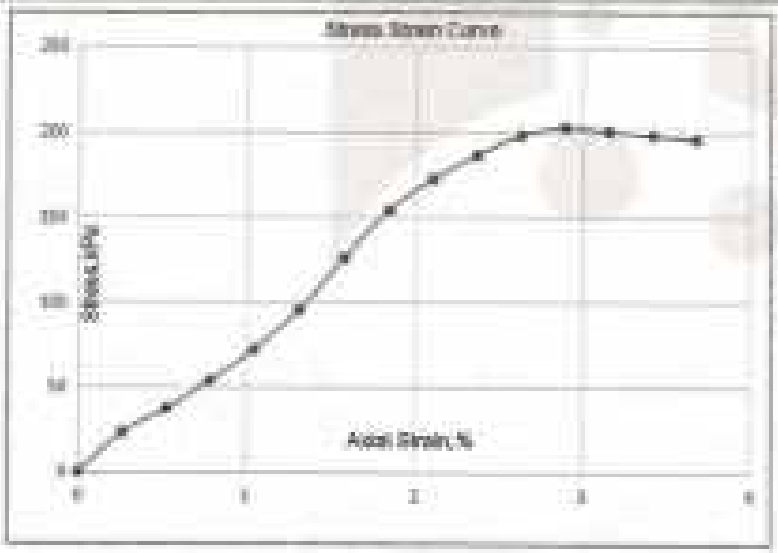
| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 1603/B - 3B/B, Kaveradi Building, Karapparam Village, Kakkanad, Ernakulam, Kerala-628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallaparamba, Koothuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 7.50m |
| Work Order ID: | ML/SW-02243 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML/SW-02243/03 | Source: | BH 01, Depth 7.50m |
| Date Sampled: | 26/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 6 Approx |
| Sample Location: | Pallaparamba, Koothuparamba, Kannur District | Date Tested: | 28/06/2023 - 29/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 7.50m |
| Tested By: | GK/DK | Client Sample Desc.: | Soil (UDS-3), BH 01, Depth 7.50m |

### Test Results

Method: IS: 2720 (Part 10)-1991 (RE2018)




| | |
|---|---|
| Unconfined Compressive Strength(kPa) | 209 |
| Specimen Height (mm) | 76 |
| Specimen Dia(mm) | 38 |
| Specimen Density(g/cc) | 1.91 |
| Moisture Content(%) | 12 |
| Type of specimen | Undisturbed |
| Specimen Condition | - |

For and on behalf of Matter Lab

Comments:
*Information provided by client

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Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

# UNCONFINED COMPRESSIVE STRENGTH(UCS) OF SOIL TEST REPORT

Report No: ML23/R/[illegible]
Issue No.: 1
Report Date: [illegible]

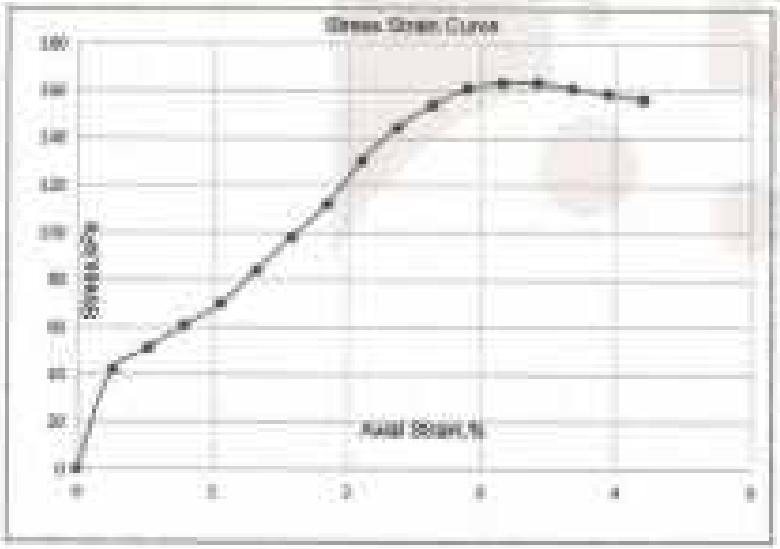
| | |
|---|---|
| Client: | Project Manger, IPE Global |
| Address: | 2nd Floor, 15/3878 - 3879, Kavenett Building, Karayanoor Village, Kakkanad, Ernakulam, Kerala-629300 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Pallaparamba, Kozhuparamba |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Pallaparamba, Koothuparamba, Kannur District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 27/06/2023 | Client Sample Ref.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Work Order ID: | ML23/WI-00240 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/WI-00240/08 | Source: | BH 01, Depth 9.00m |
| Date Sampled: | 06/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Pallaparamba, Koothuparamba, Kannur District | Date Tested: | 28/06/2023 - 29/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Lab Sample Desc.: | Soil (UDS-5), BH 01, Depth 9.00m |
| Tested By: | GK/DK | Client Sample Desc.: | Soil (UDS-5), BH 01, Depth 9.00m |

## Test Results

Method: IS: 2720 (Part 10) 1991 (RA 2011)




| | |
|---|---|
| Unconfined Compressive Strength(kPa) | 180 |
| Specimen Height (mm) | 76 |
| Specimen Dia(mm) | 38 |
| Specimen Density(g/cc) | 1.73 |
| Moisture Content(%) | 17 |
| Type of specimen | Undisturbed |
| Specimen Condition | - |

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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# Annexure B

# Environmental Test Reports

# POLUCHEM LABORATORIES (P) LTD.

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PALLATH BUILDING, N. KALAMASSERY P. O., ERNAKULAM - 683104

Phone: 0484-2544000, 8281982222, 9747400085, 9747400088, www.poluchem.com, poluchem@gmail.com


## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/137/2023 (ULR NO:TC635951000000137F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of Issue | 19/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received | 10/06/2023 |
| | Date of analysis Started | 10/06/2023 |
| | Sample Code | G/F/137/2023 |
| | Sample description | Ambient air –Kuthoparambu-Palapparambu |
| | Sample Location | Gps Reading : N- 11°50'10.14" E -75°34'18.959" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 68.5 $\mu g/m^3$ | 100 $\mu g/m^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 24.2$\mu g/m^3$ | 60 $\mu g/m^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 4.3 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 7.2 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 1.1 $mg/m^3$ | 4 $mg/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

The results are related only to the sample submitted for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory

For and on behalf of
POLUCHEM LABORATORIES (P) LTD

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5220/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 19/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received | 10/06/2023 |
| | Date of analysis Started | 10/06/2023 |
| | Sample Code | G/F/5220/2023 |
| | Sample description | Ambient air –Kuthapparambu-Palappuramba |
| | Sample Location | Gps Reading : N- 11°50'10.14"<br>E -75°34'18.959" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 $\mu g/m^3$ | 400 $\mu g/m^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 $\mu g/m^3$ | 1 $\mu g/m^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 6 $ng/m^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 20 $ng/m^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 $\mu g/m^3$ | 180 $\mu g/m^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 $\mu g/m^3$ | 5 $\mu g/m^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 $ng/m^3$ | 1 $ng/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER

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**TEST REPORT** 

| | | |
|---|---|---|
| **Client Name & Address** | **Certificate No:** | **PL/RT/SD/5222/2023** (ULR NO:TC658923000005222IF) |
| M/s.Program Manager IPE Global Ltd Kavanatt,Building Kakkanad Ernakulam (TSC Package D, KSWMP ) | Date of issue | 19/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Monitoring Location | Kuttuparambu- Palapparambu GPS Reading : N- 11 °50'10.272" E -75°34' 18.959" |
| | Sample Description | Ambient Sound Level |

| HOURLY INTERVAL | | RESULT | HOURLY INTERVAL | RESULT |
|---|---|---|---|---|
| 08.06.2023 | 11.00 Hrs | 59.1 dB (A) | 04.00 Hrs | 67.2 dB (A) |
| 12.00 Hrs | | 59.5 dB (A) | 05.00 Hrs | 60.3dB (A) |
| 13.00 Hrs | | 59.4 dB (A) | 06.00 Hrs | 65.8 dB (A) |
| 14.00 Hrs | | 61.6 dB (A) | 07.00 Hrs | 64.8 dB (A) |
| 15.00 Hrs | | 57.7 dB (A) | 08.00 Hrs | 66.3 dB (A) |
| 16.00 Hrs | | 58.3 dB (A) | 09.00 Hrs | 65.8 dB (A) |
| 17.00 Hrs | | 62.1dB (A) | 10.00 Hrs | 61.3 dB (A) |
| 18.00 Hrs | | 63.7dB (A) | | |
| 19.00 Hrs | | 56.0 dB (A) | | |
| 20.00 Hrs | | 64.0 dB (A) | | |
| 21.00 Hrs | | 60.7 dB (A) | | |
| 22.00 Hrs | | 67.1 dB (A) | | |
| 23.00 Hrs | | 59.4 dB (A) | | |
| 09.06.2023 | 00.00 Hrs | 62.1 dB (A) | | |
| 01.00 Hrs | | 58.5 dB (A) | | |
| 02.00 Hrs | | 62.4 dB (A) | LeqDay | 69.1 dB (A) |
| 03.00 Hrs | | 57.4 dB (A) | LeqNight | 61.0 dB (A) |

Limits: Industrial Area Day Time-75dB(A),Night Time- 70dB(A),Commercial area Day Time -65 dB(A),Night Time55dB(A)
Residential area Day Time -55 dB(A),Night Time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am

*End of the Report *

For Poluchem Laboratories (P) Ltd.

Authorised Signatory

SREEJA RAMESH
QUALITY MANAGER

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## TEST REPORT



Ref.No: PL/RT/GW/1423/2023
(ULR NO:TC589190000014DF)

Date of Issue: 19/06/2023

Name & address of customer : M/s Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-I
Sample Location : Kuthuparambu- Palapparambu
Gps Reading : N- 11°50'09.324"
E -75°34'21.18"

Sample code : F/1423/2023
Date of Sample Collected : 07/06/2023
Date of receipt of sample : 08/06/2023
Date of analysis started : 08/06/2023
Date of completion of analysis : 19/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.84 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | BDL(MDL-0.1 NTU) | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 390 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 119 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1 mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 128 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 124 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 24.7 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 1.68 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL-0.05mg/l) | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 2.49 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

Cont...

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Continuation of Test Certificate No: 1433/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 80 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



Ref.No: PL/RT/GW/5223/2023

Date of Issue: 19/06/2023

Name & address of customer : M/s Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location :Kuthuparambu- Palappparambu
Gps Reading : N- 11 °50'09.324"
E -75°34'21.18"

Sample code : F/5223/2023
Date of Sample Collected : 07/06/2023
Date of receipt of sample : 08/06/2023
Date of analysis started : 08/06/2023
Date of completion of analysis : 19/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | 0.38 mg/l | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 8 mg/l | — |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | — |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | — |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

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Continuation of Test Certificate No: 322/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachlor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
SREEJA RANJITH
QUALITY MANAGER

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/1424/2023**
(ULR NO:TC630923000000114F)

**Date of Issue: 19/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-2
Sample Location : Kuthuparambu-Palapparamba
Gps Reading : N- 11 °50'09.557"
E -75°34'24.809"

Sample code : P/1424/2023
Date of Sample Collected : 07/06/2023
Date of receipt of sample : 08/06/2023
Date of analysis started : 08/06/2023
Date of completion of analysis : 19/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.51 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | BDL(MDL-0.1 NTU) | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 50 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 36 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1 mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 8 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 6 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 19 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 6.12 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL-0.05 mg/l) | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 1.71 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

SREEJA RAMESH
QUALITY MANAGER

Conti...

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Continuation of Test Certificate No: 1424/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 80 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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ACCREDITED BY KSPCB AS "A" GRADE LABORATORY

# TEST REPORT



**Ref.No: PL/RT/GW/5224/2023** **Date of Issue: 19/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(ESC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-2
Sample Location : Kuzhuparambu-Palapparamba
Gps Reading : N- 11 °50'09.557"
E -75°34'24.809"

Sample code : F/5224/2023
Date of Sample Collected : 07/06/2023
Date of receipt of sample : 08/06/2023
Date of analysis started : 08/06/2023
Date of completion of analysis : 19/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 4 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1 mg/l) | ---- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level, MDL- Minimum Detection Level

SREEJA RAMESH
QUALITY MANAGER

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Continuation of Test Certificate No: 5234/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

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## TEST REPORT



**Ref.No: PL/RT/GW/1425/2023** **Date of Issue: 19/06/2023**

(ULR NO:TC699218000001425F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Polychem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : Kuthuparamba-Palapparamba
Gps Reading : N- 11°50'12.696"
E -75°34'23.087"

Sample code : F/1425/2023
Date of Sample Collected : 07/06/2023
Date of receipt of sample : 08/06/2023
Date of analysis started : 08/06/2023
Date of completion of analysis : 19/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.41 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | BDL(MDL-0.1 NTU) | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 50 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 31 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1 mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 8 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 8 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 16.15 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | BDL(MDL-1 mg/l) | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL-0.05 mg/l) | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 1.41 mg/l | 45 mg/L |
| Flouride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

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QUALITY MANAGER

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Continuation of Test Certificate No: 1425/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 80 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



Ref.No: PL/RT/GW/5225/2023 Date of Issue: 19/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : Kuthuparambu-Palapparambu
Gps Reading : N- 11°50'12.696"
E -75°34'23.087"

Sample code : P/5225/2023
Date of Sample Collected : 07/06/2023
Date of receipt of sample : 08/06/2023
Date of analysis started : 08/06/2023
Date of completion of analysis : 19/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 – 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 2.6 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | ---- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

SREEJA RAMESH
QUALITY MANAGER
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Continuation of Test Certificate No: 5225/2021

## RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER

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## TEST REPORT



**Ref.No: PL/RT/5245/2023** **Date of Issue: 19/06/2023**

Name & address of customer : M/s, Program Manager
IPE Global Ltd
Kavanatt, Building Kakkunad
Ernakulum
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Leachate
Sample Location : Kuthuparambu- Palapparamba
Gps Reading : N- 11 °50'10.854" E -75°34'18.659"

Sample code : F/5847/2023
Date of sample collected : 07/06/2023
Date of receipt of sample : 08/06/2023
Date of analysis started : 08/06/2023
Date of completion of analysis : 18/06/2023

| Parameters tested | Test method | Results | Limit for disposal to inland surface water |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.97 | 5.5-9.0 |
| Total Dissolved Solids(Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 847 mg/l | 2100 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 56 mg/l | 100 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 187.6 mg/l | 1000 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 156 mg/l | 250 mg/l |
| B O D (3 days at 27° C) | IS 3025 (P) 44 – 1993RA 2014 | 63.5 mg/l | 30 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 21.3 mg/l | 100 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 14.3 mg/l | 50 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 0.41 mg/l | 1 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.23 mg/l | 2 mg/l |
| Cyanide as CN | IS 3025 (P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) | 0.2 mg/l |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) | 3 mg/l |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) | 2 mg/l |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL(MDL- 0.01 mg/l) | 0.1 mg/l |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | BDL(MDL- 0.01 mg/l) | 3 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | BDL(MDL- 0.01 mg/l) | 5.0 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) | 0.2 mg/l |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/SW/1426/2023**
(ULR NO:TC039923000000426F)

**Date of Issue: 19/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water
Sample Location : Kuthuparumbu- Palupparumba
Gps Reading : N- 11 °50'08.064"
E -75°34'23.087"

Sample code : P/1426/2023
Date of Sample Collected :07/06/2023
Date of receipt of sample :08/06/2023
Date of analysis started :08/06/2023
Date of completion of analysis :19/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 – 1983RA2017 | 7.18 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 8 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 2.8 NTU | — | — |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 270 µS/cm | — | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 162 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 8 mg/l | — | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 76 mg/l | 200 mg/l | — |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 68 mg/l | — | — |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 22.8 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 11.94 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 - 1989RA2014 | 5.2 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL-0.05 mg/l) | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1 mg/l) | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL- 0.1mg/l) | 1.5 mg/l | 1.5 mg/l |

SREEJA RAMESH Contd...
QUALITY MANAGER

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Continuation of Test Certificate No: 1426/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 220 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | — | — |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

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## TEST REPORT



Ref.No: PL/RT/SW/5226/2023 Date of Issue: 19/06/2023

Name & address of customer :M/s. Program Manager
IPE Global Ltd
Kavenatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water
Sample Loaction : Kuthuparamba-Palapparamba
Gps Reading : N- 11 °50'08.064"
E -75°34'23.087"

Sample code : P/5226/2023
Date of Sample Collected :07/06/2023
Date of receipt of sample :08/06/2023
Date of analysis started :08/06/2023
Date of completion of analysis :19/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | – | – |
| Cadmium as Cd | IS 3025(P) 41 – 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | — |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | — |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27° C ) | IS 3025 (P) 44 -1993RA2014 | 3.2mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 8 mg/l | — | – |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | – | – |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 2.6 mg/l | — | – |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

SREEJITH RANGHAT
QUALITY MANAGER
CHEMICAL LABORATORIES (P) LTD.

*End of the report*

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ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5227/2023 |
|---|---|---|
| M/s Program Manager IPE Global Ltd Kowsum,Building Kakkanad Ernakulam (TSC Package D: KSWMP ) | Date of issue: | 19/06/2023 |
| | Date of monitoring | 07/06/2023 |
| | Date of sample received: | 08/06/2023 |
| | Date of analysis | 08/06/2023 |
| | Sample Description | Waste Analysis -Kuthiyanmbu -Palappanmbu |
| | Sample Location | Gps Reading : N- 11°30'10.834" E -75°34' 18.659" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 36.5 |
| 02 | Bulk Density | | | USEPA | kg/m³ | 820 |
| 03 | Density | | | USEPA | g/cm³ | 0.813 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 987 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 75 | -- | | | 0 |
| | | 40 | -- | | | 8.6 |
| | | 20 | -- | | | 12.4 |
| | | 8 | -- | | | 17.8 |
| | | 4.75 | 4 + | | | 16.3 |
| | | 3.36 | 8 | | | 17.3 |
| | | 1.18 | 16 | | | 16.4 |
| | | 0.6 | 30 | | | 4.4 |
| | | 0.3 | 50 | | | 6.8 |
| | | 0.15 | 100 | | | 0.3 |
| | | 0.09 | 170 | | | 0 |
| | | 0.075 | 200 | | | 0 |
| | | 0.045 | 325 | | | 0 |

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AUTHORIZED SIGNATORY

SREEJA RAMESAN

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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5228/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 19/06/2023 |
| | Date of monitoring | 07/06/2023 |
| | Date of sample received: | 08/06/2023 |
| | Date of analysis | 08/06/2023 |
| | Sample Description | Waste Analysis -Kuthuparambu- Palapparambu |
| | Sample Location | Gps Reading : N- 11°50'10.572"<br>E -75°34'17.331" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 24.3 |
| 02 | Bulk Density | | | USEPA | kg/m³ | 865 |
| 03 | Density | | | USEPA | g/cm³ | 0.859 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 1012 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 75 | -- | | | 0 |
| | | 40 | -- | | | 0 |
| | | 20 | -- | | | 8.8 |
| | | 8 | -- | | | 22.4 |
| | | 4.75 | 4 + | | | 22.8 |
| | | 2.36 | 8 | | | 15.5 |
| | | 1.18 | 16 | | | 18.6 |
| | | 0.6 | 30 | | | 11.9 |
| | | 0.3 | 50 | | | 0 |
| | | 0.15 | 100 | | | 0 |
| | | 0.09 | 170 | | | 0 |
| | | 0.075 | 200 | | | 0 |
| | | 0.045 | 325 | | | 0 |

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5229/2023 |
|---|---|---|
| M/s Program Manager<br>IPE Global Ltd<br>Kaveram,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 19/06/2023 |
| | Date of monitoring | 07/06/2023 |
| | Date of sample received: | 08/06/2023 |
| | Date of analysis | 08/06/2023 |
| | Sample Description | Waste Analysis –Kuthuparambu- Palapparambu |
| | Sample Location | Gps Reading : N- 11 °50'10.854"<br>E -75°34'18.659" |

### CHEMICAL PARAMETERS

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | " | 8.30 |
| 02 | Biodegradable Factor | USEPA | % | 2.0 |
| 03 | Total carbon | USEPA 9060A | % | 4.1 |
| 04 | Phosphorus(P) | USEPA | % | 0.018 |
| 05 | Nitrogen(N) | USEPA | % | 0.24 |
| 07 | Potassium(K) | USEPA | % | 0.046 |
| 08 | C/N Ratio | USEPA | " | 17:1 |
| 09 | Calorific Value | ASTM D 5865 | K.cal/kg | 920 |

Conti.....

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5229/2023 |
|---|---|---|
| M/s. IPE Global Ltd<br>Kavanat,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 19/06/2023 |
| | Date of monitoring | 07/06/2023 |
| | Date of sample received: | 08/06/2023 |
| | Date of analysis | 08/06/2023 |
| | Sample Description | Waste Analysis - Kathuparamba- Palapparamba |
| | Sample Location | Gps Reading : N- 11°50'10.854"<br>E -75°34'18.659" |

| TOXICITY ANALYSIS- HEAVY METALS | | | | |
|---|---|---|---|---|
| **SL NO** | **Parameters tested** | **Test Method** | **Unit** | **Result** |
| 10 | Iron (Fe) | USEPA 3050 | % | 5.24 |
| 11 | Arsenic(As) | USEPA 3050 | mg/kg | <0.1 |
| 12 | Selenium(Se) | USEPA 3050 | mg/kg | <0.1 |
| 13 | Nickel(Ni) | USEPA 3050 | mg/kg | 19.08 |
| 14 | Zinc (Zn) | USEPA 3050 | mg/kg | 261 |
| 15 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 |
| 16 | Copper (Cu) | USEPA 3050 | mg/kg | 58.15 |
| 17 | Chromium(Cr) | USEPA 3050 | mg/kg | 6.3 |
| 18 | Lead(Pb) | USEPA 3050 | mg/kg | 90.17 |
| 19 | Mercury(Hg) | USEPA 3050 | mg/kg | <0.1 |
| 20 | Manganese(Mn) | USEPA 3050 | mg/kg | 238.5 |

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## TEST REPORT



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| Client Name & Address | Certificate No: | PL/RT/5628/2023 |
|---|---|---|
| M/S.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernkulam<br>(TSC Package D, KSWMP ) | Date of issue: | 19/06/2023 |
| | Date of sample collection | 08/06/2023 |
| | Date of sample received: | 10/06/2023 |
| | Date of analysis | 10/06/2023 |
| | Sample Received From | Kuthuparambu-Palapparamba |
| | Sample description | Waste Segregation |
| | Sample Location | Gps Reading : N- 11°50'10.854"<br>E -75°34'18.659" |

| PHYSICAL COMPOSITION | | | | |
|---|---|---|---|---|
| SL NO | Parameters | | Result | |
| | | | Weight | Percentage |
| 01 | BioEarth | (-4.75mm) | 7.75 | 31 |
| | | (+4.75 to 8 mm) | 4.0 | 16 |
| 02 | C&D | C&D (+8mm) | 5.25 | 21 |
| 03 | Plastics | Plastics | 5.0 | 20 |
| 04 | MLP/SUP | MLP/SUP | 1.0 | 4 |
| 05 | Cloths | Cloths/ Rags | 0.92 | 3.68 |
| 06 | Glass | Glass | 0.45 | 1.8 |
| 07 | Metals | Metals | 0.50 | 2.0 |
| 08 | Rubber | Rubber | 0.125 | 0.5 |
| 09 | E-Waste | E-waste | 0.0025 | 0.01 |
| 10 | Leather | Leather | 0.0025 | 0.01 |
| Total Weight Of sample -25 g | | | | |

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SREEJA RAMESH
QUALITY MANAGER

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## TEST REPORT



| Client Name & Address | | |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavamit,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Certificate No: | PL/RT/5633/2023 |
| | Date of issue: | 19/06/2023 |
| | Date of sample collection : | 08/06/2023 |
| | Date of sample received: | 10/06/2023 |
| | Date of analysis | 10/06/2023 |
| | Sample Received From | Kuthuparambu Palapparamba |
| | Sample description | Waste Segregation |
| | Sample Location | Gps Reading : N- 11°50'10.572"<br>E-75°34'17.331" |

### PHYSICAL COMPOSITION

| SL NO | Parameters | | Result | |
|---|---|---|---|---|
| | | | Weight | Percentage |
| 01 | BioEarth | (+4.75mm) | 8 | 32 |
| 02 | C&D | (+4.75 to 8 mm) | 4 | 16 |
| 03 | Plastics | C&D (+8mm) | 5.75 | 23 |
| 04 | MLP/SUP | Plastics | 4.5 | 18 |
| 05 | Cloths | MLP/SUP | 0.87 | 3.5 |
| 06 | Glass | Cloths/ Rags | 0.9 | 3.6 |
| 07 | Metals | Glass | 0.37 | 1.5 |
| 08 | Rubber | Metals | 0.47 | 1.9 |
| 09 | E-Waste | Rubber | 0.12 | 0.5 |
| 10 | Leather | E-waste | 0.005 | 0.02 |
| | | Leather | 0.005 | 0.02 |
| | Total Weight Of sample -25 g | | | |

* End of the Report*

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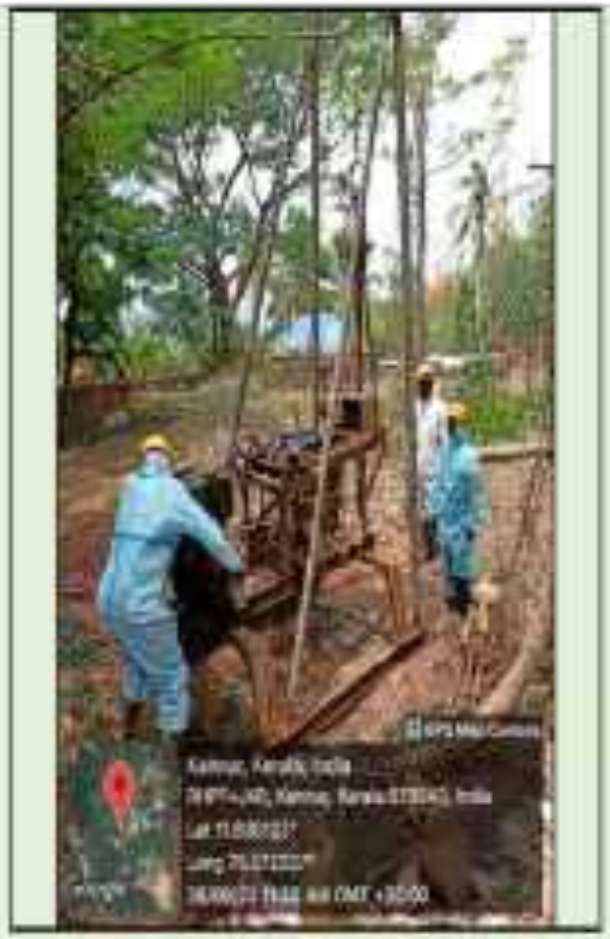
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CHECKED BY

# Annexure C

## Sampling Photographs









*Geotechnical Investigation*

*Ground Water Sampling Collection*





*Air Sampling Collection at Different Locations*



Surface Water Collection | Noise Level Data Collection

*Figure 11 Photos of Borehole and Environmental Sampling*

# Annexure D

# Volumetric Analysis

| S. No. | Name | Area (m2) | Height above the GL (m) | Avg Height below the GL (m) | Total Height (m) | Volume (cum) |
|---|---|---|---|---|---|---|
| **A** | **Capped Area** | | | | | |
| 1 | Plot 1 | 1156.18 | 3 | 1.5 | 4.5 | 5202.81 |
| 2 | Plot 2 | 1020.31 | 2.5 | 1.5 | 4 | 4081.24 |
| 3 | Plot 3 | 720.69 | 2 | 1.5 | 3.5 | 2522.415 |
| 4 | Plot 4 | 428.194 | 2 | 1.5 | 3.5 | 1498.679 |
| | | | | | **Total (A)** | **13305.144** |
| **B** | **Open Dump Area** | | | | | |
| 1 | Plot A | 199.74 | - | 2 | 2 | 399.48 |
| 2 | Plot C | 465.76 | 3 | - | 3 | 1397.28 |
| | | | | | **Total (B)** | **1796.76** |
| | | | | | | |
| | | | | | **Grand Total (A+B)** | **15101.904** |

# Annexure E

## Site Plan

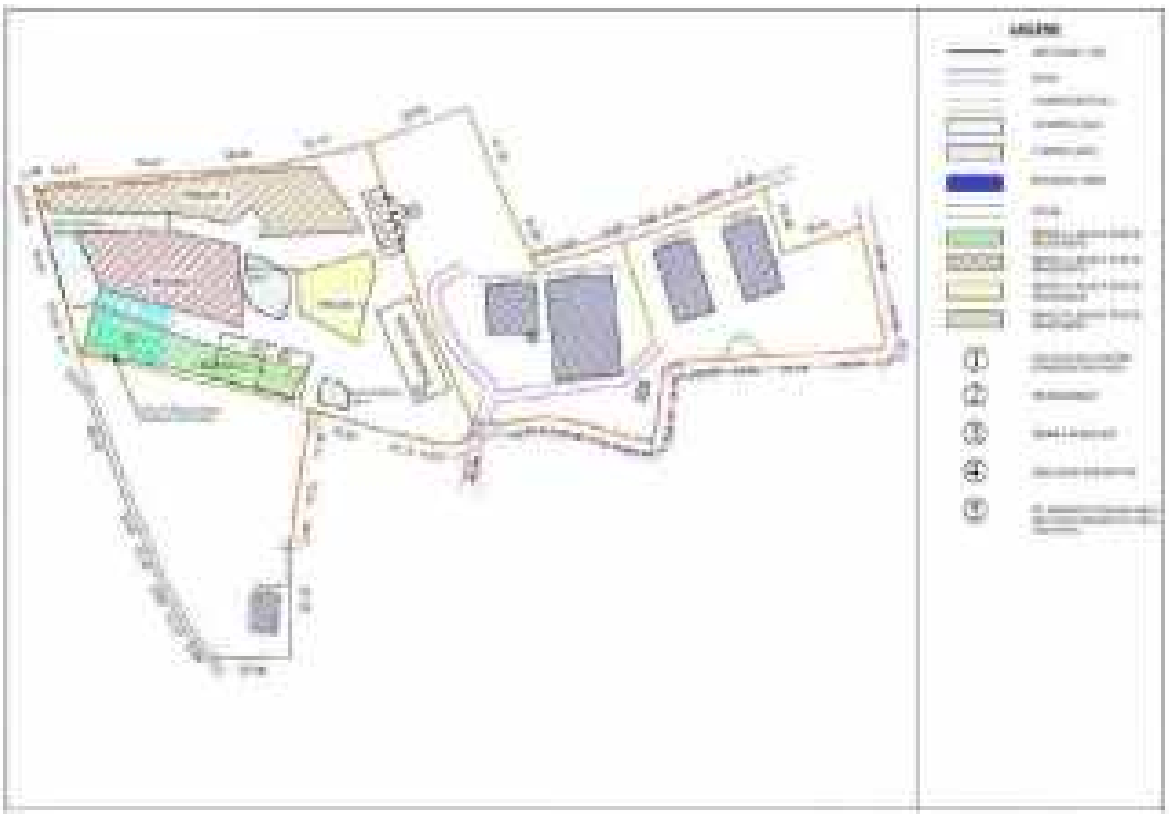


*Figure 12 Site Management Plan of Dumpsite*

# Annexure F

## Survey Contour Plan



*Figure 13 Contour Map of Dumpsite*

Annexure-G

# REQUIREMENT OF VEHICLE & MACHINERY

*Table 40 Details Analysis*

| S.No. | Machinery & Vehicles | Qty | Units |
|---|---|---|---|
| 1 | Excavation Process | | |
| | Design capacity | 800 | TPD |
| | Required Material to be Excavated per hour | 100 | TPH |
| | Capacity of front-end loader with backhoe per hour | 40 | TPH |
| | No of front-end loader with backhoe required | 3 | Nos |
| 2 | Vehicles Needed for Site movement | | |
| | Tipper capacity per Trip | 4 | Tons |
| | No of trips Per hour | 3 | |
| | No of tippers required | 4 | |
| 3 | No of Tipper required for transporting Byproducts of Biomining ( Earth,RDF, Inerts & Recyclables) | 5 | |
| 5 | Windrow formation and turning | | |
| | Front end loader required for formation of Windrow from the material dropped by the tipper trucks and for turning of waste | 2 | Nos |
| 6 | Feeding to sieving and baling operations | | |
| | Quantity of waste to be fed to sieving machines | 800 | TPD |
| | Quantity of RDF material to be fed to baling machine | 96 | TPD |
| | Capacity of front-end loader to feed in a day to feeders (20 TPH X 10 hours) | 200 | TPD |
| | No of front-end loaders required for feeding sieving and baling machines | 2 | Nos |
| 5 | Water Tanker | 1 | Nos |
| 6 | Tractor | 1 | Nos |
| 7 | Backhoe Loader | 2 | Nos |

# Annexure H

# Specifications of Machineries & Vehicles

*Table 41 Machineries Details*

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| 1 | Mobile Trommel | 1 | Model – Doppstadt Scalper MSS 802 |
| | | | Crawler Chassis – Chassis B3HD |
| | | | Drive – KYB MAG 85 NP, Speed 0.98 km/h |
| | | | Fuel Tank holding Capacity – 330 litres |
| | | | Feed Capacity (up to approx.) – 500 t/h |
| | | | Screen Size (W*L) – 1,550 *4,880 mm |
| | | | Machine Weight – 30,000 - 36,000 Kg |
| | | | Drive Output – 99 kW at 1800 rpm |
| | | | Screen Slope – 15.4 - 20 Degree |
| | | | Screen Spoe Conveyor – 12.5 Degree |
| | | | Fine-grain Conveyor Belt Width – 1200 mm |
| | | | Hopper Discharge Capacity – 9.1 cum |
| | | | Screen Pore Size – Less than 900 * 7760 mm |
| | | | Between 900*7760 mm and 1550*4880 mm |
| | | | Greater Than 1550*4880 mm |
| | | | Warranty – 12 months, however max. 2,000 operation hours from setting into operation, however 15 months after the reported date of readiness for shipment resp. |
| 2 | Baling Machine | 1 | Model – FLT-BMPO 25MT |
| | | | Capacity – 25 Tonnes |
| | | | Cylinder – Single Cylinder (140mm*80mm@3000psi) |
| | | | Oil Tank Capacity – 250 Literes Lifetime Oil |
| | | | Bale Size – 600*600*600 - 900mm |
| | | | Bale Weight – 50-75 Kg |
| | | | Cycle Time – 15-20mm per Bale |
| | | | Power – 7.5 HP |
| | | | Production Capacity – 1000-1500 Kg/Hr Shift |
| | | | Feed Type – PET, HDPE, MLP, PAPER, CLOTHS, BAGS, CHAPPAL |
| 3 | Weighing bridge | 1 | Model – Modular U Shape Weighbridge, Load Capacity: 10t To 150 |

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| | | | Capacity – 30 Tonne (10-150 Tonnes) |
| | | | Size – 5 to 10 m |
| | | | Power Supply 90V to 270V |
| | | | Shape – S Shape |
| | | | Accuracy – 5 Kg |
| 4 | Ballistic Separator | 1 | Drive Power (15 HP) – 1 No.<br>Blower- 1 No.<br>Screen Size - 70*70 MM<br>Material of Construction – IS:2062 ( MS )<br>Throughput Capacity - 30 TPH<br>Output Material - 3 Fraction ( RDF , Inert, Compost)<br>Automatic Feeding Conveyor<br>Drive Power (7.5HP)<br>Feeding Conveyor Inclined<br>Drive Power (7.5HP)<br>Inert Conveyor<br>Drive Power (3.0HP)<br>RDF Conveyor<br>Drive Power (3.0HP)<br>Compost Conveyor<br>Drive Power (3.0HP)<br>Material of Construction – IS:2062 ( MS )<br>Electrical Control Panel Complete With Wiring |

*Table 42 Vehicle Details*

| B | Vehicle | Nos | Technical Specification |
|---|---|---|---|
| 1 | Back Hoe Loader | 2 | Type – BS 6 |
| | | | Bucket min. Capacity – 0.6 cum |
| | | | Gross Power – 84 HP |
| | | | Fully power shift transmission source from the internationally renowned ZF, with heavy duty cluth packs for smooth |

| Sl | Vehicle | Nos | Technical Specification |
|---|---|---|---|
| | | | and easy click of the knob gear shift as per approved design standard |
| 2 | Tipper | 5 | Type = BS 6 |
| | | | Hydraulic Lifting Capacity = 10 cum single stock front end hydraulic system |
| | | | Wheel consist of heavy duty steel radials with spare wheel along with 6 cylinder engine, inter cooled as per approved design standard with current pollution |
| 3 | Tractor (separately) | 2 | Mahindra 275 Eco Tractor (BS-6) |
| | | | Fuel Tank Capacity = 45L |
| | | | Brake Type = Oil Brakes |
| | | | Engine Rated RPM = 1900 r/min |
| | | | Main Cluth Type = Single Clutch Heavy Duty Diaphragm type |
| | | | Tyre = 13.6 * 28 / 12.4 *28 (Front / Rear) |
| 4 | Trolley for tractor (separately) | 1 | Jauta Enterprise Trolley Making |
| | | | Material = MS |
| | | | Size of Trolley = 1700*825*1200 |
| | | | Capacity = 7 Tonne |
| | | | Weight = 900 Kg |
| 5 | Water Tanker for tractor (separately) | 1 | Brand = QEE |
| | | | Capacity = 500-10000 Litres |
| | | | Materials = MS |
| 6 | Front End Loader | 1 | Types = BS 6 |
| | | | Minimum Capacity = 1 cum |
| | | | Gross Power = 125 HP |
| | | | Fully power shift transmission source from the internationally renowned ZF, with heavy duty clutch packs for smooth and easy click of the knob gear shift. |

# Annexure I

# Proposed Operational Plan

## Proposed Operational Plan

The project of the Bio-mining with land recovery will be implemented through 100% outsourcing model. The detailed operations of land recovery is provided below:

### 1. Project Kick-off

The existing legacy waste dumpsite should be visited jointly by representative of implementation agency, officials ULB and experts of PMU/PMC & TSC for the following

- ✓ For assessment of ***As –Is Situation*** of local settings viz., human settlement & environmental settings etc.,
- ✓ For validation of profile, quantity & physical characterization of legacy waste.
- ✓ Available services viz., electrical power, source of water and access road etc.,
- ✓ For ground truthing the sampling locations of baseline environmental parameter, locations where monitoring will conduct during operation phase and post reclamation phase
- ✓ For sensitizing/awareness of the upcoming the project activity to the stakeholders within the vicinity of the dumpsite.
- ✓ For understanding the sensitive of environmental & social aspects/social considerations viz., educational institutions, religious places and settlements settings.
- ✓ For ensuring that the implementation agency understands and to complies with all local and national regulations related to project activities.

### 2. Site Management Plan

The position of the machineries and other auxiliary machineries/equipment's in-line with the defined process of bio-mining with land recovery play imperative role in effective implementation of the project activities.

A detailed site management plan is prepared including the details of excavation & pre stabilization area in phases (1 to 4), machineries, weigh bridge, area allocation for by-products storage, vehicle parking area and position of CCTV cameras. The detailed site Management plan is provided below.



### 3. Site Preparation

The portion of the legacy waste dumpsite will be clear vegetation and leveling the area to create a stable & level platform for positioning of bio-mining machineries/equipment's and for processing of legacy waste.

### 4. Procurement of Machinery & Vehicles and Equipment's

An indicative list of Machineries &Vehicles and equipment's are proposed to for effective processing the quantity of existing legacy waste in-tune to the timeline of NGT orders. The indicative list of the Machinery & Vehicles and equipment's are provided in the Section 8.3.2

### 5. Mobilization of Manpower

For effective management of the project activities, an indicative list manpower provided in the Section 8.4.1 shall be required.

### 6. Statutory Approvals

The implementation agency is responsible for obtaining all required permission/consent/approvals from the competent authorities. The ULB/DPMU/DPMC will only facilities implementation agency in obtaining the approvals etc. The indicative list of statutory approvals required for the project is provided below.

a. Site Authorization from KSPCB in conforming to SWM Rules 2016 and Consent to Establish/Operate KSPCB.
b. Dept. of mining and geology
c. Necessary permission for storage of process materials and chemicals
d. NOC from Dept. of Fire and Rescue
e. Segregated Hazardous waste disposal arrangement (eg: KEIL Ambalmedu, Kochi)
f. NOC from Heritage/Archeology if the site is in regulated zone of heritage/protected building

g. Any other statutory approvals/ permissions

## 7. Establishment of forward linkages

The By-products from the bio-mining process/operations viz., Bio earth/ C&D waste (Inert), RDF and Recyclables will be stored in the designated place (as indicated in the site management plan) within the dumpsite. The contractor is responsible for management/establishment of forward linkages. Utilization of Bio earth/C&D (inert) may be finalized in consultation with ULB. An indicative forward linkage is provided in the Section 9.1. The compost should conform to Schedule II of SWM Rules 2016, and RDF should conform to the Guidelines on Usage of RDF in various Industries issued by MoHUA. Bi-weekly sampling will be carried out to confirm the same.

**Bio-mining operations**

- Step-1 – Waste Stabilization

The initial step involves the use of a front-end loader to excavate the legacy waste, allowing for the leachate to dry out through exposure to solar radiation and for the removal of trapped methane from the heap. To ensure the decomposition of biodegradable waste such as discarded food, fruits, flowers, and garden waste, proper aeration is necessary to prevent the generation of leachate and odors. The top layer of the legacy waste, approximately 150 mm in depth, is repeatedly loosened using the front-end loader. Additionally, the waste is lightly mist-sprayed with bio-cultures to manage odors and disperse decomposing microbes throughout the waste. The loosened legacy waste forms windrows.

- Step-2 – Windrow Formation

The second step involves creating windrows of the legacy waste using backhoe. Composting bio-cultures are added to accelerate decomposition and generate biological heat within the waste, aiding in drying it out and reducing its volume. These windrows are turned every 3 days to ensure proper biological treatment and moisture loss. After 1-2weeks, when the heaps have reached a suitable consistency for screening, the material is weighed and transferred to a Mobile Trommel, which consists of rotating cylinders with different-sized perforations.

- Step-3 – Sorting and Segregation by Mobile Trommel

The third step is to move stabilized waste to mobile trommel to get 3 different sizes of fractions

- ✓ Fraction 1 – (minus 30 mm) – Bio Soil/earth -Used for side development/ filling.
- ✓ Fraction 2 – (30-80) mm – Mixed fraction – Plastics with C&D (send to Ballistic Separator)
- ✓ Fraction 3 – (80 +) mm – Mixed fraction – (send to Ballistic Separator)

The Fraction-2 & Fraction-3 (30-80) mm & (80 +) mm is required to move for further separation process through ballistic separator.

- Step-4 – By - products - C&D materials



In the fourth step, the fraction-2 and fraction-3 are sorted into three types based on their shape and weight heavy and rolling fraction (referred to as 3D) - C&D Material, light fraction (referred to as 2D) - RDF, and the sieved fraction (or under-screen fine fraction) - Plastic.

- Step-5 – Byproducts – RDF

In the fifth step, the RDF sorted by the ballistic separator (30TPH) is moved to the baling machine (50TPD) for packaging the RDF fractions. The baled RDF is then transported to Cement plants via a weigh bridge (30Tons), where a co-processing facility is available.



i) Monitoring & Supervising Mechanism

Supervision and monitoring during dumpsite remediation by TSC/PIU/DPMU

## 9. Record keeping and Reporting

i. The Implementation agency shall maintain a record of the daily processed legacy waste and also keep proper record of all the recovered and disposed of materials.

ii. The Implementation agency shall maintain authorized weigh bridge records at the point of receipt by end designated agency. A consolidated weigh bridge records certified by the Plant Manager/competent authority of the authorized Cement plant/ WtE or such units certifying the total RDF received from the Project is a valid proof of compliance.

iii. The Implementation agency shall maintain all the statutory records, as per SWM Rules, 2016, and also conditions stipulated in Site Authorization/Consent to Establish/Operate by KSPCB if any, KSWMP/WB requirements and other project relevance statutory requirements.

iv. The site shall be operated in CCTV surveillance with data storage of entire contract period. For CCTV surveillance High-Definition IP based cameras in adequate numbers. As per the requirement of the ULB/KSWMP link with mobile compatibility may be provided for online monitoring of the project activities.

v. The vehicles engaged for the project activities shall be equipped with Vehicles Tracking System (VTS) by equipping with GPS and online monitoring system.

## 10. Land recovery/project closure

Land shall be reclaimed i.e. all the legacy waste will be removed till it reaches the surface of the earth/ soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the bidder to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to bi-weekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site.

Annexure-J

# LSGD GUIDELINES FOR REMEDIATION OF LEGACY WASTE DUMPSITES THROUGH BIOREMEDIATION

# GOVERNMENT OF KERALA

## Abstract

Local Self Government Department - Guidelines for Remediation of Legacy Waste Dumpsites through Bio Remediation - orders issued.

## DEPARTMENT

G.O.(Rt)No.2629/2022/LSGD Dated,Thiruvananthapuram, 29-10-2022

Read 1 Letter No. 2683/C2/2022/SM dated 16.09.2022 from Executive Director Suchitwa Mission.

## ORDER

As per the letter read above, Executive Director, Suchitwa Mission had submitted draft guidelines for implementation of project for remediation of Legacy Waste Dumpsites through Bio Remediation.

2) Government have examined the matter in detail and are pleased to approve the guidelines enclosed herewith for implementation of project for reclamation of legacy waste dumpsites through bio remediation.

(By order of the Governor)
SHIBI ABRAHAM
DEPUTY SECRETARY

To:

Principal Director Local Self Government Department

Director Local Self Government(Urban) Department

Director, Local Self Government (Rural) Department

Executive Director, Suchitwa Mission

Principal Accountant General (A&E/Audit-I/Audit-II)Kerala, Thiruvananthapuram.

Executive Director, Information Kerala Mission.

The Information Officer (Web & New Media ) I&PRD

Stock File / Office Copy

G.O.(Rt)No.2629/2022/LSGD

Forwarded /By order

Signed by Prasanth C
Date: 29-10-2022 14:53:04

Section Officer

**Copy to:- PS to Minister LSGD**

**PA to ACS LSGD**

**CA to SS LSGD**

I/5470223/2022

**ബയോ**റെമഡിയേഷൻ വഴി തദ്ദേ**ശ** സ്വ**യംഭരണ** സ്ഥാപന**ങ്ങ**ളിലെ ലെഗ**സി മാ**ലിന്യ **നിക്ഷേപ** സൈ**റ്റുകൾ/ഭൂമികൾ** വീ**ണ്ടെടു**ക്കുന്നതി**ലേ**ക്കുള്ള പദ്ധതികൾ **ന**ടപ്പിലാ**ക്കുന്ന**തിന**ുള്ള** മാർഗ്ഗനിർദ്ദേശങ്ങൾ

ഖരമാലിന്യ സംസ്കരണ ചട്ടങ്ങൾ 2016-ലെ വ്യവസ്ഥകൾ അനുസരിച്ച കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ പുറപ്പെടുവിച്ച മാർഗ്ഗനിർദ്ദേശങ്ങളുടെ അടിസ്ഥാനത്തിൽ ലെഗസി മാലിന്യങ്ങൾ നിർമ്മാർജ്ജനം ചെയ്യുന്നതിനും അത്തരം ഭൂമി വീണ്ടെടുക്കുന്നതിനും തദ്ദേശ സ്ഥാപനങ്ങളെ ചുമതലപ്പെടുത്തിയിട്ടുണ്ട. ടി മാനദണ്ഡങ്ങൾ പ്രകാരം നിർമ്മാർജ്ജനം ചെയ്യേണ്ട മാലിന്യത്തിന്റെ സ്വഭാവവും അളവും വിലയിരുത്തൽ, ലെഗസി മാലിന്യ നിക്ഷേപങ്ങൾ ഉറക്കുന്നതിനുള്ള ഉത്ഖനന പ്രവർത്തനങ്ങൾ, മാലിന്യം തരംതിരിക്കുന്നതിനായി സ്ക്രീനിംഗ് സോർട്ടിംഗ്, വീണ്ടെടുക്കപ്പെട്ട വസ്തുക്കളുടെ പുനരുപയോഗം, വിൽപ്പന/വിപണനം, തിരസ്കൃത വസ്തുക്കളുടെ ശാസ്ത്രീയ നിർമ്മാർജനം എന്നിങ്ങനെ വിവിധ പ്രവർത്തനങ്ങൾ ആയതിൽ ഉൾപ്പെടുന്നു. കൂടാതെ ഇത്തരം സൈറ്റുകൾ/ഭൂമികൾ വീണ്ടെടുക്കേണ്ടതിന്റെ ആവശ്യകത 17.07.2019 ലെ OA 519/2019-ലെ ഉത്തരവിൽ ബഹു: ദേശീയ ഹരിത ട്രൈബ്യൂണൽ നിർദ്ദേശിച്ചിട്ടുണ്ട. ഇതിനെത്തുടർന്ന, പ്രവർത്തനങ്ങൾ വേഗത്തിലാക്കുന്നതിനായി 22.03.2020 ലെ സ.ഉ (സാധാ) നം 702/2020/തസ്വഭവ പ്രകാരം ബയോമൈനിംഗ വഴി ലെഗസി മാലിന്യ നിക്ഷേപ ഭൂമികൾ വീണ്ടെടുക്കുന്നതിന വിവിധ സ്റ്റേക്ക ഹോൾഡർമാരുടെ ഉത്തരവാദിത്തം ഉൾപ്പെടെയുള്ള നിർവ്വഹണ സ്ട്രാറ്റജി അംഗീകരിച്ച ഉത്തരവായിരുന്നു. എന്നാൽ, നാളിതുവരെ ഇത്തരം പദ്ധതികളുടെ നിർവ്വഹണത്തിൽ ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ പുരോഗതി കൈവരിച്ചിട്ടില്ലാത്തതാണ. ലെഗസി മാലിന്യ നിർമ്മാർജ്ജന പദ്ധതികൾക്ക പ്രോജക്ടിന്റെ അംഗീകാരം മുതൽ നടപ്പിലാക്കുന്ന രീതി (വീണ്ടെടുത്ത വസ്തുക്കളുടെ വിൽപ്പനയും സംസ്കരണവും ഉൾപ്പെടെ) വരെയുള്ള നടപടിക്രമങ്ങളിൽ വ്യക്തതയില്ലാത്തതാണ ഒരു പ്രധാന കാരണമായി കണക്കാക്കുന്നത. ഇത്തരം പദ്ധതികൾ പൊതു നിർമ്മാണ/സിവിൽ പ്രവൃത്തികൾക്ക സമാനമല്ലാത്തതിനാലും, നിലവിലുള്ള ഒരു ലെഗസി ഡംപസൈറ്റിൽ നിന്ന വീണ്ടെടുക്കാൻ കഴിയുന്ന വസ്തുക്കളുടെ സ്വഭാവം, ഗുണമേന്മ, അളവ എന്നിവ അത്തരം ഡംപസൈറ്റുകൾ ഉറക്കാതെ കൃത്യമായി മുൻകൂട്ടി നിർണ്ണയിക്കാൻ കഴിയാത്തതിനാലും, മറ്റ പൊതുമരാമത്ത പ്രവർത്തികൾ പോലെ ഇത്തരം പ്രവൃത്തികൾക്ക എസ്റ്റിമേറ്റ തയ്യാറാക്കുന്നത പ്രായോഗികമല്ല. ഈ പ്രശനങ്ങൾ പരിഹരിക്കുന്നതിനായി, സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-നും സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന "അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ (Adv sory on Landf Rec amat on)" പുറപ്പെടുവിച്ചിട്ടുള്ളതാണ. ആയതിലെ അനുയോജ്യമായ വ്യവസ്ഥകൾ കേരളത്തിൽ ഇത്തരം പദ്ധതികൾ നടപ്പിലാക്കുന്നതിന സ്വീകരിക്കാവുന്നതാണ. മേൽ സാഹചര്യത്തിൽ, സർക്കാർ ഇക്കാര്യം വിശദമായി പരിശോധിക്കുകയും തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ മുഖേന ലെഗസി മാലിന്യ നിർമ്മാർജ്ജന പദ്ധതികൾ നടപ്പിലാക്കുന്നതിന ഇനിപ്പറയുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങൾ പുറപ്പെടുവിക്കുന്നു.

പാ**ലി**ക്കേണ്ട **മാന**ദ**ണ്ഡ**ങ്ങളും **മാർ**ഗ്ഗനി**ർദ്ദേശ**ങ്ങ**ളും**

- കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ 2019-ൽ പുറത്തിറക്കിയ "ഗൈഡലൈൻസ ഫോർ ഡിസ്പോസൽ ഓഫ ലെഗസി വേസ്റ്റ (ഓൾഡ മുനിസിപ്പൽ സോളിഡ വേസ്റ്റ)"

- കേന്ദ്ര പാർപ്പിട-നഗരകാര്യ മന്ത്രാലയവും (MoHUA) സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന 2020 ൽ പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ (SBM U - Adv sory on Landf Rec amat on)"

- പ്രസ്തുത വിഷയവുമായി ബന്ധപ്പെട്ട കാലാകാലങ്ങളിൽ കേരള സർക്കാർ പുറപ്പെടുവിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങൾ

**തദ്ദേശ** സ്വയം**ഭരണ** സ്ഥാപനങ്ങ**ൾ** മു**ഖേ**ന **ലെഗ**സി **മാ**ലിന്യ **നി**ർമ്മാർജന പദ്ധതികൾ നടപ്പി**ലാ**ക്കുന്നതിനുള്ള **മാതൃകക**ൾ

- 100% ഔട്ടസോഴസ ചെയത മോഡൽ (MoHUA-യും CPHEEO-യും പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഫിൽ റിക്ലമേഷൻ" പ്രകാരം)

**ലെഗസി മാ**ലിന്യ **നിർമ്മാർ**ജന പദ്ധതികളു**ടെ നിർവ്വഹ**ണ ഉദ്യോഗ**സ്ഥ**ൻ

- ലെഗസി മാലിന്യ നിർമാർജന പദ്ധതികളുടെ നിർവ്വഹണ ഉദ്യോഗസ്ഥൻ തദ്ദേശ സ്വയംഭരണ സ്ഥാപനത്തിന്റെ എഞ്ചിനീയർ ആയിരിക്കും

നിർമ്മാർജനം ചെയ്യേണ്ട ലെഗസി മാലിന്യ നിക്ഷേപങ്ങളുടെ അളവ തിട്ടപ്പെടുത്തൽ

- പൊതുവായി, നിർമ്മാർജ്ജനം ചെയ്യേണ്ട ലെഗസി മാലിന്യത്തിന്റെ അളവ (ക്യൂബിക മീറ്ററിൽ) ടോട്ടൽ സ്റ്റേഷൻ സർവേയിലൂടെ കണ്ടെത്താവുന്നതാണ. എന്നാൽ ടോട്ടൽ സ്റ്റേഷൻ സർവേ സാധ്യമല്ലാത്ത സാഹചര്യത്തിൽ, ഒരു ലക്ഷം ക്യൂബിക മീറ്റർ വ്യാപ്തിയിൽ കൂടുതലുള്ള വലിയ ഡംപസൈറ്റുകളുടെ കാര്യത്തിൽ ഡ്രോൺ സർവ്വേ രീതി സ്വീകരിക്കാവുന്നതാണ.

- ആവശ്യമുള്ള പക്ഷം, പുറമെയുള്ള സർവേ ഏജൻസികളെ നിശ്ചിത നടപടിക്രമങ്ങൾ പാലിച്ച ഇതിനായി ഏർപ്പെടുത്താവുന്നതും, അതിനുള്ള ചെലവ ലഭ്യമായ ഫണ്ടിൽ നിന്ന തദ്ദേശ സ്വയംഭരണ സ്ഥാപനം വഹിക്കേണ്ടതുമാണ.

- സൈറ്റിന്റെ കോണ്ടൂർ മാപ്പ തയ്യാറാക്കേണ്ടതും ആയത തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ പരിശോധിച്ച അംഗീകരിക്കേണ്ടതുമാണ.

എസ്റ്റിമേറ്റ തയ്യാറാക്കലും പദ്ധതി രൂപീകരണവും

- സൈറ്റിന്റെ നിലവിലെ അവസ്ഥ, മാലിന്യത്തിന്റെ സ്വഭാവം/തരം, മാലിന്യ നിക്ഷേപത്തിന്റെ കാലയളവ, മറ്റ അടിസ്ഥാന വിശദാംശങ്ങൾ എന്നിവയെക്കുറിച്ചുള്ള വിശദമായ റിപ്പോർട്ട അനുബന്ധം- I ൽ നൽകിയിരിക്കുന്ന പ്രൊഫോർമയിൽ തയ്യാറാക്കേണ്ടതാണ

- അനുബന്ധം-II ൽ നൽകിയിരിക്കുന്ന സ്പെസിഫിക്കേഷനും ഡാറ്റയും അനുസരിച്ച ബയോമൈനിംഗ മുഖേന പ്രവൃത്തി നടപ്പിലാക്കുന്നതിന എസ്റ്റിമേറ്റ തയ്യാറാക്കേണ്ടതാണ.

- പ്രൊപ്പോസൽ തയ്യാറാക്കുന്നതിന്റെ ഭാഗമായി പ്രസ്തുത പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള എല്ലാത്തരം ചെലവുകളും പരിഗണിക്കേണ്ടതാണ.

- വാർഷിക പദ്ധതിയുടെ ഭാഗമായി പ്രോജക്ട ഏറ്റെടുക്കേണ്ടതും ലഭ്യമായ സ്രോതസ്സുകളിൽ നിന്നും ഫണ്ട വകയിരുത്തേണ്ടതുമാണ.

സാങ്കേതിക അനുമതി

നിലവിലുള്ള സാമ്പത്തിക അധികാരങ്ങൾ അനുസരിച്ച തദ്ദേശ സ്വയംഭരണ വകുപ്പ(ലോക്കൽ ഇൻഫ്രാസ്ട്രക്ച്ചർ & എഞ്ചിനീയറിംഗ വിങ) ലെ ബന്ധപ്പെട്ട എഞ്ചിനീയർ പ്രോജക്ടിന സാങ്കേതിക അനുമതി നൽകുകയും മാനദണ്ഡങ്ങൾ പാലിക്കുന്നതിനായി ചീഫ ടെക്നിക്കൽ എക്സാമിനർക്ക (ഫിനാൻസ വിംഗ) ആവശ്യമായ റിപ്പോർട്ടിംഗ ഉറപ്പാക്കുകയും ചെയ്യേണ്ടതാണ.

തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ ലെഗസി മാലിന്യ നിക്ഷേപ സൈറ്റുകൾ/ഭൂമികൾ വീണ്ടെക്കുന്നതിനുള്ള പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള നടപടി ക്രമങ്ങൾ

ടെൻഡറിംഗ

- ലെഗസി മാലിന്യ നിക്ഷേപ സൈറ്റുകൾ വീണ്ടെടുക്കുന്നതിനുള്ള പ്രവൃത്തിയുടെ വിശദമായ സ്കോപ്പ ഓഫ വർക്ക, നിബന്ധനകളും വ്യവസ്ഥകളും മുതലായവ വ്യക്തമായി പരാമർശിക്കുന്ന 'ടു കവർ ബിഡ്സ താല്പര്യപത്രം'(Request for Proposa - wo Cover Bd) തയ്യാറാക്കേണ്ടതും ആയത നടപടിക്രമങ്ങൾ പാലിച്ച പ്രസിദ്ധീകരിക്കുകയും ചെയ്യേണ്ടതാണ.

- കേന്ദ്ര പാർപ്പിട-നഗരകാര്യ മന്ത്രാലയവും (MoHUA) സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ" ൽ നൽകിയിരിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങളെ

അടിസ്ഥാനമാക്കി RFP-യിലെ വ്യവസ്ഥകൾ/യോഗ്യതാ മാനദണ്ഡങ്ങൾ നിശ്ചയിക്കാവുന്നതാണ.

- കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ പുറപ്പെടുവിച്ച "ഗൈഡലൈൻസ ഫോർ ഡിസ്പോസൽ ഓഫ ലെഗസി വേസ്റ്റ (ഓൾഡ മുനിസിപ്പൽ സോളിഡ വേസ്റ്റ) " പ്രകാരം ലെഗസി മാലിന്യ നിക്ഷേപങ്ങൾ നിർമ്മാർജ്ജനം ചെയ്യേണ്ടതാണെന്ന നിബന്ധന പ്രവൃത്തിയുടെ 'സ്കോപ്പ ഓഫ വർക്കിൽ' ഉൾപ്പെടുത്തുന്നുണ്ടെന്ന ഉറപ്പ വരുത്തേണ്ടതാണ.

- ലഭ്യമാകുന്ന ടെക്നിക്കൽ ബിഡ്സുകൾ പരിശോധിച്ച വിലയിരുത്തേണ്ടതും സാങ്കേതിക യോഗ്യത നേടുന്ന ബിഡ്ഡർമാരെ ബിഡ/ടെൻഡർ അംഗീകാരത്തിന്റെ തുടർ ഘട്ടത്തിനായി ഷോർട്ടലിസ്റ്റ ചെയ്യേണ്ടതുമാണ. ടെക്നിക്കൽ ബിഡ്സുകളുടെ മൂല്യനിർണ്ണയം നടത്തുന്നതിനായി താഴെപ്പറയുന്ന അംഗങ്ങളെ ഉൾപ്പെടുത്തി തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ സാങ്കേതിക സമിതി രൂപീകരിക്കേണ്ടതാണ;

    - സെക്രട്ടറി
    - LSGD (LID & EW) എഞ്ചിനീയർ
    - ഹെൽത്ത വിഭാഗം ഉദ്യോഗസ്ഥൻ (നഗര തദ്ദേശ സ്ഥാപനങ്ങളുടെ കാര്യത്തിൽ)
    - ജില്ലാ ശുചിത്വ മിഷനിൽ നിന്നുള്ള സാങ്കേതിക വിദഗ്ധൻ
    - ജില്ലാ മലിനീകരണ നിയന്ത്രണ ബോർഡിന്റെ പ്രതിനിധി
    - അക്കാദമിക സ്ഥാപനങ്ങളിൽ നിന്നുള്ള മറ്റ വിദഗ്ധർ

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ സാങ്കേതികമായി ഷോർട്ടലിസ്റ്റ ചെയ്ത ബിഡഡർമാരുടെ ഫിനാൻഷ്യൽ ബിഡ്സുകൾ തുറക്കേണ്ടതും നടപടിക്രമങ്ങളും മാനദണ്ഡങ്ങളും പാലിച്ച അംഗീകരിക്കേണ്ടതുമാണ.

- തിരഞ്ഞെടുത്ത കരാറുകാരന/ഏജൻസിക്ക ലെറ്റർ ഓഫ അവാർഡ (L O A) നൽകുകയും കരാറിൽ ഏർപ്പെടേണ്ടതുമാണ.

നിർവ്വഹണം, മേൽനോട്ടം, ബില്ലുകൾ തയ്യാറാക്കൽ

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയറും മാലിന്യ പരിപാലന പ്രവർത്തനങ്ങളുടെ നിരീക്ഷണ ചുമതലയുള്ള ഉദ്യോഗസ്ഥനും അടങ്ങുന്ന ഒരു മേൽനോട്ട സമിതി (Superv s on Commttee) രൂപീകരിക്കേണ്ടതാണ

- R F P ഡോകുമെന്റിലും കരാറിലും ഉൾപ്പെടുത്തിയിട്ടുള്ള 'സ്കോപ്പ ഓഫ വർക്ക' കരാറുകാരൻ കൃത്യമായി പാലിക്കുന്നുണ്ടോ എന്ന നിരീക്ഷിക്കുന്നതിനായി തദ്ദേശ സ്വയംഭരണ സ്ഥാപനം മേൽനോട്ട സമിതിയെ ചുമതലപ്പെടുത്തേണ്ടതാണ.

- പ്രസ്തുത പ്രവൃത്തി 'സ്കോപ്പ ഓഫ വർക്കിൽ' നിഷ്കർഷിക്കുന്ന പ്രകാരമാണോ നടപ്പിലാക്കുന്നതെന്ന മേൽനോട്ട സമിതി കൃത്യമായും പരിശോധിക്കുകയും നിരീക്ഷിക്കുകയും ചെയ്യേണ്ടതാണ.

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ കരാറുകാരന/ ഏജൻസിയ്ക്ക സൈറ്റ ഹാൻഡ ഓവർ ചെയ്ത നൽകേണ്ടതും പ്രവൃത്തി നടപ്പിലാക്കുന്നതിനുള്ള/ നിർവഹിക്കുന്നതിനുള്ള പിന്തുണ നൽകുകയും ചെയ്യേണ്ടതാണ.

- മാലിന്യ പരിപാലന പ്രവർത്തനങ്ങൾ നിരീക്ഷിക്കുന്നതിന്റെ ചുമതലയുള്ള ഉദ്യോഗസ്ഥൻ പ്രസ്തുത പ്രവൃത്തിയിൽ ഉൾപ്പെടുന്ന മാലിന്യ പരിപാലനവുമായി ബന്ധപ്പെട്ട പ്രവർത്തനങ്ങളായ വിൻട്രോ ഫോർമേഷൻ, മാലിന്യം

തരംതിരിക്കൽ, മലിനീകരണ നിയന്ത്രണ മുൻകരുതലുകളും ആരോഗ്യപരമായ കാര്യങ്ങളും ഉറപ്പുവരുത്തൽ എന്നിവയ്ക്ക മേൽനോട്ടം വഹിക്കേണ്ടതും കരാറുകാരന/ഏജൻസിക്ക മേൽനോട്ട സമിതി മുഖേന ആവശ്യമായ നിർദ്ദേശങ്ങൾ നൽകേണ്ടതുമാണ.

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ എംബുക്കിൽ 'ഇനിഷ്യൽ', 'ഇന്റർമീഡിയറ്റ്', 'ഫൈനൽ' ലെവലുകൾ എന്നിവ എടുത്ത അളവുകൾ രേഖപ്പെടുത്തേണ്ടതും, തദ്ദേശ സ്വയംഭരണ വകുപ്പിന ബാധകമായ അധികാരമനുസരിച്ച ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ വകുപ്പ (എൽ.ഐ.ഡി & ഇ.ഡബ്ല്യു) എഞ്ചിനീയർ ചെക്ക മെഷർമെൻറ നടത്തുകയും ചെയ്യേണ്ടതാണ.

- കരാറിൽ വിശദമാക്കിയിട്ടുള്ള ജോലിയുടെ വിവിധ ഘട്ടങ്ങൾ പൂർത്തിയാക്കിയ ശേഷം കരാറുകാരൻ/ഏജൻസി ക്ലെയിം ചെയ്യുന്ന പ്രവൃത്തിയുടെ വർക്ക ബില്ലുകൾ തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ തയ്യാറാക്കേണ്ടതും തദ്ദേശ സ്വയംഭരണ സ്വയംഭരണ വകുപ്പിന ബാധകമായ അധികാരമനുസരിച്ച ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ വകുപ്പ (എൽ.ഐ.ഡി & ഇ.ഡബ്ല്യു) എഞ്ചിനീയർ ചെക്ക മെഷർമെൻറ നടത്തുകയും ചെയ്യേണ്ടതാണ.

- <u>GUIDELINES FOR IMPLEMENTATION OF PROJECTS FOR RECLAMATION OF LEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION (BIO MINING AND MANAGEMENT OF RECOVERABLES AND REJECTS)</u>

As per the provisions of Solid Waste Management Rules 2016, local bodies are mandated to remediate legacy waste dumpsites and reclaim the land based on the guidelines issued by CPCB. Remediation of legacy dumpsites involves various activities such as assessment of the nature and quantity of waste to be remediated, excavation works to open the dumps, screening and sorting to segregate the waste fractions, reuse and sale/marketing of recovered materials, scientific disposal of rejects as per the norms. The remediation of dumpsites is further directed by Honorable NGT in its order on OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. However, the progress of implementation of such projects has not been satisfactory so far. One of the main reasons is that there is a lack of clarity in the procedures to be followed for legacy waste remediation projects right from the approval of the project to the mode of execution (including sale and disposal of recovered materials) by LSGIs since the nature of such projects is not similar to the general public construction/civil works. Also, the nature, quality and quantity of material that can be recovered from an existing legacy dumpsite cannot be accurately predetermined without opening up such dumpsites and hence it is not practical to prepare a workable estimate for the same like other public works . In order to tackle these issues, Swachh Bharat Mission(Urban) and CPHEEO have issued an "Advisory on Landfill reclamation", and suitable provisions of this advisory can be adopted for the State of Kerala. In these circumstances, the Government has examined this matter in detail, and the following guidelines are issued for the implementation of projects for remediation of legacy dumpsites by Local Self Government Institutions.

**<u>Standards, guidelines and advisories to be followed</u>**

- "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" issued by Central Pollution Control Board
- "SBM-U Advisory on Landfill Reclamation" published by MoHUA and

CPHEEO

- Guidelines issued by Government of Kerala in this regard from time to time

**Models for implementing legacy waste dumpsite remediation by LSGI's**

- 100% outsourced model (As per "SBM -U Advisory on Landfill Reclamation" published byMoHUA and CPHEEO)

**Implementing officer for legacy waste dumpsite remediation projects**

The implementing officer for legacy waste remediation shall be the Engineer of the LSGI

**Quantification of legacy waste to be remediated**

- The volume of legacy waste (in m3) to be remediated shall be generally assessed through Total Station Survey. If a total station survey is not feasible, a drone survey may be adopted for large dumpsites having a volume of more than 1 (One) Lakh m3.
- If required, external survey agencies may be engaged following laid down procedures and the cost for the same shall be met by LSGI from available funds.
- Contour mapping of the site shall be prepared and approved by the Engineer of the LSG

**Project Cost Estimation and Formulation by LSGI**

- Detailed report regarding the site conditions, nature of dump, history of dumping and other basic details shall be prepared in the format given in **Annexure - I**
- The estimate for biomining shall be prepared as per the specification and data given in
  - **Annexure -II**
- The overall cost for the implementation of the project shall be considered as part of the proposal.
- Project shall be taken up as per annual projects and funds from available sources shall be ear marked

**Technical Sanction**

- Technical sanction for the project shall be issued by the concerned Engineer in LSGD (LID & EW) as per the existing financial powers and necessary reporting to the Chief Technical Examiner (Finance Wing) may be ensured for compliance as per norms

**Implementation steps for remediation of legacy waste dumpsites by LSGIs**

**Tendering**

- Request for Proposals (RFPs-Two cover bid) clearly mentioning the scope of work, terms and conditions for reclamation of legacy waste dump sites shall be prepared and published as per laid down procedures.
- Conditions/eligibility criteria in the RFP shall be fixed based on the guidelines given in"**SBM-U Advisory on Landfill Reclamation"** published by MoHUA and CPHEEO
- It shall be ensured to mention in the scope of work that remediation of legacy waste dumpsites shall be undertaken as per the **"Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)"** issued by Central Pollution Control Board.
- The technical proposals received should be evaluated and technically qualified bidders shortlisted for further stage of bid approval. A Technical committee shall be formed at LSGI level for evaluation of the technical bids with the following members;
    - Secretary
    - LSGD (LID & EW) Engineer
    - Health Official (in the case of Urban local bodies)
    - Technical expert from District Suchitwa Mission
    - Representative from District Pollution Control Board
    - Other experts from academic institutions if any
- Financial bids of the technically shortlisted firms should be opened at LSGI level and approved as per procedures and norms
- Letter of Award (LoA) is to be issued to the selected contractor agency and agreement executed

**Execution, Supervision and preparation of bills**

- LSGI shall constitute a supervision committee consisting of LSGI Engineer and the officer in charge of monitoring waste management activity
    - LSGI shall authorise the supervision committee to monitor that the contractor correctly follows the scope of work included in the RFP document and agreement
- The supervision committee shall inspect and monitor that the work is being carried out as per the scope defined.
- LSGI Engineer shall hand over the site and provide support for execution of work at the site by the contractor/agency
- The officer in charge of monitoring waste management shall oversee the waste management related activities such as formation of windrows, segregation of waste into various streams,ensuring pollution control measures and health matters involved in the project and shall give direction to the contractor/agency through the supervision committee.

- LSGI Engineer shall measure, record quantities by taking initial, intermediate and final levels in M-book and Check measurements shall be done by the officials of LSGD (LID & EW) as per the powers vested with in the Local Self Government Department.
- LSGI Engineer shall prepare the work bills claimed by the contractor/agency after completing stages of work detailed in the agreement and check measurement shall be made by the officials of LSGD (LID & EW) as per the powers vested within Local Self Government Department.

അനുബന്ധം - I

PROPOSAL FOR BIO MINING / BIO REMEDIATION OF LEGACY WASTE DUMPSITE AT ..... CORPORATION /MUNICIPALITY/ GRAMA PANCHAYAT

BASIC DETAILS OF DUMPSITE

| | | |
|---|---|---|
| Name of LSGI | : | |
| Name of location of legacy dumpsite | : | |
| Extend of land (Acres) | : | |
| Survey No | : | |
| Land owned by | : | |
| Volume of waste (m3) | : | |
| Maximum depth below ground level (m) | : | |
| Maximum height above ground level (m) | : | |
| Approx. level of water table (m) | : | |
| GPS location (Co-ordinates & link to google map) | : | |
| Period from which dumping is done (in Years) | : | |
| Whether waste is still dumped at the site (Yes/No) | : | |
| Availability of water source for remediation process (Yes/No) | : | |
| Availability of electricity (Yes/No | | |

I/5470223/2022

DE AILED REPOR

- Introduct on (Br ef about the s te nc udng s te photograph)
- Survey deta s (Methodo ogy adopted, Deta s of eve measurements and quant ty ca cu at on)
- Cost est mate
    - Abstract est mate
    - Deta ed est mate
    - Data

S gnat**ure**

Des**g**nat on **o**f E**ng**neer n **c**harg**e**

Nam**e o**f LSG**I**

അനുബന്ധം - II

SPECIFICA ION & OBSERVED DA A FOR RECLAMA ION OF LEGACY DUMPSI E HROUGH BIO R M DIA ION ( o m g, man gng ecove abe and eje t

Bo remedat on (Bo mnng, managng recoverab e and rejects) by

**a.** Excavat ng the ex st ng mxed compacted garbage wh ch underwent b o og ca degradat on n the and port on a ocated and spray ng w th m croba nocuum for san t s ng and stab s ng the excavated mass, s ev ng them us ng Mechan ca s ev ng mach ne or any other equ pment,

**b.** Contro of ma odour us ng deodor z ng agent and stab z ng the waste us ng Bo Cu ture for aerob c ompo t g

**c** o f e dy d o po t g po e o de to ed e t e mp t of d mp g te t e dj e t e

**d** eg eg te t e e v ted g b ge t e d po to e m ked, to m y k d d tego e poss b e by mechan ca means nc udng the cost of any power or fue consumpt on.

**e.** Creat on and mantenance of nfrastructure, fac t es and amen t es for s ev ng, the excavated garbage, stor ng the segregated mater a s.

**f.** Dep oyment of necessary manpower, mater a s, equ pment, too s and creat on of fac t es for hand ng, separat ng, segregat ng and stor ng for the operat on of the p ant.

**g.** Leve ng the earth's surface by bu -dosser or any other earth mov ng equ pment

h. Provding security arrangements for the plan project site, machineries, equipment etc.

DSR 2018 Cost Index- 1.00 (For reference)

| Code | Description of Items | Unit | Quantity | Rate | Amount |
|---|---|---|---|---|---|
| | *Details of cost for 50 m3/day* | | | | |
| | LABOUR | | | | |
| 115 | Cooli | day | 20.00 | 558.00 | 11160.00 |
| | MACHINERY | | | | |
| MR | Double stage screener with conveyor | day | 1.000 | 7200.00 | 7200.00 |
| MR | Magnetic separator- capacity 5HP | day | 1.000 | 600.00 | 600.00 |
| MR | Dust screenning remover | day | 1.000 | 900.00 | 900.00 |
| MR | Baling press | day | 1.000 | 450.00 | 450.00 |
| 17 | Hire and running charges of tipper 5 m3 | day | 2.000 | 1700.00 | 3400.00 |
| 20 | Hydraulic excavator 3D with driver and fuel | day | 1.000 | 7000.00 | 7000.00 |
| 18 | Hire and running charges of loader | day | 1.000 | 5000.00 | 5000.00 |
| 9999 | Deodorizer & Inoculum | L.S | 124.860 | 2.00 | 249.72 |
| | Total | | | | 35959.72 |
| | Market Rate cost | | | | 9150.00 |
| | Add water charges 1% on MR | | | | 91.50 |
| | Net total ( A) | | | | 9241.50 |
| | Total excluding Market rate | | | | 26809.72 |
| | Add water charges 1% on this | | | | 268.10 |
| | Net total (B) | | | | 27077.82 |
| | Total A + Cost Index B | | | | 36319.32 |
| | Add CPOH 15% | | | | 5447.90 |
| | Total for 50 m3 | | | | 41767.22 |
| | Hence for 1 m3 | | | | 835.34 |

NB:- **Rates shall be prepared based on the cost index applicable to each locality*

# Thankyou!

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# Part B

# Social Impact Assessment

# REMEDIATION OF PALAPARAMBA DUMPSITE IN KUTHUPARAMBA, MUNICIPALITY-KANNUR

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# 1. Introduction

Social safeguarding is paramount during dumpsite remediation, with a strong emphasis on engaging with stakeholders, understanding their risk perceptions, and restoring sites to a safe and environmentally sustainable state. This involves a series of systematic social actions, including social inclusion, effective labor management, prevention of gender-based violence, rehabilitation of affected individuals, and reducing health risks for the surrounding community. The World Bank-supported KSWM Project has incorporated the bio-mining process for the Palaparamba dumpsite in Kuthuparamba.

## 1.1 Profile of ULB

Kuthuparamba is a municipality in Kannur district of Kerala. It's located about 24 km southeast of Kannur and 14 km east of Thalassery. Kuthuparamba was part of Kottayam dynasty under the reign of Pazhassi Raja in the medieval period. Since the British captured Kuthuparamba area, the area fell under British rule was formed as Kottayam taluk. Thalassery – Coorg road which was made by the British for sending troops to Mysore also plays an important role in the history of Kuthuparamba. The town was formed as Panchayat in the year 1939 by fixing Kuthuparamba revenue village as its boundary. Kuthuparamba was established as a Municipality in 1990. Kuthuparamba Municipality with an area of 16.76 square kilometers.

| Socio Economic Profile | |
|---|---|
| Name of District | Kannur |
| Total Population | 34198 |
| Total Male Population | 16396 |
| Total Female Population | 17802 |
| Total Scheduled Castes Population | 431 |
| Total Scheduled Castes Male Population | 200 |
| Total Scheduled Castes Female Population | 231 |
| Total Scheduled Tribes Population | 13 |
| Total Scheduled Tribes Male Population | 5 |
| Total Scheduled Tribes Female Population | 8 |

*Table 1 Socio Economic Profile*

Social safeguard aspects during dump site remediation mainly focusing on meaningful stakeholder engagement, understanding stakeholder's risk perception, and restoring them to a safe and environmentally sustainable state. It involves a series of systematic social actions which include social inclusion, effective labor management, and prevention of gender violence during the process, successive rehabilitation of the affected people and reduction of health risk of the host community. The bio mining process of Kuthuparamba municipal dumpsite has been included in the World Bank supported KSWMP project.

### 1.2 Profile of Dumpsite

The bio mining process of Kuthuparamba municipal dumpsite is included in the World Bank-supported Kerala Solid Waste Management Project (KSWMP) project. The dumpsite, which is in Palapparamba, ward No. 5 of the municipality, has been functional for many years and has a land area of 0.98 acres owned by the ULB.The waste at the site is approximately 50 years old, with dumping activities started in 1973 and since then, the site has been used for any dumping purposes. And it stopped in 2013 due to public protest. Twenty households are staying within 200 meters from the dumpsite.

The site is at 1 km from Thalassery-Mysore Road. The information on socio-economic profile is being gathered adopting different social tools including transect walk and Key Informants Interview (KII). The participants for the exercise include ward councilors, Kudumbashree members, HKS members etc. The RRF and MCF units are functioning in the compound of the dumpsite.

### 1.3 Socio economic baseline of host community

It is identified that there are 20 households situated within 200 meters from the dumpsite. They are engaged with various agricultural and allied sectors, service sector and construction work sectors. In the premises of the dumpsite, has a windrow compost unit, RRF, and MCF buildings are existing. The windrow compost unit is waiting for inauguration. The MCF and RRF buildings are in use. These units are managed by 4 workers including one woman. The dumpsite has sufficient road access and thus there will not be any disruption to the nearby households. No public facilities, properties or commercial establishments are existing near to the dumpsite. There are no scheduled tribes, rag pickers and other vulnerable communities living near the dumpsite.

### 1.4 Vulnerability mapping of host community

| Sl.No | Particulars | Number |
|---|---|---|
| 1 | Number of Senior citizen residing Near dumpsite | 10 |
| 2 | Number of single women staying near the dumpsite | NIL |
| 3 | Number of persons with disabilities | NIL |
| 4 | Number of person with severe disease | NIL |

| | | |
|---|---|---|
| 5 | Number of persons with respiratory issues | 2 |
| 6 | Number of Kids | 6 |

### 1.5 Stakeholder Analysis

Twenty households reside within 200 meters of the dumpsite. No inventory of Kudumbashree/ Haritha Karma Sena is located at the dumpsites. Building of a windrow compost unit constructed near to the dumpsite, but it is yet to be inaugurated. MCF and RRF buildings are also in the compound of the dumpsite, about 50m away from the dumpsite. These facilities are separated with a compound wall. The livelihood of the 4 persons working in the MCF and RRF may not be affected during the time of bioremediation. Municipality started the construction of the agriculture office, just outside of the dumpsite premises. No other public utilities or facilities are present near the dump site. Rag pickers do not reside within 200 meters of the site, Since the site is currently not in use for waste disposal, so no protest/ agitation from the side of the general public. The proposed project activity did not impact any vulnerable communities.

| **Sl. No** | **Stakeholders** | **Roles of the stakeholders w.r.t remediation process** |
|---|---|---|
| Service Providers | | |
| 1 | ULB Council | Providing ground support to the remediation process |
| 2 | Govt institutions like PCB,KSEB,KWA etc | To deliver necessary approvals and provide necessary services for remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | DPMU | Monitoring and Evaluation |
| 5 | TSC/PMC | Technical support and consultation |
| 6 | Contractor | Execution of the Remediation process |
| 7 | Service providers/HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| Community | | |

| | | |
|---|---|---|
| 8 | 23 Workers in the RRF, MCF and | Support and cooperation for the remediation process |
| 9 | Members of 20 HHs in the 200 m radius of the dumpsite | Support and cooperation for the remediation process |
| 11 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |
| | | |
| 12 | Waste Generator in Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |
| 15 | End recyclers | Process the inert and legacy waste safely after remediation |

*Table 2 Stakeholder Analysis*

# 2. Output of Social screening

## 2.1 Social Screening Checklist

Social screening of the dumpsite remediation to understand the social impacts and other social issues, by a joint team of DPMU, DPMC, TSC and PIU, was carried out on 19.01.2023 using a social screening checklist. Social screening was done to identify the potential social risks anticipated during dumpsite remediation. Site is not situated in a densely populated area. However, around 20 houses exist within 200 meters. The social screening has been conducted with a social screening checklist to identify the potential social risks. Major findings during the screening process are shown below

- The dumpsite is in an isolated hilly area.
- MCF and RRF buildings are situated near to the dumpsite. The units are managed by 4 workers. A windrow compost unit is constructed but to be inaugurated. The dumpsite remains near ten houses within 200 m distance.
- There will not be any adverse social impacts on dwellings, land, and community resources of host communities.
- There are no scheduled tribes, rag pickers living near the dumpsite.
- Since there is not much risk with respect to the social and economic conditions of the host communities, the dumpsite can be categorized into "Moderate Risk".

## 2.2 Transect walk

A transect walk was conducted on 3rd June 2023. Twelve persons actively participated in the transect walk. Residents, HKS, municipal workers, Kudumbashree members and project officials were the participants. Gathered a consultation meeting and social map prepared with the support of participants followed by the transect walk through a predetermined route.

RRF and MCF units are functional in the compound of the dumpsite. These units are approximately 50m from the dumping area. But it is This unit is operated by four individuals from the Ibrahim agency, which is working as registered recyclers

The presence of rag pickers is not found in the dumpsite; vulnerable groups are also not found. The project does not affect land or livelihood of any individual in the area. The transect walk was useful to understand the social risk and social impacts to prepare the mitigation plans and strategies.

## 1.1 Stakeholder Consultation meeting

A stakeholder consultation meeting in connection with the Palapparamba dumpsite was conducted on 4.7.2023 in the municipality. The Municipal Health Standing Committee Chairperson chaired the meeting. Councillors, political leaders, Kudumbashree members, HKS members, ward

convener, KSWMP project officials, etc participated in the meeting. The agenda of the meeting was the procedures of dumpsite remediation and realizing the concerns of the community.

The Municipal Chairperson emphasized the need for dumpsite remediation and available assistance from the government. The dumpsite is already closed. But the accumulated legacy waste, till the closure, is there and the menace of dumpsite can be removed only after the bio-mining process. Chairperson added, the dumpsite remediation is possible with the effective use of available funds and technical support. The ward councilor extended the support of the people residing near the dumpsite. The Kudumbashree members and ward convener raised a concern of dumping of waste again in the remediated land. The project officials intimated in the meeting that the technical processes started and hopefully the subproject can tender before the end of 2023. They briefly explained about the process and positive impacts of dumpsite remediation.

The output of the meeting: The concerns of the community will be taken up before the commencement of work. The maintenance of BDW facilities and livelihood of workers during the bio-mining process will be taken care of. The community extended their support to the remediation.

### 2.3 Key informants Interviews

As part of the assessment, they conducted key informants' interviews (KIIs) in the affected communities and gathered data on socio-economic conditions, health status, waste management practices, and opinion on the proposed remediation project to develop suitable and adequate mitigation plans.

KIIs has conducted in the dumpsite with 1. ward councilor and 2. Clean City Manager. A predefined schedule used to gather information from the informants. Open ended questions with sub questions and clarifications during the interview was productive. Data regarding the history and emergence of dumpsite, people's protest, issues like flees and odour and views regarding people's concerns and expectations, etc are delivered during the interview.

### 2.4 Findings of Social Screening:

1) Land acquisition or land loss is not applicable here for the execution of the work.
2) There are no scheduled tribes, rag pickers living near the dumpsite.
3) Since there is not much risk with respect to the social and economic conditions of the host communities, the dumpsite can be categorized into "Moderate Risk".
4) There will not be any adverse social impacts on dwellings, land, labour, livelihood, and community resources of host communities.
5) Solid waste dumping stopped, and capping was done by the recommendation of IIT madras in the year 2013

## 2.5 General observations

The status of the dumpsite is inactive. The menace of waste can be totally removed by the proposed bio-mining process. The positive outcome of the subprojects brings the support of the nearby community. But the community strongly opposes any plan to make the site again a waste management location.

## 2.6 Expected Positive Social impacts after remediation

### 2.6.1 Enhanced quality of life

The remediation can restore the aesthetics of the area, reducing visual blights, foul odour and improving air and water quality. According to the opinion of people residing around the dumpsite, the project can contribute to an improved sense of well-being. Livelihood and employment of vulnerable community

It is identified that no rag pickers are currently engaged in collecting waste from the dumpsite or making a living from it. Therefore, the proposed dumpsite rehabilitation project will have no impact on housing or livelihood of any rag pickers.

### 2.6.2 Economic opportunities

After remediating the site, the Municipality is planning to enhance the capacity of the MCF and RRF to process more non-biodegradable waste and to set up a centralized waste management unit to process the biodegradable waste. These projects will create more job opportunities to the people who are looking for employment in the waste management sector. Remediation creates new opportunities for economic development in the area. The cleaned-up land can potentially be used for new construction, commercial development, or recreational activities. Remediation process will help to increase property values for surrounding residents.

### 2.6.3 Access to service

It is observed that the project will not affect access to any facilities, services, or natural resources as there is enough space/land available in the existing site.

### 2.6.4 Land availability

The dumpsite is not situated near the residential area. Living near a waste dump site can significantly impact the quality of life for residents. The removal of these sites can improve the aesthetics of the area, reduce odor and noise pollution, and increase property values for surrounding residents.

# 3. Scoping of Social Impact Assessment

All the social risks were identified through the social screening and Transect walk conducted at site. Since there are families and institutions in the proximity of the dumpsite, below shown action plans have been formulated to be followed at site

## 3.1 Labour Management Plan

An average of 30 laborers are expected to be engaged in the remediation process at a time. A detailed labour Management plan has been prepared and attached as Annexure.

## 3.2 Labour Influx Management Plan

Since 20 families are residing in 200 m Households there are chances of influx issues. A detailed labour Influx Management plan has been prepared and attached as Annexure.

## 3.3 Preventive GBV Action plan

Since an MCF, RRF and Bio waste processing units are functioning inside the dumpsite and close proximity to households there is a high chance of occurrence of GBV incidents. A detailed GBV action plan has been prepared and attached as Annexure.

## 3.4 Citizen Engagement Plan

Being a socially sensitive area with past protest history, public protest might have happened during the execution period of the project. A detailed citizen engagement plan has been prepared and attached as Annexure.

## 3.5 Livelihood Action Plan

Four workers are engaged in the MCF and RRF facilities. The WIndrow compost unit is yet to be started. MCF/RFF facilities are approximately 50m from the waste accumulated area. No livelihood loss can be expected as an impact of dumpsite remediation.

The assessment of potential social risk during the remediation process and the identification from social screening with screening checklist, transect walk and focus group discussion indicates that there will not be any impact on the livelihood of the community and service providers.

It is identified that land acquisition is not required as sufficient land is available.

# 4. Required Action plans

## 4.1 Labour Management Plan

### 4.1.1 Details of Labors

The proposed remediation process at Palapparamba, requires following category and number labors

| No | Manpower | No |
|---|---|---|
| 1 | Site In-charge/Head | 1 |
| 2 | Environmental, Social and Health & Safety (ESHS) Officer | 1 |
| 3 | Security (3 X 8 Hrs) | 3 |
| 4 | Operations Supervisor & Accountant | 2 |
| 5 | Machine Operator, Mechanic & Electrician | 2 |
| 6 | Labors for stone removal | 2 |
| 7 | Labors for spraying Bio culture | 2 |
| 8 | Labors near Screening machinery | 4 |
| 9 | Labors at Baling facility | 2 |
| 10 | Drivers for tipper trucks, excavators, backhoe loaders and tractors | 11 |
| | **Total** | **30** |

*Table 3 Details of Labours*

#### Working Hours

**8 hours per shift**

#### Type of Engagement

Contract. (Direct workers/contracted workers/daily wage workers/etc)

### 4.1.2 Assessment of key potential labour risks

**Project Activities:**

The bioremediation of the dumpsite at Palapparamba includes the following activities.

- Mobilization of plant and machinery for bio-mining
- waste excavation and forming of windrow
- Spraying with inoculum and waste stabilization
- Waste segregation and refinement

- sorting materials into recyclable, RDF, compost and inert
- Transport to the authorized recyclers and end users

### 4.1.3 Key Labor Risks

It is assessed that key labour risks would be associated with health and safety risks related to the construction activities such as exposure to physical hazards during construction activities such as: use of heavy equipment, exposure to noise and dust, falling objects, exposure to hazardous materials and exposure to electrical hazards from the use of tools and machinery, lack of proper sanitation facilities, availability of separate toilet for women workers. As the construction activities will involve hazardous work, persons under the age of 18 will not be employed by the Project. Many workers will be exposed to occupational health and safety hazards, primarily including but not limited to:

- Injuries/accidents/ fatalities leading to even death, while at work.
- Inadequate accommodation facilities at work force camps, including inadequate sanitation and health facilities.
- Non-payment of wages by Employer.
- Non-payment of benefits (compensation, bonus, maternity benefits etc.) by Employer
- Discrimination in Employment (e.g., abrupt termination from employment, working conditions, wages or benefits etc.)
- Engagement of child labour.
- Sexual harassment at work sites.
- Forced labour or trafficking.
- Security of women workforce.
- Inadequate facilities for pregnant women and lactating mothers.
- Inadequate facilities for the children of the workforce at workforce camp sites
- Possibility of Gender based violence as the work is mostly carried out within the premises of the existing facilities like MCFs/ RRFs etc where female SWM workers are engaged.
- Absence or inadequate or in accessible emergency response system for rescue of labour/workforce.
- Health risks of labour relating to HIV/AIDS and other sexually transmitted diseases.
- Unclear terms and conditions of employment.
- Discrimination and denial of equal opportunity in hiring and promotions/incentives/training opportunities.
- Denial for workers' rights to form worker's organizations, etc.

- Absence of a grievance redressal mechanism for labour to seek redressal of their grievances/issues.

### 4.1.4 Brief overview of labour legislation: Terms and Conditions

| Sl No | Applicable Acts | Details |
|---|---|---|
| 1. | Employees Compensation Act 1923: | The Act provides for compensation in case of injury, disease or death arising out of and during employment |
| 2. | Contract Labour (Regulation & Abolition) Act 1970 | The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. |
| 3. | Minimum Wages Act 1948: | The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. |
| 4. | Payment of Wages Act 1936: | It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the workers. |
| 5. | Equal Remuneration Act 1976: | The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training, and promotions etc. |
| 6. | Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: | The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc. |
| 7. | Child Labour (Prohibition & Regulation) Act 1986: | The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in the Building and Construction Industry. |

| Sl No | Applicable Acts | Details |
|---|---|---|
| 8. | Employees State Insurance Act 1948: | The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the Central Government. The Act also provides for benefits to dependents of insured persons in case of death because of an employment injury. |
| 9. | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: | This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee |
| 10. | Industrial Disputes Act 1947: | the Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing the establishment. |
| 11. | Trade Unions Act 1926: | The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. |

*Table 4 labour legislation*

### 4.1.5 Responsibility Mapping

The ULB (Urban Local Body) will award the proposed work to the contractor through competitive bids. The contractor will be responsible for hiring laborers for both civil and skilled work. In the recruitment process, the contractor is obligated to provide opportunities to members of the host community who possess the necessary skills and willingness to engage in the activities available at the dumpsite for remediation.

The contractor is required to adhere to existing labour laws in the state of Kerala while employing laborers, ensuring compliance with all applicable welfare measures mandated by the relevant labour legislation and rules. Additionally, the contractor is responsible for implementing measures to protect and assist vulnerable groups of workers, including individuals with disabilities, migrant workers, and women workers. These protective measures should be explicitly outlined in the work agreement.

Furthermore, the contractor must prioritize occupational health and safety measures for the laborers. The ULB will actively monitor the contractor's compliance with legal and welfare

requirements. The ULB will also organize training sessions for the workers and establish a forum at the ULB level to address any grievances raised by the workers.

It is a prerequisite for the contractor to possess a valid Labor License, and all laborers working on the site must be registered with the appropriate authorities. This comprehensive approach ensures the well-being and fair treatment of workers throughout the remediation project.

### 4.1.6 Code of Conduct

A code of conduct needs to be incorporated with the contract under the project. The contractor should conduct continuous awareness generation and training activities to ensure that the workers abide by the code of conduct. While preparing the code of conduct, following aspects should be ensured;

- Compliance with applicable laws, rules, and regulations of the jurisdiction
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment (PPE), preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment)
- The use of illegal substances
- Non-Discrimination (for example based on family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction)
- Interactions with community members (for example to convey an attitude of respect and non-discrimination)
- Sexual harassment (for example to prohibit use of language or behavior, towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate)
- Violence or exploitation (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favours or other forms of humiliating, degrading or exploitative behavior)
- Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behavior with children, limiting interactions with children, and ensuring their safety in project areas)
- Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by their employer and not open areas)
- Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favours, are not provided to any person with whom there is a financial, family, or personal connection)
- Respecting reasonable work instructions (including regarding environmental and social norms)
- Protection and proper use of property (for example, to prohibit theft, carelessness, or waste)

- Duty to report violations of this Code
- No retaliation against workers who report violations of the Code, if that report is made in good faith.

### 4.1.7 Systematizing the code of conduct

Awareness raising: The Contractor is required to conduct ongoing awareness-raising and training activities to ensure that workers consistently adhere to the Code of Conduct. Additionally, the Contractor must take measures to ensure that local communities are well-informed about the Code of Conduct, enabling them to report any concerns or instances of non-compliance. This proactive approach aims to foster a shared understanding of ethical standards and accountability within both the workforce and the surrounding communities.

### 4.1.8 Transparency in contract specific terms and conditions

All contracts must contain;

- Wages: Specific wages and payment modality, timeline
- Working Hours: hours of work, maximum number of hours that can be worked on the project, overtime, compensation
- Leaves: rest per week, annual leave, maternity leave, sick leave
- Benefits: medical treatments in case of accidents or otherwise
- Notice of termination of employment and details of severance payments in a timely manner
- Collective agreements that apply to the project, other specific terms, and conditions
- Details of the grievance redressal mechanism

### 4.1.9 Labour Management plan matrix

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To complete the registration by the Principal Employer, the ULB, as per the provisions of the Contract Labour (Regulation & Abolition) Act 1970 (CL Act), Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979 (ISML Act) and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 (BOCW Act) and procure certificate to that effect. | 3 Registration Certificates to be procured by the ULB under CL Act, ISML Act and BOCW Act respectively. | Before Awarding works | Registration Certificate issued by District Labour Officer under CL Act, ISML Act and BOCW Act | PIU |
| To Procure license under CL Act, ISML Act and registration under BOCW Act by the contractor | 2 Licenses and One registration under CL Act, ISML Act and BOCW Act respectively. | Before commencing the work at site | License and registration certificate issued by the competent Authority. | Contractor |
| To procure Workmen Compensation insurance policy proportionate to the number of | One insurance policy. | Before commencing work at site | Copy of insurance policy | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| labour force deployed. (By the Contractor) | | | | |
| To display a copy of the certificate of registration at the conspicuous place at the premises where the building and other construction work is being carried on. | One notice board | As soon as the work is started. | Photographs of the notice board where the license is displayed. | Contractor |
| To establish a labour information signboard at camp site by including following details like, date of payment of wages, working hours, holidays, wages rates for different categories of labours and name and contact details of local labour inspector and his/ her office and emergency contact numbers. | One notice board | do | do | |
| To conduct pre- employment medical examination (as per the provisions of BOCW Act)- to ensure medical fitness of the employee. | All workers must be examined | No of workers employed by the contractor | Pre-Medical Examination certificate issues as per Rule 223(C) of BOCW Act (Form No. IX) by the Registered Medical Practitioner. | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To conduct Periodical Medical Check-ups (once in every six months) | All workers must be examined. | No of workers employed by the contractor | Medical Examination certificate issued by a registered medical practitioner. | Contractor |
| To provide safe drinking water- the contractor must provide safe drinking water at worksite as well as camp site* (Guideline is provided along with this document) | As per requirement | During the entire contact period | Photographs of supply of potable water, Bill of water purchase. | Contractor |
| To arrange first Aid facility at work site as well as camp site (Specifications and items to be maintained in the box is mentioned in this document) | As per requirement | During the entire contract period | First Aid Register, Bill of purchase, photographs of First Aid kit | Contractor |
| To arrange separate First Aid room at work site | Allot one specified room | To be made available during the construction period | Photographs of the facility | Contractor |
| To provide first Aid training to selected labourers or staff members through an authorized agency. | One training with authorized agency | Within one month of commencement of the work | Training records & Photographs | Contractor |
| To establish linkage with local hospitals/ health care institutions for emergency medical assistance | Tie up with at least one hospital | Within one month of the commencement of the work | Letters issued by the hospital or correspondence and agreement with the hospital. | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To establish rest room at work site or camp site | | Before the commencement of the work | Photographs of the rest room | Contractor |
| To establish Canteen facility for labours if the contractor engages more than 250 labours | | Before the commencement of the work | Photographs of the facility, canteen register etc | Contractor |
| To maintain essential registers and records like Form A (Registration of employees), Attendance Register, Wages Register, and other registers like incidents registers including Accident register, Harassment complaints, recovery register, Maternity leave, Termination etc | | As and when the work starts | Copy of registers. | Contractor |
| Constitute GRC for labours (maximum members to be six. Number of members from employer and employee to be equal. Female members should be minimum 50%. ) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| Constitution of ICC (minimum members to be four. The presiding member should be a senior female employee) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To publish the abstract of labour laws within the premises of the labour camp.<br>1. The Payment of Wages Act<br>2. The Employee Compensation Act<br>3. The Building and Other Construction Workers (RECS) Act<br>4. The Contract Labour (A&R) Act<br>5. The Child and Adolescent Labour (P&R) Act<br>6. The Maternity Benefit Act | Abstract of Six acts | As and when the camp is established | Photos of the notices published. | Contractor |
| To establish code of conduct and provide induction trainings | | As and when new employees are joined | Training reports and other documents | Contractor |
| Conduct HIV/AIDS awareness programs | As per requirement | Once in six months | Reports, photographs etc | Contractor |
| All the Drivers should possess effective and valid Driving License | Drivers should be selected after verification of DL | As and when drivers are appointed | Photocopy of licence ids to be collected | PIU |
| All the vehicles involved in the project shall be insured to cover the third-party risk | Vehicle must be allowed to be plied in the project only after procurement of third- | As and when vehicles are plied in the project | Photocopy of insurance is to be collected | PIU |

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| | party insurance to the vehicle | | | |

*Table 5 Labour Management plan matrix*

**Budget for LMP**

| S.No | Item | Cost |
|---|---|---|
| 1 | Labour compliance as per LMP | [redacted] |

### 4.2 Labour Influx Management Plan

An average of 30 laborers will be engaged in the dumpsite remediation process. The labour influx matrix is given in the below table

| Risk | Mitigation Measures | Implementation responsibility | Monitoring indicators | Monitoring responsibility |
|---|---|---|---|---|
| Social and Community wellbeing | Joint Meeting with the community by ULB officials and Elected members | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report<br>• | TSC/DPMU |
| Economic and Livelihood Issues | Skilled /Unskilled jobs for the Community embers in the sub-project | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Accommodation /labour camp | • Ensure basic amenities are provided to the laborers (Toilets, Water, Kitchen facilities etc)<br>• Daily briefing to the laborers | Contractor | • Risk identification report<br>• Proposed action/mitigation plan<br>• List of facilities in labour camp<br>• Details of labors | TSC/DPMU |

| Risk | Mitigation Measures | Implementation responsibility | Monitoring indicators | Monitoring responsibility |
|---|---|---|---|---|
| Communicable Diseases | • Access to Medical Check-up<br>• Awareness to the laborers | Contractor | • SOP for prevention of communicable disease and health wellbeing on worksite and labour camp<br>• Report on medical check-up | TSC/DPMU |
| Crimes | • Intimation to the Local police about the camp | Contractor | • Work site complaint register<br>• Number of cases reported, and action taken | TSC/DPMU |
| Child Labour | • Ensure Adhar card of all laborers at the site | Contractor & TSC | • Number of child labour issues reported<br>• Data of labors | ULB/DPMU |
| Gender-based violence, including sexual harassment child abuse and exploitation | • Gender sensitization briefing to the laborers | Contractor/TSC | • Number of cases reported<br>• Action taken report<br>• Number of cases resolved<br>• Time taken for resolving complaints | ULB/DPMU |
| Labour license | Mandatory provisions to be followed | Contractor/PIU | • Number of labors having license | DPMU |

*Table 6 Labour Influx Management Plan*

### 4.3 Preventive GBV Action Plan

GBV Action Plan – matrix

The purpose of the Gender-Based Violence Action Plan in the Kerala Solid Waste Management Project (KSWMP) is to prevent and address gender-based violence (GBV) in all aspects of the project. This includes during the planning, implementation, and monitoring of project activities. The GBV AP is an integral part of the KSWMP's Environmental and Social Management Framework (ESMF). The GBV action plan outlines a number of measures that will be taken to prevent and address gender based violence.

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| Formation of internal complaints committee | •ULB level ICC will be constituted | Before implementation | ULB | •Minutes and Reports | TSC |
| Map GBV issues | Ensure justice, safety and protection, reasonable wages, care and support, adequate Work space, Avoid Gender discrimination Physical, Sexual , Psycological and socio Economic violence, stress, emotion, conflict, abuse, threatens | During implementation | Contractor/ULB | Issue tracking system in place Feedback report(monthly) | TSC |
| Map GBV service providers and quality assessment of services | •NGOs<br>•Police Station KELSA<br>•Women protection officer<br>•List of Nongovernment and private | Before implementation | TSC | •Directory of service providers<br>•List of key partners<br>•Mapping of roles and responsibilities | TSC |

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| | agencies providing GBV support<br>• Map local informal grassroot level organizations<br>• Review the quality of services in terms of prevention, protection, rescue, rehabilitation, restoration, reintegration, research, and documentation | | | •Monthly report on quality Assessment | |
| Facilitate GBV awareness and sensitization programs | •Organize sensitization activities<br>•Display sign boards around the project site | During implementation | Contractor/ICC | •Detailed activity plan<br>•Progress reports<br>•Completion report | TSC |
| Create a GBV response and support mechanism | SOP for the actions be followed in terms of any incidents related to GBV will be formed along with ICC. The SOP will detailed the identification of support mechanism and terms of conditions for comply with existing rules and | During implementation | ULB/ICC | •SOP for prevention, protection, and rehabilitation | TSC |

| Action | Tasks | Timeline | Implementing Responsibility | Monitoring Indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| | regulations and operational strategy. | | | | |
| Reporting, monitoring and review | •Create GBV data fields<br>•Quarterly reports<br>•Conduct review | During implementation | Contractor/ TSC | •Progress reports (Monthly, quarterly)<br>•CB repoet<br>•Monthly complaint status and action taken repoet<br>•Establishment of Feedback system | TSC |

*Table 7 GBV Action Plan – matrix*

**Budget for Preventive GBV action Plan**

| S.No | Item | Cost |
|---|---|---|
| 1 | Activities as per GBV plan | [redacted] |

### 4.4 Site Specific Citizen Engagement Plan

#### 4.4.1 Stakeholder identification

As part of social safeguard initiatives for the bioremediation of dumpsites at Palapparamba, Kuthuparamba municipality. The social experts of DPMU, DPMC and TSC conducted brainstorming exercises with local community, municipal officials, and PIU. A detailed list of primary and secondary stakeholders is prepared on the basis of these exercises.

#### 4.4.2 Waste Generators

The dumpsite is located in Palapparamba ward No 5. The dumpsite is located inside the existing common solid waste management facility of the municipality. MCF and RRF units are working and a windrow compost unit is constructed inside the compound of the dumpsite land. But the dumpsite and the facilities are separated with a compound wall.

#### 4.4.3 Service Providers

For the successful completion of the bioremediation sub project, service of many people, agencies and departments are to be ensured by proper advocacy and networking initiatives. Following is the list of service providers identified through stakeholder analyses and their expected role/responsibility in the project

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| Service Providers | | |
| 1 | ULB Council | Providing ground support to the remediation process |
| 2 | Govt institutions like PCB,KSEB,KWA etc. | To deliver necessary approvals and provide necessary services for remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | Contractor | Execution of the Remediation process |
| 5 | Service providers/HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| Community | | |

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| 6 | 4 labourers are workingin the MCF/RRF units | Support and cooperation for the remediation process |
| 7 | Members of 20 HHs in the 200 m radius of the dumpsite | Support and cooperation for the remediation process |
| 8 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |
| 9 | Waste Generator in Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |

*Table 8 Service Providers*

#### 4.4.4 Need of the plan

Citizen engagement as part of the proposed bioremediation of dumpsite in Kuthuparamba municipality aims to facilitate two-way communication between the project and its stakeholders in order to make better informed decisions. Such an engagement will certainly pave the way for better implementation of the project, and it will ensure public participation in trouble shooting at all the stages of the implementation of the project.

#### 4.4.5 Objective of the plan

The citizen engagement plan for the proposed dump site remediation is prepared with following objectives;

- To create a conducive environment for the smooth implementation of the proposed bioremediation of the dumpsite by promoting constructive dialogues between the project and its stakeholders.
- To ensure stakeholder participation in the planning, implementation, and monitoring of the sub-project.
- To suggest appropriate activities with a monitoring plan and an expected budget for engaging the stakeholders with the motive of enhancing their ownership in the project through increased participation.

#### 4.4.6 Stakeholder concern

**Waste Generators**

The waste collection may get delayed/stopped due the remediation process.

**Service Providers**

Major concerns of the service providers which has to be addressed by the citizen's engagement plan can be summarized as follows;

- Precautions to be taken to avoid the livelihood of workers in the MCF and RRF may get affected.
- SWM related Service providers/HKS of the municipality should be trained and motivated for proper timely collection, segregation and transportation of waste to appropriate processing units to prevent the formation of such dumping yards in the future.

### 4.4.7 Activities proposed

Community/citizen Awareness

- Focus group discussions to host community
- Organize exposure visit for the identified members from host community and council members
- Formation of GRM committee to take up any issue raised at site level and help to resolve an emergency.
- Sensitization programs to nearby vendors

Awareness to Service providers

- Sensitization on the bio-remediation activity is to be conducted for the Kuthuparamba Municipal Council and officials prior to the commencement of the actual bio-remediation process.
- Meeting with Contractor to understand their plan of operations/No labors involvement/timeline etc.
- Orientation to the Service providers/HKS of Kuthuparamba Municipality
- Sensitization meetings to the local and district level police officials on the proposed bio remediation of dumpsite and anticipated issues and action required.
- Sensitization programs to Fire Force, and PCB regarding dumpsite remediation.
- Orientation regarding the dumpsite remediation process and its benefits to local community

### 4.4.8 Citizen engagement plan

**Citizen Engagement Plan matrix**

| S. No | Engagement Challenge | Impacts on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| 1 | Lack of Awareness on Project activities | Non co-operation of Community/stakeholders | Awareness campaigns /IEC material/ sensitization programs to the stakeholders | ULB/Contractor |
| 2 | Delay in decision making and timely support from the ULB | To establish transparency and building confidence in the project commitments to ULB elected members and officials | Sensitization on the bio-remediation activity for the elected representatives and officials prior to the commencement. | ULB/Contractor |
| 3 | Lack of proper GRM system | Delay in the execution of remediation work | Constitution of GRM Committee to take-up social issues raised at site level | ULB/Contractor |
| 4 | Lack of conducive environment for bioremediation activity | Delay in the execution of remediation work | Sensitisation meetings to various departments | ULB/Contractor |

*Table 9 Citizen Engagement Plan matrix*

### 4.4.9 Monitoring Plan

| S. No | Activity | Means of Communications | Monitoring Indicator | Monitoring Responsibility |
|---|---|---|---|---|
| 1 | Sensitization on the bio-remediation activities for the Municipal Council and officials | Presentation and group discussion | No of councilors and officials attended | DPMU/DPMC/ TSC |
| 2 | Sensitization meeting to host community | Presentation and group discussion | No of persons attended. | DPMU |

| S. No | Activity | Means of Communications | Monitoring Indicator | Monitoring Responsibility |
|---|---|---|---|---|
| 3 | Formation of GRM committee | Office order/ proceedings on the formation of GRM committee | Office order/ proceedings | DPMU |
| 4 | Orientation to the Service providers/HKS | Presentation and group discussion | No of service providers/HKS attended | ULB/DPMU |
| 5 | One to one meeting district administration, line departments, PCB, KSEB, KWA, Fire & Safety and Police | Presentation | No of one-to-one meeting conducted / no of officials attended | ULB/DPMU |
| 6 | IEC display board | IEC boards | No of IEC developed and displayed | ULB/DPMU |

Table 10 Monitoring Plan

### 4.4.10 Budget

| S. No | Activity | Specification | Quantity / events | Cost |
|---|---|---|---|---|
| 1 | Sensitization on the bio-remediation activities for the Municipal Council and officials prior to the commencement of the work | Half day Program for Councilors and municipal officials | 1 | [redacted] |
| 2 | Sensitization meeting to host community | Half day Program by incorporating all host community members | 2 | [redacted] |
| 3 | Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency. | Committee formation | 1 | [redacted] |
| 4 | Meeting with Contractor to get an understanding of their plan of | One to one interaction | As required | [redacted] |

| S. No | Activity | Specification | Quantity / events | Cost |
|---|---|---|---|---|
| | operations/No labors involvement/timeline etc. | | | |
| 5 | Orientation to the Service providers/HKS | Half day programme | 2 | [redacted] |
| 6 | Issue based one to one meeting district administration, line departments, PCB, KSEB, KWA, Fire & Safety and Police | One to one | As required | [redacted] |
| 7 | IEC display board for information dissemination | IEC display in the site | 1 | [redacted] |
| **Total** | | | | [redacted] |

*Table 11 Budget*

**Summary of SMP budget**

| S.No | SMP Activity | Cost |
|---|---|---|
| 1 | Labour Management Plan | [redacted] |
| 2 | Labour Influx Management Plan | [redacted] |
| 3 | Preventive GBV action plan | [redacted] |
| 4 | Citizen Engagement Plan | [redacted] |
| **Total** | | [redacted] |

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

# KOTHAMANGALAM DUMPSITE

**SUBMITTED BY**

**KERALA SOLID WASTE MANAGEMENT PROJECT (KSWMP)**

# Part A

# Environmental Impact Assessment

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# SUMMARY

**INTRODUCTION:** Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio mining of multiple Legacy Waste Dumpsites in various districts. Bio mining and bioremediation of Kumbalathumury dumpsite figures in Cluster 1. The selected dumpsite is Kumbalathumury which is falling under this cluster 1 and is located near Ward no 06 Kothamangalam municipality, Ernakulum District.

**RATIONALE FOR THE PROPOSED SUB-PROJECT:** Kothamangalam ULB proposes bio mining and bioremediation of the Kumbalathumury legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

**PROPOSED SUB-PROJECT DETAILS:** Kothamangalam dumpsite is located at a distance of 6.0 km from the centre of Kothamangalam town in western side and encompasses a total area of 2.6 acres of land. The geographical coordinates of the dumpsite are 10.078930° N & 76.647811° E. The volume of legacy waste to be remediated in the dumpsite is 29,915 Cu.m. The legacy waste is presented about 3.0 m below and 2.5 m above the ground level respectively. Hence bioremediation of the dumpsite is essential to mitigate the environmental impacts.

**APPLICABLE NATIONAL, STATE LEGISLATIONS AND TECHNICAL GUIDELINES:** To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed.

**THE WORLD BANK SAFEGUARDS POLICIES, AND KSWMP ESMF**: The World Bank policies and directives on environmental and social safeguards have been adhered to the proposed dump site remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are ensured.

**SUB-PROJECT SCREENING AND ITS CATEGORIZATION:** As per indicative categorization for dumpsite bio mining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (2.60 acres) and waste spread (2.13 acres) and environmentally sensitive features around this subproject is individually considered as E2 and EIA is prepared accordingly.

**ENVIRONMENTAL BASELINE:** Physiographically, Kothamangalam in and around topographical features falls under midland category with hilly terrain zone. The favourable time for remediation is between October-2023 to March-2024 non-monsoon period. As per Wind rose, the predominant wind directions are blowing from SW and WSW direction throughout the year. As per the geotechnical investigation, the subgrade soil was encountered at 3.0 m below the waste depth of the dumpsite and the predominant soil is gravelly clay. The dumpsite is surrounded by predominantly of Dry cultivation land use and the same will act as odour attenuation during remediation. The cultural heritage zone near dumpsites is Mar Thoma Cheriyapalli church at a distance of 6.0 Km in SW direction. Hence, no significant physical impact to the heritages sites is envisaged during remediation. The total number of vehicles that will be operational at the dumpsite is 5 numbers per day which increase the traffic load by only 0.1% per hour and reducing the impacts to negligible. As per the district disaster management plan-2015 and flood vulnerability map the dumpsite is not under flood prone zone.

**DESCRIPTION OF ENVIRONMENTAL PARAMETERS:** The analysed air pollution data indicates that the levels are within acceptable limits of NAAQs for all the parameters. The ambient Noise Levels are well within the National Ambient Noise standards for Residential Area for night time however during the day time noise equivalent (55.6 dB (A) was found to be marginally higher than the standards. The ground water quality results indicate that the dumpsite has not caused any major increase of the parameters and the quality parameters are within the IS10500:2011, except the coliforms which are found to be higher than the above said standard. Similarly, the surface water sample shows that it is not largely influenced by the dumpsite as the quality is within the limits of IS 2296, except for BOD which shows a marginal increase in value of about 4.6 mg/l and COD of 8 mg/l. The leachate monitoring data indicates, the TDS is about 1885 mg/l, while the suspended solids is about 180 mg/l. The chlorides are 788 mg/l, while the COD, BOD are 320 mg/l and 110 mg/l respectively.

**SOCIO-ECONOMIC BASELINE:** Kothamangalam Municipality has population of 38,822, literacy rate of 92.95% as per Census 2011. The dump site is situated in the land owned by the Municipality. They have full authority to plan and implement the remediation process in this land. The remediation process will be conducted by an experienced agency decided by the Municipality with the supervision of a ULB level project implementation unit.

**SOCIO-ECONOMIC ENVIRONMENT:** In connection with the dumpsite only one family is residing in an aerial distance of 200 m and the remediation process will not affect them in any way. The remediation process will not affect the socio economic environment in and around the dump site in any way. Within a 200-meter radius of the dumpsite, there are no public utilities or facilities. The site is isolated and located far from habitation and settlements.

**ANALYSIS OF ALTERNATIVES:** After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

**ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS:** Environment: During operational phase (bio-remediation), the main potential nuisances caused by a dump site are fugitive dust, odour, foul gases, smoke from the site (in case of fire), and leachate generation. Birds, vermin, and rodents, littering, noises both from machineries operating at the site and waste collection vehicles. Social: No specific social risk is identified for initiating the remediation process except the occupational hazards to the workers engaged in the remediation process. It can be overcome by using adequate protective measures properly. In connection with the dumpsite only one family is residing in an aerial distance of 200 m and the remediation process will not affect them in any way.

**ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN:** The management plan proposed are for pre-remediation as well as during remediation stage. The mitigation measures are recommended for impacts from air, noise, water, leachate, health and safety, OH&S aspects. The proposed monitoring plan includes leachate, surface and ground water monitoring for a period of once in three months. The cost of [redacted] is required for implementation and supervision of EMP.

**SOCIAL MANAGEMENT AND MONITORING PLAN:** The social management plan proposed are for pre-remediation as well as during remediation stage. The mitigative measures proposed addressing concern of local community about remediation work, labour management issues, health and safety risks of labours, gender discrimination.

**EMERGENCY PREPAREDNESS PLAN:** The identified emergency situations which may arise from remediation activities are fire risk in summer, occupational health and safety related risks. The

Kothamangalam police station at 3.5 km, Taluk hospital at 4.5 km, Kothamangalam Fire and Rescue station at 5 km are the nearest emergency services. Periodic Compliance monitoring system will be done by the contractor during remediation.

**PUBLIC CONSULTATION AND INFORMATION DISCLOSURE: A** Transect walk was carried out on 06.06.2023 covering the surrounding area of the dump site. Effective IEC drive to be initiated to engage with the community to build support as the activity will create positive impact. Warning sign boards and project information boards with full details of grievance redressal mechanism along with all related contact details will be installed at site during the process at the site. Site control measures should be enforced to prevent unauthorized personnel into the work site.

***Note: All the references to Social Impact Assessment and Social Management Plan may be referred to Part B- Social Impact Assessment which is a separate document attached along with this document.***

[redacted]

[redacted]



[redacted]

# CHAPTER 1. INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-Financing Framework agreement and as agreed Project Co-Lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio mining of multiple Legacy Waste Dumpsites in various districts. There are 19 dumpsites identified for remediation under the Kerala Solid Waste Management Project. Several others have been taken up for remediation directly by the ULBs. Currently, 7 dumpsites considered within the three districts, which are (Ernakulum, Alappuzha and Idukki) falling under Package B are selected by Kerala Solid Waste Management Project (KSWMP) for remediation under the project. One of the selected dumpsite is Kumbalathumury is located near Ward no 06 Kothamangalam municipality, Ernakulum District.

## 1.2 The rationale for the Proposed Sub-Project

Kumbalathumury dumpsite in Kothamangalam ULB at Ward no 06 has a total waste quantity of 29,906 cum, spreading over 2.13 acres. The site is located between Latitude 10.078930° N and Longitude 76.647811° E and has an elevation of MSL +20 (m), with a gentle slope from North West to the south-eastern part. During monsoon season, due to the geography of the site, Leachate from dump waste flows downhill towards southern side of the dry agricultural land. Kothamangalam ULB proposes bio mining and bioremediation of the Kumbalathumury legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

## 1.3 Proposed Sub-Project Details

Kothamangalam dumpsite is located at a distance of 6.0 km from the centre of Kothamangalam town in western side and encompasses a total area of approximately 2.6 acres of land, out of this 2.13 acres of land is covered with solid waste. The geographical coordinates of the dumpsite are 10.078930° N & 76.647811° E. It is located in ward no. 6 of the municipality. Kothamangalam municipality holds the ownership of the dumpsite. The South and West direction from the dumpsite is vacant land and the nearest road is Malayinkeezhu- Nadukani Road in the South direction at a distance of 250 m from the dumpsite.

Currently, the quantity of waste dumped at this site is about 29,906 Cu.m above the surface level as per the topographic survey, and 8620 Cu.m below the surface as per geotechnical survey. The legacy waste is presented about 3.0 m below and 2.5 m above the ground level respectively. Hence bioremediation of the dumpsite is essential to mitigate the environmental impacts. Dumpsite reclamation involves excavation, screening, and separation of material from dumpsites into various components such as soil, recyclable materials, and residues.

### 1.4 Objectives and Scope of the EIA & SIA

As per indicative categorization for dumpsite bio mining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (2.60 acres) and waste spread (2.13 acres) and absence of environmentally sensitive features around, this subproject is individually considered as E2 and EIA is prepared accordingly.

The EIA & SIA process involves the identification of the potential environmental and social issues in the project and trying to address them during design interventions. The EIA & SIA further carries out impact prediction and evaluation of residual environmental and social issues of the project. It then goes on to outline the proposed mitigation measures for residual impacts and enhancement measures for positive impacts which the Project will implement.

### 1.5 Structure of the Report

The Consolidated EIA report has been structured into the following Chapters:

- Introduction and Project Description.
- Policy, Legal and Administrative Framework presents a review of the existing Institutions and legislation relevant to the project at the National and the State levels;
- Environmental Assessment Methodology discusses sequence of tasks carried Out in preparing EIA;
- Existing Environmental Scenario presents a consolidated picture of the existing Environmental setting of the project;
- Assessment of Potential Impacts identifies and quantifies the potential impacts on each of the environmental components due to the proposed project development;
- Analysis of Alternatives discusses the criteria for analysis of alternatives of technology for remediation.
- Mitigation Measures presents an elaborate listing of the nature of impacts on each of the environmental components and the avoidance and mitigation measures suggested.
- Public Consultation details the stages and types of public consultations carried out during the project preparation stage and people's perceptions of the project benefits and the Potential impacts;

# CHAPTER 2. POLICY AND REGULATORY FRAMEWORK

## 2.1 Applicable National, State Legislations and Technical Guidelines

**National Environmental Rules and Regulations: -**

To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed. A summary of environmental legislation/regulations relevant to the project is furnished in the following **Table-2.1**.

**TABLE: 2.1 SUMMARY OF ENVIRONMENTAL LEGISLATION/REGULATIONS**

| Sr. No. | Act / Rules | Purpose | Applicable (Yes / No) | Reason for Applicability | Authority |
|---|---|---|---|---|---|
| 1 | Environment Protection Act, 1986 | To protect and improve the overall environment. This is an umbrella Act. | Yes | As all environmental notifications, rules and schedules are issued under this act. | MoEF&CC, CPCB, SPCB |
| 2 | Solid Waste Management Rules, 2016 | To manage collection, transportation, Segregation, Treatment, and disposal of solid wastes (other than Hazardous water, Plastic Waste, Bio Medical waste) | Yes | Dumpsite remediation/bio mining | MoEF&CC, CPCB, SPCB |
| 3 | Air (Prevention and Control of Pollution) Act, 1981 | To control air pollution by controlling emission of air pollutants as per the prescribed standards. | No | No, Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 21 of Air (Prevention and control of Pollution) Act 1981. | State Pollution Control Board, Kerala |
| 4 | Water Prevention and Control of Pollution) Act, 1974 | To control water pollution by controlling discharge of pollutants as per the prescribed standards | No | No, Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 25 of this Act. | State Pollution Control Board, Kerala |
| 5 | The Noise Pollution (Regulation and Control) Rules, 2000 & amendments | The standards for noise for day and night have been promulgated by the MoEF&CC for various activities. | Yes | This act will be applicable for all construction equipment deployed at worksite and in operation. | State Pollution Control Board, Kerala |
| 6 | Public Liability and Insurance Act, 1991 | Protection from accidents. | Yes | This act will be applicable for providing immediate relief to the persons affected by accident occurring during work | State Pollution Control Board, Kerala |
| 7 | Central Motor Vehicle Act 1988 | To check vehicular air and noise pollution. | Yes | This rule will be applicable to vehicles deployed for construction activities and construction Machinery. | Motor Vehicle Department |

| | | | | | |
|---|---|---|---|---|---|
| 8 | The Plastic Waste Management Rules, 2016 | For the storage and disposal of plastic wastes through authorized vendors. | Yes | This act will be applicable for the storage and disposal of all the plastic wastes. | State Pollution Control Board, Kerala |
| **Other applicable Rules** | | | | | |
| 9 | Construction & Demolition, Waste Management Rules, 2016 | | | | |
| 10 | Batteries (Management and Handling) Rules, 2001 | | | | |
| 11 | E-Waste (Management) Rules, 2016 | | | | |
| 12 | Kerala Municipality Act, 1994 & Rules | | | | |
| 13 | Hazardous & Other Wastes (Management And Transboundary Movement) Rules, 2016 | | | | |
| 14 | Bio-medical Waste (Management & Handling) Rules, 1998 | | | | |

## Applicable Social and Other Legislation

**Other Legislations applicable to Construction activities under the project**

- Workmen's Compensation Act 1923 (the Act provides for compensation in case of injury by accident arising out of and during the course of employment);
- Payment of Gratuity Act, 1972 (gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years);
- Employees PF and Miscellaneous Provision Act 1952 (the Act provides for monthly contributions by the employer plus workers);
- Maternity Benefit Act, 1951 (the Act provides for leave and some other benefits to women employees in case of confinement or miscarriage, etc.);
- The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 is introduced to prevent and provide redressal of complaints of sexual harassment.
- The Protection of Women from Domestic Violence Act, 2005 defines domestic violence, describes the powers and duties of protection officers, service providers and lists the procedures for obtaining reliefs.
- Contract Labor (Regulation and Abolition) Act, 1970 (the Act provides for certain welfare measures to be provided by the contractor to contract labour);
- Minimum Wages Act, 1948 (the employer is supposed to pay not less than the Minimum Wages fixed by the Government as per provisions of the Act);
- Payment of Wages Act, 1936 (it lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers);
- Equal Remuneration Act, 1979 (the Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees);
- Payment of Bonus Act, 1965 (the Act provides for payments of annual bonus subject to a minimum of 83.3% of wages and maximum of 20% of wages);
- Industrial Disputes Act, 1947 (the Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment);

- Industrial Employment (Standing Orders) Act; 1946 (the Act provides for laying down rules governing the conditions of employment);
- Trade Unions Act, 1926 (the Act lays down the procedure for registration of trade unions of workers and employers. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities);
- Child Labour (Prohibition and Regulation) Act, 1986 (the Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labour is prohibited in Building and Construction Industry);
- Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979 (the inter-state migrant workers, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home to the establishment and back, etc.);
- The Building and Other Construction Workers Act (BOCW), 1996 is a social welfare legislation that aims to benefit workers engaged in building and Other Constructions Works.

### 2.2 The World Bank Safeguards Policies, and KSWMP ESMF

The World Bank policies and directives on environmental and social safeguards have been adhered to the proposed dump site remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are summarized in the following table.

**Environmental Codes of Practices (ECoP):** The ECoP's guidelines for environmental management of bio-mining and bio-remediation activities which are seen to be of limited extent of impacts/risk, temporary and reversible, and readily managed with good practices during the implementation. The following key points should be considered.

**Key Points of ECop to be considered:**

- The bio-mining activities and preparatory activities shall follow the "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" published by CPCB in February 2019.

- Bio-mining methods include Tractor Tiller, Trench method, Cone Method, windrow, Thin Layer Method, etc. More appropriate may be the Cone method for legacy waste and window for relatively fresh waste.

- Leachate channelization and treatment facility shall be set up before starting the bio-mining works. Works shall take place only during the non-monsoon period; and there shall be suitable precautions to prevent any rainwater disturbing the operations (like seasonal unexpected rains, storm water, runoffs from other sources).

- Ballistic separator and trommel may be used for screening. Screened fractions into which waste is segregated include RDF, inert, Compost, and C&D wastes.

**Applicable World Bank Operational policies**

OP 4.01 Environmental Assessment Help to ensure the environmental and social soundness and sustainability of investment projects. Support integration of environmental and social aspects of projects in the decision-making process

OP 4.04 Natural Habitats Promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions.

OP 4.09 Pest Management includes training to prevent risk to human beings or animals from Bio-culture, enzymes, insecticides and such formulations used for remediation.

OP 4.11 Physical Cultural Resources (PCR) includes resources of archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites), aesthetic, or other cultural significance. Assist in preserving PCR and in avoiding their destruction or damage.

WB General EHS Guidelines Recommendations of these guidelines would be incorporated in the EMP & SMP and Bidding document for this sub-project.

The Environmental Management Framework (EMF) has been prepared to assist in the screening, assessment, and management of environmental risks of all solid waste management projects at an early stage during the planning and integration, mitigation hierarchy during the subproject design, implementation, and operation. The framework helps provide specific guidance on the policies and procedures to be followed for environmental assessment along with the roles and responsibilities of the implementing agencies.

# CHAPTER 3. ENVIRONMENTAL AND SOCIAL BASELINE

## 3.1 Project Location of the site

Kumbalathumury dumpsite is located at a distance of 6.0 km from the centre of Kothamangalam town in western side and encompasses a total area of approximately 2.60 acres of land, out of this 2.13 acres of land is covered with solid waste. The geographical coordinates of the dumpsite are 10.078930° N & 76.647811° E. The North and South direction from the dumpsite is vacant land and nearest highway is Malayinkeezhu- Nadukani Road in South direction at a distance of 250 m from dumpsite. The google map image showing the location of Kothamangalam dumpsite is shown below in **Figure: 3.1**.




**FIGURE: 3.1 GOOGLE IMAGE SHOWING THE LOCATION OF THE EXISTING DUMPSITE AT KOTHAMANGALAM**

## 3.2. Methodology for Environmental Baseline Studies

The baseline appraisal should consider all aspects of the environment that may be altered by the proposed project. These can be categorized as physical, biological or socioeconomic attributes. The baseline should be based upon the findings of the screening and scoping studies. Surface water, groundwater, air quality, noise, soils, land use, Biodiversity Socio-economic (social), cultural heritage, traffic and transport, etc., provide information on the existing baseline conditions of the site. It is important to re-emphasize that the scope (and detail) of the baseline study should be commensurate with the size and scale of the project and hence the potential changes that the project may have upon the environment and society. The baseline study will typically be developed in three stages:

**Desktop study:** Office-based exercise during which readily available existing information (i.e. that can be used to describe the existing environment) is collected and reviewed to ensure its appropriateness for use within the EIA & SIA;
**Field study:** The stage within which additional data is captured in the field, with the intent of addressing any gaps that have been identified in the existing knowledge base; and
**Reporting stage**: Collation of the captured information into the baseline report.

The below table indicates the environmental attributes and location of monitoring.

**TABLE : 3.1 ENVIRONMENTAL ATTRIBUTES**

| S.No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | Down wind direction in North East boundary of within the dumpsite.<br>Upwind direction in South West (SW) boundary of the dumpsite | The AAQ locations were chosen based on the Wind rose data obtained for Kothamangalam. The most predominant wind direction are from WSW and South West. |
| 2 | Noise (1 Location) | Ambient Noise level (E(P)) for 24 hours | Within the dumpsite. Distance 15 m from the boundary of MCF. | Most vulnerable point in the site in regards of Noise quality is due to the operation of the MCF and entry and exit of the waste loading and unloading vehicle. Please note that the site is devoid of proximity to any sensitive receptors within a 200 m radial circle . |
| 3 | Surface water (1 Location) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, Ecoli and Total coliforms (IS 10500-2012). | Surface water sampling location at 15 m distance in Eastern direction. | Surface water sample points are selected based on the water flow from upwards to downwards and for this site, it is from North East to South-west direction. |
| 4 | Ground water (1 Locations) | pH, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total coliform (IS 10500-2012). | Groundwater sampling location at 330 m distance in South East direction. | |

| TABLE : 3.1 ENVIRONMENTAL ATTRIBUTES | | | | |
|---|---|---|---|---|
| **S.No** | **Description** | **Parameters Tested** | **Sampling location** | **Justification** |
| 5 | Bore Hole(1 location) | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coeff of permeability, Strength compressibility (vertically-3 samples per borehole). | Centre of the dumpsite | Volume of legacy wastes were found to be higher in the center part of the dumpsite during investigation. So the bore hole test was performed in the center. |
| 6 | Waste & Environmental Analysis | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammonical nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cynide, Chloride, Fluoride, Phenolic compounds. | East boundary direction within the dumpsite - one point | Based on contour mapping and cross section diagram, the leachate sampling location was identified as North (N)- 915 and East (E) - 975 points. |
| | | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | Within the dumpsite at 2 locations. | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. So the two locations were considered for sampling. |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor | 1 | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. |

### 3.3 Environmental Audit of the Existing Facilities

Inside the dumping yard, there is a-functional MCF and non-functional RRF for dry waste in the Kumbalathumury dumpsite, both of the facilities are within the same existing building. The MCF/RRF is not supported under KSWMP under this subproject. However, an environmental audit of the facility is important as this may be used as an associated facility to which some

recyclables may be channelized to and is situated at the same site and might be impacted during the bio-mining activities.

| TABLE: ENVIRONMENTAL AUDIT OF EXISTING FACILITIES | | |
|---|---|---|
| **S. No** | **Aspects** | **Remarks** |
| 1 | Structural Characteristics | Area – 423.98 (in Sq. m)<br>Buffer/setback around the MCF – 3 FT<br>Distance from waste pile of dumpsite- 10 m.<br>Roof: (GI Sheet Roof, Good condition)<br>Floor (Cement Floor, Damaged, Renovation proposed under KSWMP)<br>Walls: (Column structure filled with brickwork up to 80 cm and thereafter mesh net till top)<br>Doors & windows: Entrance door and exit door available. No windows since mesh net is given all around. |
| 2 | Functional Characteristics | Activities in the MCF/RRF: Functional MCF and Non-Functional RRF. No machineries functioning now.<br>Materials and condition of stacking: Not organized<br>Activities spilling out onto the dumpsite: Yes<br>Access to the MCF (Common access for MCF/RRF & Dumpsite. Both are in the same premises.)<br>No: of workers – 5 in MCF |
| 3 | Facilities | Parking area-NIL<br>Loading/unloading Area-Yes<br>Storage room & area: No<br>Worker snack/rest areas: No, Proposed under KSWMP Year 1<br>Worker / other washrooms & sewerage: Yes<br>Water supply for Cleaning, Washroom: Yes<br>Greenbelt: NIL |

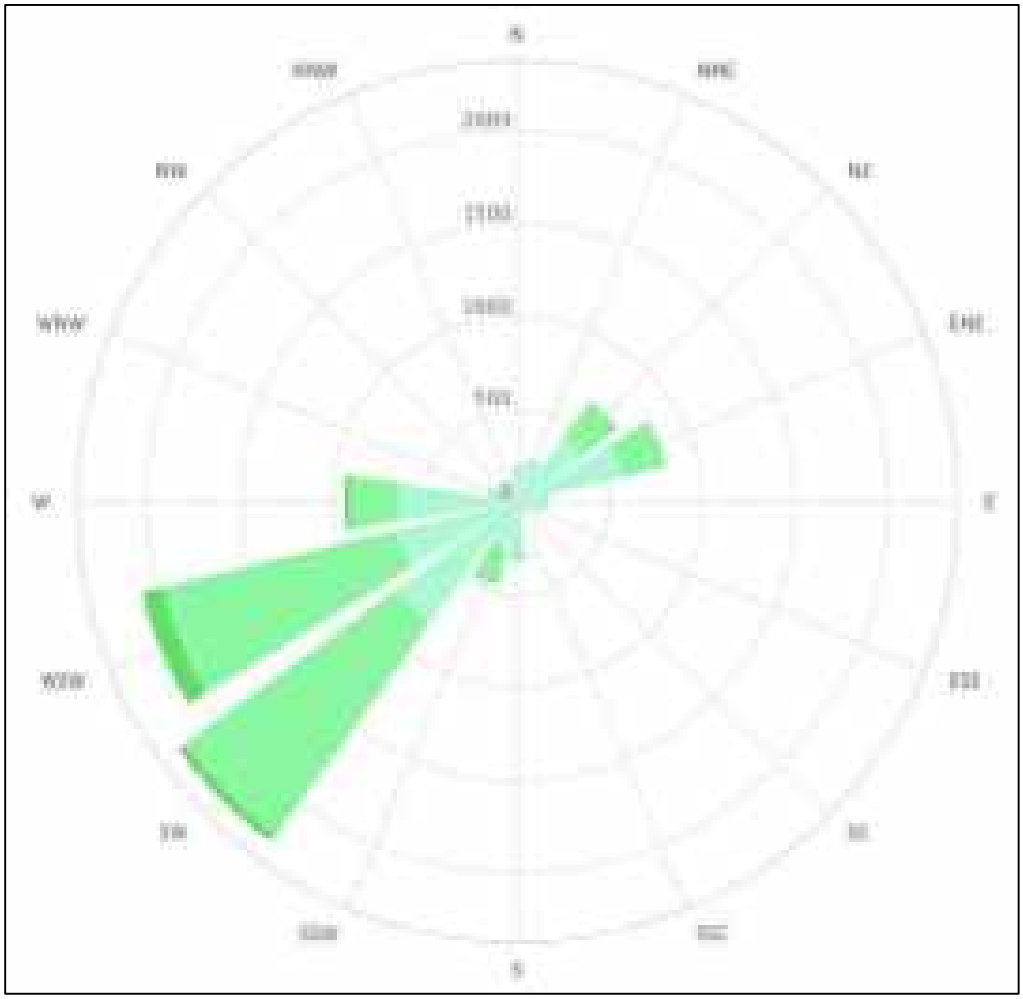
### 3.4 Physiography and Climate

**Physiography**

Physiographically, Kothamangalam falls under midland category with hilly terrain zone.

**Climate**

Kothamangalam has a tropical climate. As per Climate-Data.org, the average annual temperature is 27.8 °C in Kothamangalam. Precipitation here average value of 1051 mm. Most of the precipitation here falls in June-July with an average of 206 mm and lowest in February with an average of 15 mm. So, the favourable time for remediation is between October-2023 to March-2024, non-monsoon period. As per wind rose diagram, the most predominant wind directions are blowing from South West (SW) and West South Western (WSW) direction, hence it was being considered for AAQ monitoring location. The wind rose diagram for Kothamangalam is shown in **Figure: 3.2**.



**Source:** meteoblue

**FIGURE: 3.2 WINDROSE DIAGRAM FOR KOTHAMANGALAM**

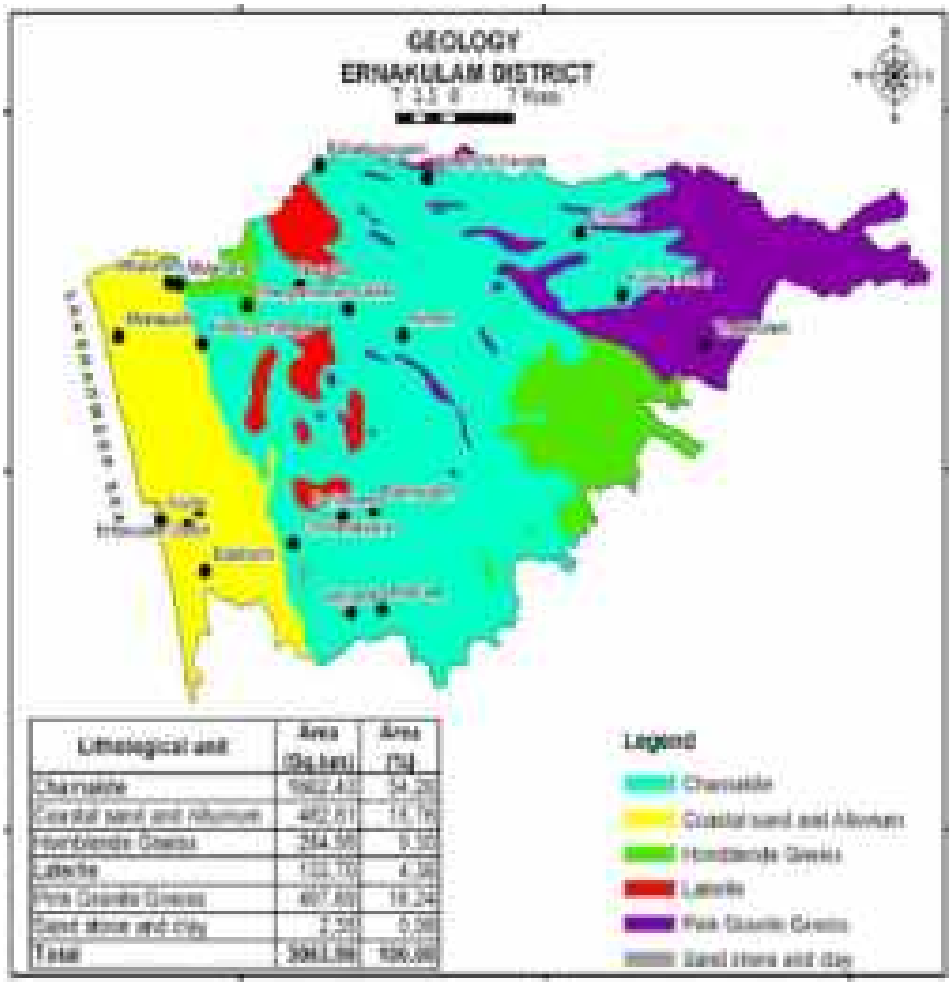
### 3.5 Hydrology, Hydrogeology, and Soil

**Hydrogeology**

The occurrence and movement of groundwater is mainly controlled by factors like physiography, geological setting, etc. As per CGWB, the groundwater table level ranges from 3.5 to 6.5 m below ground level during most of the year 2021-2022.

**Geology**

The geology of Kothamangalam is predominantly of Charnockite group. The geology map of Ernakulum District is shown in **Figure: 3.3.**



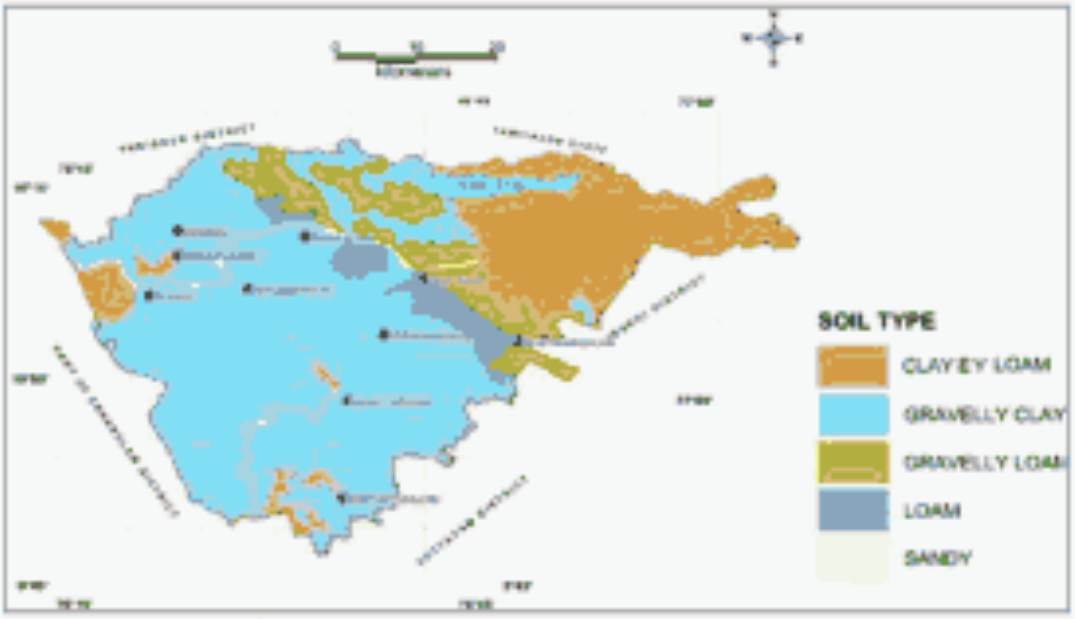

| Lithological unit | Area (Sq.km) | Area (%) |
|---|---|---|
| Charnockite | 1062.43 | 54.26 |
| Coastal sand and Alluvium | 462.61 | 14.76 |
| Hornblende Gneiss | 284.56 | 9.08 |
| Laterite | 133.72 | 4.26 |
| Pink Granite Gneiss | 407.63 | 13.24 |
| Sand stone and clay | 7.50 | 0.39 |
| Total | 3068.84 | 100.00 |

**Source:** CGWB, Ernakulum

**FIGURE: 3.3 GEOLOGICAL MAP OF ERNAKULAM DISTRICT**

**Soils**

As per the geotechnical investigation, the soil was encountered at 3.0 m below the waste dump and the predominant soil is gravelly clay. The detailed geotechnical investigation report is enclosed in the FR. The map showing soil type of Ernakulum is shown in **Figure: 3.4**.




**Source:** CGWB, Ernakulam

FIGURE: 3.4 MAP SHOWING SOIL TYPE OF ERNAKULAM DISTRICT

### 3.6 Land Use & Land Cover

The highest percentage of land use and land cover falls under agricultural mix (67%), residential developments (25%), and water bodies (2.9%), and the remaining areas are under other built up land use. The dumpsite is surrounded predominantly by Dry cultivation and the same will act as odour attenuation during remediation. The land use & land cover map of Ernakulam District is shown in **Figure: 3.5**.




**Source:** CGWB, Ernakulam

FIGURE: 3.5 LANDUSE & LANDCOVER MAP OF ERNAKULAM DISTRICT

### 3.7 Cultural Heritage

The cultural heritage zone near dumpsites is Mar Thoma Cheriyapalli church at a distance of 6.0 Km in SW direction. Hence, no significant physical impact to the heritages sites will be envisaged during remediation.

### 3.8 Ecology and Biodiversity

The wild faunal species present near the dumpsite are, mainly dogs, rodents and flies. Also, crow, egrets, and other birds are seen feeding on the wastes. The flora includes shrubs, tubers, and trees.

### 3.9 Site Connectivity

The nearest connectivity is Malayinkeezhu-Nadukani road at 250 m in the South direction to the dumpsite and access road has a width of 3 m.

### 3.10 Natural Disasters

As per the district disaster management plan-2015 and flood vulnerability map the dumpsite is not under flood prone zone.

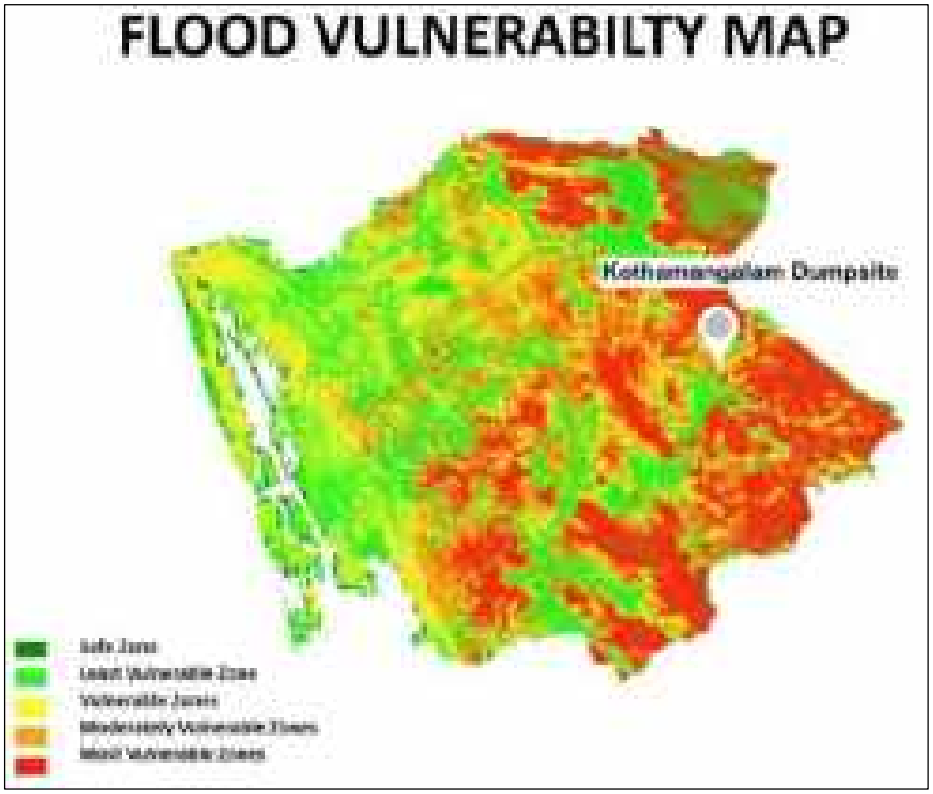



**FIGURE: 3.6 MAP SHOWING FLOOD VULNERABLITY MAP OF ERNAKULAM DISTRICT**

### 3.11 Description of Environmental Parameters

| TABLE- 3.3 DESCRIPTION OF ENVIRONMENTAL BASELINE PARAMETERS | | | |
|---|---|---|---|
| **S No** | **Environmental Aspect** | **Discussion on Baseline Scenario** | **Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject** |
| 1 | Water Source<br>a) Surface water<br>b) Ground Water | A) Surface water: Surface water sampling collected at pond located at 15 m distance in Eastern direction. Surface water sample was collected and the test results showed – all parameters are well within limits except BOD.<br>B) Ground Water collected from 1 location at 330 m distance – all parameters are well within limits except for Coliform. | Site Drainage & leachate Impacts due to bio mining activity (especially during any seasonal rain) is important as far as the nearby soil & water environment are concerned. |
| 1.2 | Leachate | The data indicates that the TDS is about 1885 mg/l, while the suspended solids is about 180 mg/l. The chlorides are 788 mg/l, while the COD, BOD are 320 mg/l and 110 mg/l respectively. The heavy metals are found to be low, hence the soil is unlikely to be contaminated by heavy metals from the waste. | |
| 1.3 | Air Quality | Air samples were collected from 2 locations within the dumpsite and results found to be well within the permissible limits | |
| 1.4 | Noise Level | Noise Level monitoring samples collected at a distance of 15 m from the MCF boundary of the dumpsite. Noise levels are found to be higher than the National Ambient Noise standards for Residential Area limit during both daytime and night time Leq. | Proper remedial measures for increased noise level shall be ensured by the contractor during bio mining activity. |

# CHAPTER 4. ANALYSIS OF ALTERNATIVES

## 4.1 Alternative 1: No Project Alternative (without Dumpsite Remediation)

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevent further contamination of the site.
If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows.
1. Foul Odor Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.
2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.
3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.
4. Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the surrounding environment, disrupting natural habitats and causing long-term ecological imbalances.
5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

## 4.2 Alternative 2: Mode of Execution / Management Alternative

Kothamangalam Municipality intends to complete the remediation project as earlier. However, considering the time required for mobilization, installation, sieving and handling recoverable etc., a time frame of about six months will be considered. The broad timeline chart for the execution of this project is given below Table – 4.1.

**TABLE – 4.1 TIMELINE CHART FOR EXECUTION**

| S. No. | Task Name | M 1 | M 2 | M 3 | M 4 | M 5 | M 6 |
|---|---|---|---|---|---|---|---|
| 1 | Planning & Mobilization | | | | | | |
| 2 | Foundation & Civil Works (Cover Shed installation) for machineries , Hiring & Installation of Machineries, Electrical Works | | | | | | |
| 3 | Excavation of Legacy Waste | | | | | | |
| 4 | Site Development for Windrows & Leachate Collection | | | | | | |
| 5 | Windrow Formation & Spraying of Bio culture | | | | | | |
| 6 | Sieving Operations | | | | | | |
| 7 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | | | | | |
| 8 | Project Closure Activities:<br>• Levelling of Reclaimed Land using Bio-soil<br>• Handover the available infrastructure at site to the ULB<br>• Closure Report Submission to ULB, | | | | | | |
| 9 | Buffer Period (Rainy Season) | | | | | | |

### 4.3 Alternative 3: Technology Alternatives

The selection of the appropriate method or technique for remediation is determined by considering several parameters. These include the significant aspects and suitability of remediation types such as,

1. Capping without land recovery,
2. Bio-mining – reclamation/recovery of 100% land
3. Capping with partial land recovery.

Additionally, factors like available resources such as manpower, machinery, finances, and physical site conditions, including the quantity and characteristics of legacy waste, Environmental baseline, social concerns, regulatory compliance (KSPCB/NGT), the need for complete land recovery, and opportunities for utilization of processed aggregates/by-products are taken into account.

After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

# CHAPTER 5. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

Bio mining and bioremediation of existing legacy dumpsites brings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more man-days at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, bio-mining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration) are important in this case. In addition to the below mentioned,

(i) Drainage and leachate flow into regional waterbodies (& esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies,
(ii) Pollution on land/soil, dust and odour nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks,
(iii) Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and
(iv) Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at this stage, while some would be known only based on the project details that would be known from the work plan of the contactor once on board.

## 5.1 Impact Assessment Methodology

Impacts are assessed based on Magnitude, Duration, and Significance of the impacts and sensitivity of the receptors present within the 200 m aerial distance of Kumbalathumury dumpsite.

### 5.1.1 Magnitude and Duration of Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Bio-mining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;
- The spatial extent of the potential impact;
- Reversibility of the Impact;
- Legal standards and established criteria.
- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table Aspects for Determining the Magnitude of Impacts. Magnitude is assessed as medium, considering shorter duration of the activity. However, magnitude of cumulative impacts of various dumpsite remediation might be High.

| TABLE: 5.1 ASPECTS FOR DETERMINING THE MAGNITUDE OF IMPACTS | | | | |
|---|---|---|---|---|
| **Aspects** | **Large** | **Medium** | **Small** | **Negligible** |
| **Duration of the potential impact** | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or Less than the lifespan of the program | Temporary with no detectable potential impact |
| **Spatial extent of the potential impact** | Regional – much beyond project boundaries | Beyond immediate Program components, site boundaries or local area | Within program boundary (but cumulative impact of various dumpsite bio mining activities will be on larger extent) | A specific location within program component or site boundaries with no detectable potential impact |
| **Reversibility of potential impacts** | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months | Baseline remains constant |
| **Legal standards and established professional criteria** | Against national/approved standards and or international guidelines/obligations | Complies with limits given in national standards but not confirming to international lender guidelines in one or more parameters | Meets minimum national standard limits or international guidelines | Not applicable |
| Likelihood of potential impacts occurring | Commonly occurs under typical operating or construction conditions (Certain) | Usually seen occurring under most situations (Likely) | Occurs under abnormal, exceptional or emergency conditions (Occasional) | Unlikely to occur |

NOTE: Anticipated Project Duration - 5 to 6 months

### 5.1.2 Sensitivity of Receptor

The dumpsite is surrounded by dry cultivation and one residential house. The project site lies near to only one residence within 200-meter radius, during remediation it may cause potential impacts on air, noise, surface water, and ground water that will directly or indirectly affect the family for a duration of 5 to 6 months. The sensitivity of these receptors is Low due to the surrounding dry agriculture land which act as natural barrier against noise and air impacts. In

addition, there is a pond at a distance of 15m from the dumpsite, there is zero chance of runoff and leachate towards the pond during rainy season, due to the natural slope gradient of the landscape. Hence, the sensitivity of this receptor is estimated as Low.

### 5.1.3 Significance of the impact

The significance of the project impact is tabulated below: -

| TABLE: 5.2 SIGNIFICANCE OF THE PROJECT | | | |
|---|---|---|---|
| **Project Details** | **Sensitivity** | **Vulnerability of Resource** | **Importance of Resource** |
| No project Impacts | High | Medium | Medium |
| Project with Bio Remediation (Bio-mining) | Low | Low | Low |

Overall, Bio mining will have a low to medium impact, with more of a positive Impact on the Environment and Human health in the longer term.

**Source-Pathway-Receptor Analysis**

A) Source: The source of contamination is the legacy waste remaining and being deposited at the Kumbalathumury dumpsite, more specifically the landfill gas and leachate get generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. In this case the waste is 43 years old, as dumping had started in year 1980 and currently there is no dumping activity in the site. The total waste volume is 29,906 cu. m with the dumpsite spread over 2.13 acres and the legacy waste is presented about 3.0 m above and 2.5 m below from the existing ground level. In addition to the landfill gas and leachate, windblown dust and litter are also considered as sources of contamination.

B) **Pathways:** The following pathways for migration of contaminants have been identified: Wind- The main pathway for litter and dust dispersion is the wind. As long as the waste is kept uncovered, the dust and litter will continue to be blown off the dumpsite to the surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. Rainwater runoff through the dumpsite acts as a pathway for transport of leachate to the soil and groundwater. The rainwater flowing off the dumpsite along the slope from North Western direction acts as a pathway for the uncovered waste to flow along the boundary to South Eastern side, which runs through the dry agricultural land.

   The leachate flows with groundwater and acts as the pathway. Surface water contaminants like run-off from the dumpsite, leachate and windblown dust and litter that reach nearby surface water bodies like canals and rivers are further transported by surface waters and in this case the surface water acts as the pathway.

**C) Receptors:**

   Receptors are air, surface water and ground water. For drinking purpose, they mainly use municipal water supply at one House within 200 m soil, flora, fauna and humans. In the case, to remediate dumpsite, the most prominent group of receptors are the nearby residences. As the dump is not contaminated by hazardous wastes, remediation would

improve the pollution scenario provided the bio-earth used is pollution free and of good quality. However, other impacts are expected on the final destinations of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF in the region. Depending on the locations of end use of fractions retrieved from bio-mining, the contractor shall assess the impacts on communities and workers on site & nearby; and near locations of end-use. Key impacts may result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after bio-mining activity, activities in bio-mined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post bio mining activity.

**5.2 Impacts on Air Environment**

Key impacts on air include:

- Emission of Methane and other Greenhouse gases; and its impacts on scavengers, workers on site/other facilities on site (MCF in this case), nearby communities of Ward 06.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odour, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.
- When the legacy site is opened, existing gases would get emitted. Further, any delay /unexpected stoppage of bio mining activity, might further aggravate the process of gas formation depending on waste composition, leading to odour and fire risks.

***5.3 Impacts on Water Environment***

**Ground water:**

- The ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. With the slope of the dumpsite, this tends to get accumulated at low-lying gradients and flows into dry agricultural land. Slightly high BOD levels of the drain and ground water wells around are indicative of leachate and runoff pollution. Oozing & pooling of leachate & it draining to nearby areas during rains would be an important aspect to be managed during bio mining to prevent ground water contamination.
- Leachate samples: BOD, COD, TDS exceeding limits may impact the ground water quality in nearby residences, wells, and long term soil pollution.
- Borehole data: Dump below water table may impact water resources and wells nearby.
- Ground beneath the dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. There are no parameters exceeding the permissible limits for heavy metals.

**Surface water:**

- The dumpsite not experienced any flooding during 2018 floods and the site is not vulnerable to flooding. The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas. An abandoned pond is at a distance of 15 m, east direction from the dumpsite.
- Predominant slope is in the South East Direction. At Southeast direction, (end direction) there are dry vegetation. During rainy season leachate from the site flows to dry agricultural land. It is important to contain and treat leachate from the proposed bio

mining activities on site. Treated leachate may be recirculated or used for other purposes.

**5.4 Impact due to Odour**

Dumpsite of organic, or partly organic waste, always results in anaerobic degradation of the waste and consequently, the production of landfill gas, consisting mainly of methane, $H_2S$, Ammonia, and carbon dioxide. If not properly managed the gas can cause odor problems in the neighborhood and since landfill gas is a highly potent greenhouse gas it will also contribute to the increased level of greenhouse gases (GHG) in the atmosphere. Dumpsite gas may also increase the risk of fires or explosions at the landfill site and surroundings.

**5.5 Impact on Noise**

A potential nuisance is a noise from transport of vehicle and machinery operating during remediation phase of the Dumpsite and transports of waste to the Dumpsite. The topography is favorable to attenuate noise to the surroundings. The distance to nearby residential areas is at 10 m with 5 households. Hence, the impact will be higher during remediation to the residents.

**5.6 Impacts on Soil**

- Historic land use assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it shall be excluded from the site as bio mining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.

- Spillover of activities to nearby road and land would result in pollution of all types on these areas. Hence it is important to restrict all activities to the site for legacy waste bio mining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.

- Ground beneath dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. In Kumbalathumury, all heavy- metals are falling within the limit as per Fertilizers Control Order 1985 and its amendments. Kumbalathumury does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste (including legacy asbestos), e-waste or biomedical waste is found while bio mining, same shall be retrieved, transported, treated and disposed as per specific waste guideline of the Central Pollution Control Board, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste), Feb 2019 and World Bank EHS Guidelines. A plan shall be prepared to auditing of all wastes, management, eliminating pollution & OHS risks; and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.

**5.7 Other impacts on Biodiversity - Fauna/Flora**

- There are no sensitive biodiversity areas within 10 km of the site. However, since the project involves transport of wastes, it is important to consider the impact beyond the project boundaries. Within 42 Km, east from the site, there is a Kothamangalam Forest Range.
- Fauna: impacted by direct consumption of the solid wastes, sharps, entanglement, or by consumption of plants and/or animals contaminated by wastes, or as a result of leachate effects on groundwater and surface water.
- Flora: Plants near open dumpsites can be impacted directly by the waste, dust or smoke from burning. Disturbance to vegetation due to machinery, trampling by foot, vehicle or animals, or contamination by waste or leachate, the migration of landfill gas, or as a result of burning or smoke.
- Disturbance to other fauna and flora on site: onsite activities including those related to MCF and RRF may also impact fauna/flora through high noise levels of pre-construction / construction activities.
- Biodiversity of existing site: Available biodiversity of existing site is mentioned in the Environmental Baseline session and there is no key species identified which are listed by IUCN.

**5.8 Other Impacts on existing or proposed activities on site/s**

- There may be approvals from various agencies for bio mining activities and associated facilities; depending on utilities and uses on site & associated activities. These permits shall be obtained prior to initiating activities on site.
- Impacts of bio mining on existing facilities on site such as MCF, RRF etc. (disturbance to activities & people due to dust, leachate, noise, odour; additional load of wastes to these facilities, vibration impacts & structural damage, etc).
- Post bio mining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped, or if this is dumped elsewhere or not processed, it will lead to health and environmental issues. This alternate location, being associated facility need mitigation measures to avoid/minimize pollution, Health & Safety impacts on workers, communities. Also, forward linkages are considered as associated facilities/linked activities. Impacts of transportation of these fractions (traffic increase, odor, leachate, dust), impacts during rains & emergencies, handling, storage at the identified locations, reuse etc. shall be mitigated.

# CHAPTER 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN

## 6.1 Proposed Environmental Management Plan:

The detailed anticipated impacts and corresponding mitigation measures/management of the impacts are given below.

**TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN**

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| ***A*** | **Planning and Pre-Construction Stage** | | | |
| ***1*** | | ***Planning for bio mining facility*** | | |
| 1 | Bio mining & Bioremediation Plan & Capacities | ▪ Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / bio mined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these bio mined material in line with the agreements with such facility owners and National, State regulations and WB EHS<br>▪ Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate Management Plan.<br>▪ The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers.<br>▪ Contractor to get all required licenses & permits before start of any activity on site | Contractor | SPMU/DPMU/ ULB |
| 2 | Site Access Closure | ▪ The total cessation of dumping in the site will be implemented before any works.<br>▪ All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public.<br>▪ The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance to indicate that the waste dump has been closed from the operation.<br>▪ To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br>▪ Grading shall be performed where necessary to provide a neat appearance | ULB or Contractor as per Bidding mechanism | SPMU/DPMU/ ULB |
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – *impact on air quality, odor, water contamination due to* | ▪ Carry out site assessments as per Guidelines for Bio mining of Legacy Waste Dumpsites of CPCB<br>▪ Consider safe bio mining & gas / leachate generation from existing capped portion of the site<br>▪ Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means<br>▪ Provision of appropriate PPE's to the team undertaking the site assessments<br>▪ Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits | TSC, ULB, Contractor | SPMU/DPMU/ ULB |

| | | | | |
|---|---|---|---|---|
| | *leachate, health and safety impacts of the people working in the site assessment* | ▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>▪ Plan for machinery operated which will be operated by skilled operators at all times.<br>▪ Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures.<br>▪ Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | | |
| 4 | Absence / Delay in Permissions for Developing the biomining facility and associated works as per National regulations | ▪ Required permissions for undertaking biomining at the existing dumpsite and assessments conducted for undertaking biomining as per existing Laws, Regulations; including for associated infrastructure, DG Sets, Consent to Establish; and other licenses including those as per Labor Laws, before the start of works on site | Contractor, ULB | SPMU/DPMU/ ULB |
| 5 | Dust impacts due to Site works, screening & stacking of retrieved wastes *(Air Pollution) and Visual Blight due to excavation* | ▪ Plan to Provide temporary high screen, buffers around the site before the start of work to curtail dust emissions<br>▪ Arrange a green belt as early as possible on the area of the site with no / less dump. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers)<br>▪ PPEs to be used by workers<br>▪ Awareness to communities & suggest to use PPEs | Contractor and or ULB depending on agreement on bidding mechanism/DPR | SPMU/DPMU/ ULB |
| 6 | Material sourcing, transport, and stacking of construction materials *(Occupational Health and Safety issues and Air noise pollution)* | ▪ Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism<br>▪ Prior intimation to nearby Primary Health Centre on work activities need for medical support, emergency support needs, type of laborers on-site and labor camp if any<br>▪ Materials shall be sourced only from approved quarries<br>▪ Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions.<br>▪ The driver should be with required license and follow speed regulations<br>▪ Materials shall be transported preferably through well-surfaced roads. If road it kuchcha, water sprinkling shall be done to prevent dust emission before and after truck passes<br>▪ Material transport and unloading activities should not result in noise disturbance to locals and should be during daytime<br>▪ Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors.<br>▪ Provide vehicle wheel wash area on site | Contractor | SPMU/DPMU/ ULB |

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| | | ▪ Workers to be provided with Personnel Protection Equipment (PPE) including safety boots, jackets, ear muffs, gloves.<br>▪ Proper rest area on site shall be provided with water, first aid, toilets | | |
| 7 | The layout of Labour camp *(Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)* | ▪ Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp<br>▪ Nearby health center shall be informed about the labor camp & appropriate medical checkup shall be arranged periodically<br>▪ Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters)<br>▪ It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with landowners wherever the labour is accommodated<br>▪ Camp must not be provided in an area prone to Hazards<br>▪ Camp should be adequately at higher plinth levels to prevent water intrusion<br>▪ Rooms shall be of appropriate sizes with adequate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG)<br>▪ Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female laborers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc.<br>▪ The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security<br>(Refer ECOP section 06 and section 11 of EMF for KSWMP) | Contractor | Site engineer of SPMU, Labour Commissioner, PCB |
| 8 | Nearness/disturbance to sensitive areas such as forests, wildlife habitations, etc. especially in case of providing support facilities *(Impacts on Fauna / Flora)* | ▪ Ensure site selection for any support facilities or activities (such as vehicle storage etc. if no in biomining site) based on the screening checklist and the master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate, Reduce. Obtain requisite permissions from respective authorities such as Pollution Control Board, ULB etc.<br>▪ Identify appropriate government site to avoid land acquisition and resettlement impacts<br>▪ Covered and well-marked storage area with cut off drains & odour/fly/dust/ fire prevention shall be ensured for excavated wastes and washing, segregation of the same are to be arranged with due consideration to nearby residences, slope and other landuses | Contractor | SPMU/DPMU/ ULB |
| 9 | Contamination of groundwater due to leaching. Leachate parameters; BOD, COD, TDS, Ecoli, Heavy metals | ▪ During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant<br>▪ Depending on the contractors plan for biomining of the site, adopt plans to manage leachate | Contractor | SPMU/DPMU/ ULB |

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| | exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution | | | |
| 10 | Impacts on flora, fauna" consumption of wastes, leachate impacts, dust smoke burning, trampling/machinery | ▪ Movement routes of vehicles to be planned to avoid key fauna/flora on site<br>▪ Leachate collection & storage/treatment and recirculation shall be planned to avoid impacts on flora, fauna | | SPMU/DPMU/ ULB |
| 11 | Nuisance hazards to neighboring areas | ▪ Ensure proper design and adequate compound wall; high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements<br>▪ In case of waste mound and site edges are sliding or unsafe; provide engineered retention walls. | Contractor | SPMU/DPMU/ ULB |
| 12 | Treatment & Disposal of wastes and rejects | ▪ Contractor to Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & intert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventorised and quantified, including Bioearth, rejects, inerts. These shall be tested and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertiliser Control Order 1985 and their amendments. Asbestos Management Plan shall be prepared for management if Asbestos wastes retrieved if any<br>▪ Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period. | | |
| ***B*** | **Implementation or Biomining & Bioremediation stage and Construction of ancillary facilities such as access road improvements, compound walls, greenbelts, drainage etc.** | | | |
| **Implementation of biomining of the dumpsite** | | | | |

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| 1 | Impact due to the vehicular movement *(Air and noise environment & Vehiclular - Vehicular & Vehicular - Pedestrian Conflicts)* | ▪ Vehicles and machinery are to be maintained so that emission conforms to National Ambient air quality standards.<br>▪ All vehicles and machinery should obtain Pollution Under Control Certificates<br>▪ HORN PROHIBITION signpost to be erected.<br>▪ Rumble strips/speed breaker to be provided on access roads.<br>▪ Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed.<br>▪ Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle<br>▪ Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements.<br>▪ Avoid heavy vehicle movement through Kumbalathumury road during peak hours 7 a.m to 10 a.m mention: school hrs / peak hrs; and during important period / festivals when people use the road to access temple<br>▪ Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents. | Contractor, ULB | SPMU/DPMU/ ULB |
| 2 | Impact due to the use of heavy vehicle and equipment *(Air and Noise environment)* | ▪ Mixing equipment (in case of construction of ancillary facilities) should be well sealed and be equipped with a dust-removal device.<br>▪ Equipment Operators & labourers should wear dust masks, ear protection, and hard hats.<br>▪ Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load.<br>▪ Labor to be provided masks / PPEs.<br>▪ Construction / Biomining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spkreading into neighboring sensitive land uses<br>▪ Noise standards at operation machines are to be strictly monitored to prevent exceeding of GOI noise standards.<br>  ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines.<br>  ▪ Using modern, well-maintained and regularly serviced vehicles.<br>  ▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>  ▪ Provision of earmuffs and ear protection to workers and employees in high noise areas.<br>▪ Workers in the vicinity of strong noise to wear protectors and their working time should be limited as a safety measure.<br>▪ As Kothamangalam dumpsite has sensitive receptors and settlement areas within 200m of it, noisy works shall be stopped from 22:00 to 06:00.<br>▪ Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum. | Contractor | SPMU/DPMU/ ULB |

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| | | ▪ Avoid noisy activities/machines near South side of the site where settlement exist within 50m. Noise barrier shall be provided at all noise-sensitive locations / for noise generating equipment such as DG sets, mixers (for ancillary facilities) especially near South side of the dumpsite<br>▪ Adopt required measures as per CPCB guidelines, and site & work specific safety requirements | | |
| 3 | Impact during the construction activities<br>*(water environment)* | ▪ Labour camps if any (depending on Contractors work plan & arrangements) are to be located away from water bodies.<br>▪ Vehicle washing or maintenance near water bodies are to be avoided.<br>▪ Contaminated water from construction / biomining activities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated on site. | Contractor | SPMU/DPMU/ ULB |
| 4 | Leachate and Runoff from biomining activities<br>*(Soil contamination and groundwater contamination)* | ▪ Provide site cut off drain around the site to divert off stormwater from entering the site, and to prevent contaminating downstream resources with run off from the dumpsite<br>▪ Depending on the contractors plan for biomining of the capped area on site, implement leachate management to cause no harm to communities & environment<br>▪ Ensure stormwater drains will lead to drain outlets<br>▪ Provide leachate drains lined from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area<br>▪ Provide proper treatment of leachate and stormwater that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by biomining activities like excavation and waste segregation and stabilization<br>▪ The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB.<br>▪ The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata<br>▪ Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff and hence reduce infiltration<br>▪ Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism<br>▪ Plan the works on-site only during non-rainy seasons and to complete the works before rains<br>▪ Store leachate preferably in aboveground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide for emergency containment additionally | Contractor | SPMU/DPMU/ ULB |

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| 5 | Soil decontamination from accumulated waste levels *(Impact on leachate, odor)* | ▪ Decontaminate the soil / stabilized layers remaining after sieving out wastes using windrow and bioculture of appropriate quality in line with standards / regulations or appropriate means as per CPCB Guidelines<br>▪ Vegetative layer using contaminant absorptive root varieties like Vetiver may be tried on soil and along the edge of the green belt or floating wetlands may be deployed in water channels nearby to maximize absorption of leachate in the soil by root-zone phytoremediation<br>▪ Soil and water testing shall be done and changes in contamination shall be noted. | Contractor | SPMU/DPMU/ ULB |
| 6 | Excavation of waste from the waste mound *(Health and safety impacts)* | ▪ The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound.<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided<br>▪ Machinery operated for excavation should be operated by skilled operators at all times.<br>▪ Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on wastes.<br>▪ Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound<br>▪ In case of the waste mound and site edges are sliding or unsafe; provide engineered retention walls or string boundaries.<br>▪ When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection & treatment mechanism. | Contractor | SPMU/DPMU/ ULB |
| 7 | Transportation of wastes or retrieved or other material in overloaded and open vehicles *(Air, Odour nuisances; spills and littering impacts on Air, Water, Land)* | ▪ All vehicles shall carry only approved load of weight<br>▪ Regular cleaning of roads & drains and removal of spills if any.<br>▪ All waste transport vehicles shall be covered and movement shall be during non-peak hours.<br>▪ Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities.<br>▪ Adopt required measures as per CPCB guidelines, and site specific safety requirements. | Contractor | SPMU/DPMU/ ULB |
| 8 | Occupational health and safety impacts of the workers during the biomining & construction of support facilities: | ▪ Avoid direct & double handling of wastes through avoidance measures(suitable planning & equipments), engineering controls & use PPEs<br>▪ Work area & Labour camps shall be provided with First Aid and other related activities.<br>▪ Emergency Preparedness plans shall be prepared and implemented for all manpower working centers and its field extension centers.<br>▪ An Environment Health & Safety policy shall be prepared and implemented<br>▪ Adequate manpower shall be provided & manager & staff shall listen and act upon the manpower related | Contractor, ULB | SPMU/DPMU/ ULB |

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| | • Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage of chemicals/other materials, biocultures or wastes etc; by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | grievances.<br>▪ Workers will be provided with PPE such as face mask, gloves, shoes, nose masks & goggles<br>▪ Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed without slip, trip, fall especially on waste, leachate or trenches<br>▪ Proper training will be provided regarding the maintenance of health<br>▪ Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks & water supply), food, and water in a hygienic environment (with proper handwash). Provide clean eating areas where workers are not exposed to contaminated, hazardous or noxious substances.<br>▪ First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus<br>▪ Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health checkups. Arrange daily health checkup for workers working on waste heaps<br>▪ Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals.<br>▪ Measures such as deferred timings and stretch break to be adopted<br>▪ Secure all installations from unauthorized intrusion and accident risks;<br>▪ Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every days start of works / activities. Key hazards would be (but not limited to) are flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and leachate from existing capped area on site, electric shocks, works with heavy machines & equipments, slips of men & material (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc.<br>▪ EHS specialist with adequate experience & third party supervision are important for biomining activity<br>▪ Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites<br>▪ Provide visitor orientation if visitors to the site need to gain access to areas where hazardous conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible<br>▪ Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; | | |

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| | | ▪ Ensure moving equipment is outfitted with audible back -up alarms & flag men with whistles or speakers;<br>▪ Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit.<br>▪ Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenance to be marked well & safe kept before activity start near thoseIn close proximity to this location, there is a transformer. Disallow worker exposure to noise level greater than 85 dBA for more than 8 hours a day without hearing protection<br>▪ All workers shall be registered as per prevalent labor laws (including a workforce of subcontractors) and provided insurance cover & others as per existing acts/laws<br>▪ Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractors person/insurance agent<br>▪ While using heavy machinery like JCB, cranes, etc, inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle.<br>▪ While using heavy machinery like JCB, cranes, etc, inform communities to prevent children and others from going near operating / movement areas including roads.<br>▪ Flagmen shall be arranged if work is near schools, hospitals, major roads, and traffic control is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if possible<br>▪ A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs;<br>▪ No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor<br>▪ All works related to working at heights will be undertaken only during the daytime when sufficient sunlight is available;<br>▪ Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done;<br>▪ All excavation activities to be conducted in supervision of the site contractor;<br>▪ Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured.<br>▪ All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans prepared and implemented, as per Banks Incident Reporting Tool | | |
| 9 | Risk of fire due to conditions leading to spontaneous combustion | ▪ Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for Implementation of SWM Rules 2016 – Fire Incidents at MSW Dumpsites (https://cpcb.nic.in/openpdffile.php?id=UHVibGljYXRpb25GaWxlLzQyNDRfMTY1NDE2Mzk3N19tZWRpYXBob3RvNzYxMi5wZGY= ), LSGD Kerala Government GO on Fire Safety of MRF, MCFs (for the MRF on site if | Contractor, ULB | SPMU/DPMU |

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| | *(Air environment, disturbance to communities and workers, health impacts, safety issues)* | used for storage of wastes)and other Regulations, guidelines applicable<br>▪ Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3; and National/State regulations & WB EHS<br>▪ Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes<br>▪ Avoid conditions that can lead to spontaneous combustion such as:<br>o Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard<br>o Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.<br>▪ Design the facility for access by firefighting equipment, including clear aisles among waste heaps or work areas and access to adequate water supply.<br>▪ Ensure workers are briefed of fire hazard & its management<br>▪ No unauthorized entry shall be permitted to the site; including of workers during holidays, nighttime, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating "trespassers not allowed"<br>▪ The following activities should be implemented to prevent fires from occurring at the facility<br>o adequate fire-fighting equipment should be made available on-site and stored in an accessible manner,<br>o all operating staff should be trained and able to manage fire outbreaks at any part of the facility.<br>o clear signage should be established to inform workers and the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area.<br>o Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows.<br>o all fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the biomining, storage, and processing areas.<br>o all flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating stormwater.<br>▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the biomining activity in line with National State regulations, guidelines and international good practices<br>▪ Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.<br>▪ Contain all local smokes/small fires inside the dump asap. Fire brigade help shall be sought on all smokes/fires outside the dump<br>▪ Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured. | | |

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| | | ▪ Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers | | |
| 10 | Construction of new facilities in retrieved land | ▪ The excavated site shall be protected from any dumping during or after the biomining activity and shall be reserved for SWM activities in line with SWM Rules 2016<br>▪ Any new facility under KSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations | ULB | SPMU/DPMU |
| 11 | Pest / Vermin Control & Visual impacts (Odour, flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center<br>▪ Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups<br>▪ Bio pesticides / biological control shall be followed. However, biopesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used<br>▪ Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate management | Contractor, ULB | DPMU, SPMU |
| 12 | Odour nuisance | ▪ Waste with a strong odor to be covered immediately they are emptied from vehicles.<br>▪ Control and manage leachate treatment to minimize odor.<br>▪ Provide buffers screens to curtail odor from reaching surrounding communities especially to North side of site.<br>▪ Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor. | Contractor, ULB | DPMU, SPMU |
| 13 | Storage, Collection, Transport, Treatment & Disposal of wastes and rejects | ▪ Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste<br>▪ Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters<br>▪ Waste handling shall be inline with existing regulations & guidelines & avoid health & safety impacts<br>▪ No material is allowed to remain on site after the contract period<br>▪ Adequate fire safety arrangements & awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported<br>▪ Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/inerts in designated or agreed area & are in line with schedule; using GPS.<br>▪ Given that the access road is used by the public, it is imperative to implement the required safety precautions and environmental protection measures when transporting the waste. | Contractor, ULB | DPMU, SPMU |

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| 14 | Other activities | ▪ No activity other than biomining shall take place on site & any activity shall cause no adverse impacts on the environment or people<br>▪ If existing MCF shall be used for storing biomining wastes, its safety shall be ensured in terms of fire & structural safety before starting to use the facility. Further usage of the MCF after biomining works shall be after proper cleaning / washing & disposal of all rejects/inerts & tools to ensure good housekeeping & no H&S impacts<br>▪ If existing MCF shall be used by the ULB for storing dry wastes from Town, during biomining period, alternate access shall be arranged & workers shall be adequately protected against any health & safety impacts | | |
| 15 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & biomining / construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees<br>▪ Waste water and Leachate to be treated & recycled/reused | Contractor | ULB |
| **C** | **Future Site Usage (EMP shall be updated in line with EMF & used if future site usage is proposed under KSWMP). This section is not the responsibility of the Contractor for Biomining, but of the future facility operator & ULB** | | | |
| 1 | Future use of the biomined site: Green Park, MCF, MRF, RRF, Treatment plants, landfill cell or any other, preferably for SWM | ▪ ULB to ensure that the site will not be used for future dumping.<br>▪ Activities at existing MCF to be upgraded to ensure that no waste (even dry wastes) gets dumped around.<br>▪ ULB shall plan the future use of the site shall be in consultation with the communities.<br>▪ Phase 1 Environmental Assessment to be caried out, EA for existing facilities & EIA for proposed development in line with EMF in case this is proposed to be developed under KSWMP<br>▪ All applicable clearances, permits shall be arranged in line with applicable regulations for the proposed new use of the site, and appropriate designs/plans to be prepared & implemented | Future Facility Developer/ Operator & ULB | ULB (SPMU in case it is under KSWMP) |
| 2 | Vehicle movement for new activities: MCF/MRF, RRFs, Treatment plants, landfill cell<br><br>*(Air, water environment, a nuisance to biodibersity, communities, Health impacts)* | ▪ The movement route shall be scheduled for each vehicle.<br>▪ Enforce speed limits applicable and make drivers aware of this<br>▪ Vehicles movement shall be tracked by Health Supervisors to ensure keeping up to schedule; preferably using GPS<br>▪ Any adulterated fuel shall be avoided. There shall be periodic emission tests for vehicles<br>▪ Provision of Personal Protective Equipment such as face mask, gloves, nose masks & goggles to all workers in C&T vehicles, Maintenance yards<br>▪ Proper lubrication shall be provided to minimize squeaking noise due to friction<br>▪ Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br>▪ The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public<br>▪ Traffic will be managed at the site by providing adequate space for parking of vehicles<br>▪ Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design<br>▪ No waste or material shall be disposed in any place other than the designated area; including water | Future Facility operator | ULB |

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| | | bodies, coasts/forests, or sensitive areas. | | |
| 3 | Exhaust emissions *(Air impacts)* | ▪ No idling of vehicles on site.<br>▪ Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed | Future Facility operator | ULB |
| 4 | Plying of vehicles through kutcha / unsurfaced roads and idling *(Air pollution: SPM, CO, CO2)* | ▪ Vehicle movement shall be well planned – through topped roads. In case of necessity to move through Kutcha roads, ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Future Facility operator | ULB |
| 5 | Impact on the ambient noise quality during the operations *(Noise, nuisance to sensitive receptors, health impacts)* | ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines;<br>▪ Using modern, well-maintained and regularly serviced vehicles;<br>▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>▪ Provision of earmuffs and ear protection to workers and employees in high noise areas | Future Facility operator | ULB |
| 6 | Occupational health and safety impacts of the workers:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust | ▪ All OHS and CHS measures to be followed in line with applicable regulations, guidance<br>▪ Workers & communities shall be made aware of OHS, CHS risks and impacts & mitigation measures adopted<br>▪ Emergency management plan to be prepared & followed<br>▪ Workers shall be appropriately trained or OHS during construction & Operation of all future facilities | Future Facility operator | ULB |

| | | | | |
|---|---|---|---|---|
| | *(Air environment, Health impacts)* | | | |
| 7 | Pest / Vermin Control (Odour, flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted<br>▪ Biopesticides / biological control shall be followed.<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used | Future Facility operator | ULB |
| 8 | Fire Safety | ▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented in line with National State regulations, guidelines and international good practices | Future Facility Operator | ULB |
| 9 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees<br>▪ Waste water to be treated & recycled/reused | Future Facility Operator | ULB |

### 6.1.1 Disposal phase of By-products from Bio-mining process

The bio-earth and coarse fraction soil recovered from dumpsite will be used for filling low lying areas. The RDF material recovered from dumpsite will be transported to nearby cement factory and recyclable material will be handed over to the authorized recycling agency. If the by-products are not removed from the site within a three-month period, penalties will be imposed on the contractor.

## 6.2 Disaster Management and Emergency Preparedness

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care, and other necessities of life. In the case of Dumpsite remediation, Disaster Management Plan is aimed to ensure the safety of life, protection of the Environment, protection of installation, restoration of the remediation process, and salvage operations in this order of priorities.

For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel training is to be provided through rehearsals/drills. The disaster management Plan consists of Onsite Emergency Plan and an offsite Site Emergency plan, which is outlined here for Emergency Preparedness.

**TABLE: 6.2 LIST OF EMERGENCY HELPLINE SERVICES**

| Sl. No. | Emergency Services | Distance from the dumpsite |
|---|---|---|
| 1 | Kothamangalam Police Station | 3.5 Km |
| 2 | Kothamangalam Fire and Rescue Station | 5.0 Km |
| 3 | Taluk Hospital | 4.5 Km |

### 6.2.1 Approach to Disaster Management Plan (DMP)

The objective and approach of the Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effect the rescue and medical treatment of casualties;
- Safeguard other people;
- Minimize damage to property and the environment;
- Initially contain and ultimately bring the incident under control;
- Identify any dead;
- Provide for the needs of relatives;
- Provide authoritative information to the news media;
- Secure the safe rehabilitation of the affected area;
- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency.

In effect, it is to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy. Disaster Management Plan should include Emergency Preparedness Plan, Emergency Response Team, Emergency Communication, Emergency Responsibilities, Emergency Facilities, and Emergency Actions.

#### 6.2.1.1 Identified Emergency Situations

Major disasters which can affect the remediation process are as follows:

- Floods due to heavy rainfall
- Fire risk in summer
- Occupational and health risks during the remediation process
- Safety-related accidents during the remediation process

#### 6.2.1.2 Proposed Organizational Structure for Disaster Management Plan

**Response team:** Setup an Emergency Organization. Emergency Organization includes the senior executive (head of EO as a Site controller), Manager Safety (Incident controller), Shift in charge, and Emergency Coordinators.

- All Incident control would be reported to the Site Controller. Each Incident Controller organizes a team responsible for controlling the incident with the personnel under his control.
- **Shift In-charge** would be the reporting officer, who would bring the incident to the notice of the Incidence Controller and Site Controller.
- **Emergency Coordinators** would be appointed who would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential and support services. For this purpose, security in-charge, personnel department, essential services personnel would be engaged. All these personnel would be designated as key personnel.
- In each shift, the electrical supervisor, in charge, and other maintenance staff would be drafted for emergency operations. In the event of power or communication system failure, some of the staff members in the office/facility would be drafted and their services would be utilized as messengers for quick passing of communications. All these personnel would be declared as essential personnel.

### 6.3 Proposed Monitoring Plan

The proposed monitoring plan is presented in table below,

**TABLE -6.3 PROPOSED MONITORING PLAN AND FREQUENCY**

| Monitoring media/parameters | Items and parameters | Frequency | Location |
|---|---|---|---|
| Ambient Air Quality | PM10, PM2.5, NOx, CH4, CO, Ammonia | Quarterly (1 sample) | 2 point |
| Noise | Leq Day and Night | Monthly | 2 point |
| Health safety Hazards | Medical records, documentation of injuries and accidents, Health and safety assessments | As and when accident/injury occurs | Incident reports |
| Leachate | • pH<br>• Biological Oxygen Demand- BOD<br>• Chemical Oxygen Demand-COD<br>• Nitrogen (Ammonia, Nitrate, Nitrite)<br>• Oxidation-Reduction Potential- ORP<br>• Electrical Conductivity-EC<br>• Total Organic Carbon (TOC) Dioxins<br>• Heavy metals (As per SWM rules 2016 Schedule B) | Quarterly | 2 point |

| | | | |
|---|---|---|---|
| Groundwater quality | Parameters will be defined and sampling, preservation, and analysis of water will be carried out following those stipulated in the subsections below and Standards Methods for Testing Water and wastewater, 21st edition, published by American Public Health Association (2005). | Quarterly | 8 points |
| Surface water quality | | Quarterly | 6 points. 2 upstream and 4 downstream |

### 6.4 Estimated Budget for Implementation and Supervision of EMP & SMP

The estimated capital cost of [redacted] is required for budget provision for implementation and supervision of EMP. The remediation will be only during shorter time duration and hence the recurring cost won't be incurred. The estimated cost particulars for EMP is mentioned below.

**TABLE -6.4 ESTIMATED BUDGET FOR EMP**

| Particulars | Capital Cost (In Lakhs) |
|---|---|
| Dust Mitigation Measures including site barricading, water sprinkling and Wheel Washing, Leachate Management | [redacted] |
| Mobile Toilet, Pest Control, Disinfectant | [redacted] |
| Medical cum First Aid facility | [redacted] |
| PPE for workers & welfare, Fire Fighting Equipment | [redacted] |
| Monitoring / testing (air, noise, water, soil, leachate) | [redacted] |
| **Total** | [redacted] |

# CHAPTER 7 INSTITUTIONAL ARRANGEMENTS

## 7.1 Proposed Institutional Arrangements

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of ToR for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation. The Support Organisation will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments. Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level. The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances. The PIU will submit the compliance reports on clearances, permits, and environmental and social safeguards to D-ESDU.

## 7.2 Capacity Building

- Sensitize and orient different stakeholders of the project with adequate communication of benchmark standards on various project components. Ensure up gradation of awareness generation at different levels. Special focus: Health Hygiene and sanitation Sub Activity
- Training program for HKS (Health & Hygiene, source level waste segregation and source level treatment, Fire and Safety)
- Training program for ULB Councilors and Ward convener (Proposed SWM project plan of KSWMP)
- Training program for Political and trade union leaders (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for Residence Association leaders (Health, Hygiene different composting methods and source level waste segregation, littering of waste, Public Health, Fire and Safety)
- Training program for workers of Municipal Sanitary workers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for school / college students (Health, Hygiene and source level waste segregation, Fire and Safety)

- Training program for ULB officials (Proposed SWM project plan of KSWMP, proposed policies, existing policies etc... to improve the existing pattern into zero waste concept of the municipality)
- Training program for School children, Parents and Teachers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Massive awareness campaign on 5R (Reuse, Recycle, Repurpose, Reduce and Refuse)

**Importance of Capacity Building**

Capacity building is defined as the "process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in the fast- changing world. It is the development of knowledge, skills and attitudes in individuals and groups of people relevant in the design, development and maintenance of institutional and operational infrastructures and processes that are locally meaningful. It is generally defined 'capacity building' as the creation of an enabling environment with appropriate policy and legal frameworks, institutional development, including community participation, human resources development and strengthening of managerial systems. It is a long-term, continuing process, in which all stakeholders participate. The main aim of capacity building under solid waste management is to build a basic understanding regarding the solid waste management project at each step of value chain (waste generation, segregation & storage at source, primary collection, secondary collection, transportation, processing and disposal) and importance of their work and develop a sense of belonging towards the work.

## 7.3 Grievance Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizen can lodge complaint either directly to ULBs, toll free number or through digital platforms (website/email – grmkswmp@gmail.com / Toll free number-18004250238). The complaint will automatically be recorded in login of ward level official of ULB and an escalation system is constituted according to the category of each complaint to close the complaint in time. The complainer can close the complaint through a feedback form according to their satisfaction.

# ANNEXURE –I

**Environmental Screening Form**

**INITIAL ENVIRONMENTAL EXAMINATION**

Environmental Screening during the Initial Environmental Assessment Stage has been provided below:

**Subproject Details**

| | |
|---|---|
| **Name of Subproject:** | Kothamangalam Solid Waste Dumpsite Remediation by Bio mining |
| **Subproject Components:** | Dumpsite Remediation using bio-mining approach |
| **Subproject Location (City / Town/ Village with ward numbers):** | Kumbalathumury, Ward 06, Kothamangalam Municipality |

**Stage 1: Exclusion List**

**Is the Project Excluded from Consideration due to the following:**

| ***Sl.No:*** | ***Non-permissible Activities*** |
|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i) any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides |

*This dumpsite remediation project involves 1. (i) no construction in demarcated Forest areas or protected areas or their buffers, (ii) no construction of landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) no treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). 2. NO activities which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas, 3. No activities with (i) any impact on or due to Dams or embankments (ii) and project will not purchase, store and use Banned Pesticides.*

*Hence, not excluded.*

*Proceeding to Stage 2 Screening*

**Stage 2: Environmental Screening Checklist**

| Project Details | | |
|---|---|---|
| **Sl. No** | **Components** | **Details** |
| 1 | Project components | Kothamangalam Solid Waste Dumpsite Remediation by Bio mining |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste management, centralized non-biodegradable waste management facilities, centralized biodegradable waste management facilities, sanitary landfills, bio mining of dumpsites, including for Linked activities / associated facilities) | Bioremediation of Kothamangalam Dumpsite: -<br>A total station survey and geo technical survey was conducted to determine the quantity of legacy waste, revealing a total of 29,906 cubic meters. |
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project; including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination)<br>Site Survey No:/s (attach map) with ownership details, Geographical co-ordinates of the site location [including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | **Location:** Kumbalathumury, Malayinkeezhu Ward 06, Kothamangalam Municipality<br>**Survey Number:** (959/1M2-2-2 and 1005/4A)<br>**Ownership–**Kothamangalam Municipality<br>**Land use –** Solid Waste Management Facility<br>**Geographical Coordinates:**<br>Latitude: 10.078930° N<br>Longitude: 76.647811° E<br>**Earthquake zone**: III<br>**Cyclone:** Moderate<br>Dump Sites have been in existence since 1980s. |
| 4 | Land Area proposed to be used: Location wise (in sq. km / sq.m) | Current total land area of 2.13 acres will be fully remediated through bio-mining. |
| 5 | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | For domestic usage 2 KLD will be met from private supplier. |
| 6 | Power Required and Source of Power | No DG set requirement for this sub-project. Electricity connection is available within the site. Source: KSEB |

***Baseline Environmental Conditions***

| ***Sl. No*** | ***Environmental Aspects*** | ***Yes*** | ***No*** | ***Details (include distance in Km, info on its importance)*** |
|---|---|---|---|---|
| 1 | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers) | | | |
| *(i)* | Critically Vulnerable Coastal Areas (CVCAs), Eco-sensitive Areas (ESAs) | | ✓ | No Critically Vulnerable Coastal Areas and Eco sensitive Areas in the study area |
| *(ii)* | Cultural Heritage site, Protected monuments - listed by ASI/State | ✓ | | Mar Thoma Cheriyapalli church at a distance of 6.0 Km in SW direction. |

| | | | | |
|---|---|---|---|---|
| *(iii)* | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensitive area, with any schedule 1 species? If Yes, which is the area? | | ✓ | No Eco-Sensitive Areas in the study area. |
| *(iv)* | Other Wetlands/ Mangrove/ Estuarine Region | | ✓ | There is no Wetlands/ Mangrove/ Estuarine Region in the study area |
| *(v)* | Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves | | ✓ | There is no Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves in the study area |
| *(vi)* | Other Sensitive Environmental Components listed in EMF | | ✓ | There is no other Sensitive Environmental Components in the study area as listed in EMF |
| *(vii)* | Drinking water source, upstream and downstream uses of rivers, etc. | | ✓ | A pond adjacent to the dumpsite. |
| *(viii)* | Low-lying areas/areas of Tidal Influence (provide CRZ details) | | ✓ | The location is not in a low lying area and not in a CRZ region. |
| *(ix)* | Sensitive Receptors – a) Habitations / Households / Hostels, other special areas, etc. b) School c) Religious Places d) Tourist Areas | ✓ | | There is only one house at 200 metres from the site. |
| *2* | Is the site in Critical / Overexploited GroundWater Block. Provide the level of the groundwater table | | ✓ | The site is not in a critical/over exploited block. |
| *3* | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other (specify) | ✓ | | Yes, the site is vulnerable to fire. The site has a history of Fire accidents in the year 2019 and 2022.<br>Bio-mining will be carried out by considering the fire control and safety measures. |
| *4* | Describe the type of soil and vegetation on site | ✓ | | Gravelly Clayey soil is the most predominant soil type, presence of vegetation is (shrubs) |
| *5* | Is the site present in the flood plains as recorded in the last 100 years? Provide the HFL level of the site/region | | ✓ | Site is not located in a flood prone area. |
| *6* | Existing pollution/contamination or degradation on site | ✓ | | Dump Sites have been in existence since 1980. |
| *7* | Any other remark on baseline condition | | ✓ | Based on the baseline data the AAQ, surface and groundwater, noise analysis indicates that the respective results are well within permissible limits. |

***Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology, and Soils***

| *Sl. No* | *Impacts on Land / Soil Environment* | *Yes* | *No* | *Remarks* |
|---|---|---|---|---|
| *8* | Total extend of land to be covered/built | ✓ | | The existing dumpsite area of 2.13 acres will be remediated by bio-mining. |
| *9* | Total extend of land where the waste will be dumped openly / or expected to get contaminated by waste or leachate/material storage | | ✓ | The existing dumpsite area of 2.13 acres will be remediated by bio-mining. |
| *10* | Extend of Land to be remediated | ✓ | | The existing dumpsite area of 2.13 acres will be remediated by bio-mining. |
| *11* | Extend of land expected to be under green belt | | ✓ | Currently the dumpsite has no greenbelt. The Area of 2.13 acres will be fully remediated and utilized for further use by ULB. |
| *12* | Will the proposed project cause the following on Land / Soil: | | | After bio-mining the land will be remediated and will have a positive impact on the land and soil. |
| *(i)* | Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains | | ✓ | No Impact on Surrounding Environmental Conditions due to the proposed sub-project. |
| *(ii)* | Substantial removal of Top Soil (mention area in sq.m) | ✓ | | The dumpsite has legacy wastes of 3.0 m below ground level and 2.5 m above ground level. However, the legacy waste combined with soil will be remediated till the depth of 3.0 m below ground level. |
| *(iii)* | Any degradation of land / eco-systems expected due to the project? | | ✓ | No land use change or ecosystem change due to implementation of this project since the land will be reclaimed. |
| *(iv)* | Loss or impacts on Cultural/heritage areas/properties | | ✓ | No impacts or loss of cultural/ heritage areas/properties due the implementation of the project |
| *(v)* | Does the project activity involve cutting and filling/ blasting etc.? | | ✓ | The project activity does not involve any cutting, filling or blasting. The bio-mining sub-project involves only excavation of wastes which is to be remediated. |
| *(vi)* | Will the project cause physical changes in the project area (e.g., changes to the topography) due to excavation, earthwork, or any other activity? | ✓ | | Waste is about 3.0 m below Ground Level which is to be excavated and remediated. So there is a change in topography. |
| *(vii)* | Will the project involve any quarrying/ mining etc.? | | ✓ | The project does not involve quarrying/ mining |
| *(viii)* | Will the project / any of its components contaminate or pollute the Land? | | ✓ | The existing dumpsite will be remediated and utilized for further use, henceforth there won't be any contamination to the land. |

| | | | | |
|---|---|---|---|---|
| *(ix)* | Will the project contribute to any long term significant adverse (negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | ✓ | Due to the proposed bioremediation, the site will be remediated and biodiversity of the surroundings will be enhanced and it will have a positive impact in the longer term. |
| *(x)* | Will the Project or related activities cause negative impacts on the land in combination with other anticipated / existing projects in the region? | | ✓ | The proposed subproject involves only remediation through bio-mining. Hence no negative impact to the land. |

| ***Sl. No*** | ***Impacts on Air and Noise Environment*** | ***Yes*** | ***No*** | ***Details/Remarks*** |
|---|---|---|---|---|
| *13* | Will the project cause or increase air pollution due to dust and / or vehicle emissions? | ✓ | | The process of bioremediation may cause dust emission from process and vehicle movement which shall be managed by effective mitigative measures |
| *14* | Will the project cause or increase pollution due to GHG emissions? | ✓ | | Chances of GHG emissions due to un-stabilized waste. |
| *15* | Will the project cause or increase odor nuisance? | ✓ | | The process of bioremediation may cause odour during remediation for the shorter time duration, which shall be managed by effective mitigative measures |
| *16* | Is there a potential for release of toxic gases or accident risks (eg: potential fire outbreaks) | ✓ | | Chances of toxic gases release during excavation of legacy wastes. |
| *17* | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | | ✓ | Project activity stage (during the process of bioremediation, the noise may arise due to vehicular movements & working of machineries). The proposed mitigation measures will ensure the ambient noise within the permissible limits. The duration of work will be 8 hours/day. |

| ***Sl. No*** | ***Impacts on Water Environment*** | ***Yes*** | ***No*** | ***Details/Remarks*** |
|---|---|---|---|---|
| *18* | Will the activities proposed at the site(s) impact water quality (surface or ground) – leachate, runoff, wastes deposition, erosion? | | ✓ | The proposed remediation will only enhance the groundwater/surface water quality in the long term. |
| *19* | Will the activities proposed at the site(s) impact water resource availability and use - leachate, runoff, wastes deposition, erosion? | | ✓ | The proposed remediation will only enhance the groundwater/surface water quality in the long term. |
| *20* | Chances of Pollution of Water bodies/groundwater wells, nearby or downstream | | ✓ | The proposed remediation will only enhance the groundwater/surface water quality in the long term. |

| | | | | |
|---|---|---|---|---|
| *21* | Will the activities proposed at the site(s) hinder natural drainage | | ✓ | No, the proposed remediation activity does not hinder natural drainage. |
| *22* | Will the activities proposed at the site(s) decrease permeability/rainwater percolation | | ✓ | The proposed remediation will clear the legacy wastes and the land will be remediated. After remediation the permeability/rainwater percolation of the soil will be increased. |

| ***Sl. No*** | ***Impacts on Biodiversity and Host Communities*** | ***Yes*** | ***No*** | ***Details/Remarks*** |
|---|---|---|---|---|
| *23* | Will the project necessitates cutting of Trees / Loss of Vegetation | | ✓ | Cutting of trees is not required for the proposed remediation activity. |
| *24* | Will the project necessitate substantial removal of Top Soil (mention area in sq.m) | ✓ | | The dumpsite has legacy wastes of 3.0 m below ground level and 2.5 m above ground level. However, the legacy waste combined with soil will be remediated till the depth of 3.0 m below ground level. |
| *25* | Any degradation of land / eco-systems expected due to the project? | | ✓ | The proposed process of bio-mining ensures that there will be no degradation of the land. |
| *26* | Will the project result in Health & Safety Risks in the neighborhood including the release of toxic gases, leachate, accident risks | | ✓ | There is one house 200 m from the dumpsite. However health and safety management measures will be maintained periodically for the workers involved in remediation activity. |
| *28* | Potential Noise, Light Pollution/movements causing disturbance to nearby habitats/communities | | ✓ | There is no habitable area near the dumpsite. |
| *29* | Potential disruption to common property, accessibility, traffic disruptions, conflicts, or disruption to the local community within the subproject area? | | ✓ | No disruption, there will be a marginal increase in traffic of medium sized vehicle (trucks) due to the forward linking of recovered products from dump site (i.e. For compost, plastic and other recyclable waste). |

**Enclosures:**

| Access road | Site entrance |
| --- | --- |
|  |  |
| General view of waste deposit | |
|  |  |



***Project Categorization and Need for Safeguards Instruments, Oversight***

| *Project Category* | □ ✓*E2* |
|---|---|
| **Key Reasons (for categorisation)** | During screening, it has found that the project is having moderate level impacts to the baseline environment, land/ soil / water /noise environment, biodiversity or to the community. Hence it is categorized as E2. |
| **Safeguards Instruments Required** | a) E2: Project specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities) |
| **Additional Responsibilities Expected** (such as i) Specialists to be hired for Physical/Cultural resources, Natural Habitats/others, etc. for EIA preparation, and/or supervision), ii) Consultations, iii) any other aspect | |

| *Status* | *Agency / Official* | *Name, Signature with Date and Seal* |
|---|---|---|
| **Prepared by** | PIU or ULB (project in-charge) | |
| | Environmental Engineer | |
| **Checked, Categorised as ___ (E1, E2, E3) & ToR issued by:** | DESDU / SESDU | |
| | Environmental Specialist | |



# ANNEXURE II FIRE RISK ASSESSMENT

**Objectives:** The important elements of fire risk Management planning can be classified as:

- Identifying the disaster potential scenarios and advance planning to combat and minimize the damage.
- Vulnerable zone delineation.
- Assessment of loss probability and its severity.
- To deal with such emergencies expeditiously.
- Warning, protective actions like evacuation of personnel.
- To contain the disaster by isolating the area, firefighting etc.
- To make efforts to return to normal condition when the situation is controlled.

*Causes of fire and Risk:*

| Ignition (heat) sources | Fuel Sources | Oxygen Sources |
|---|---|---|
| Lit cigarettes/ butts, matches, lighters<br>Improperly stored batteries<br>Bushfire<br>Self-heating piles<br>Hot loads/contaminated waste<br>Hot work operations<br>Arson<br>Lightning<br>Fires from neighbouring activities<br>Faulty electrical wires | Flammable liquids, gases and solids<br>Combustible goods and waste (e.g. CRWM)<br>Contamination in CRWM storage<br>Dry and unmanaged vegetation | Oxidising chemicals such as oxy-acetylene sets, bleach, hydrogen peroxide, nitrates<br>Physical introduction of oxygen through unbaling or turning of loose piles |

**Fire Prevention & Management Plan**

It is a strategy well evolved, organized and rehearsed to contain the adverse effects of a possible disaster. It aims to mobilize the internal resources and use these with minimal dependence on external agencies for the following purposes:

- To control and contain incidents.
- To safeguard employees and people in the vicinity.
- To inform employees, the general public and the authorities about the hazards/risks assessed, safeguards provided, residual risk, if any, and the role to be played by them in the event of disaster.
- To effect rescue and treatment of casualties.
- To prevent recurrence of such a disaster.
- To establish machinery for review, rectification/modification of the emergency
- To ensure safety of works before personnel re-enter and resume work.

- To work out a plan with all provisions to handle and to provide for emergency preparedness and the periodic rehearsal of the plan.

**Pre-Disaster Stage**

The prevention of disaster is of vital importance and is the moral responsibility of each and every individual employed in the dumpsite site. It can be prevented by observance of precautionary and preventive measures. During pre-disaster stage following points will be followed to avert the occurrence of disaster:

The emergency operation procedures of the dumpsite site will be written down, so that no confusion is caused in the event of an emergency taking place.

- To reduce the probabilities of accidental leakage of methane.
- Smoking will be prohibited in the areas where handling of dumpsite will be done. “NO SMOKING” boards will be prominently displayed in Local Language i.e., Malayalam and English languages.
- All electrical wiring, fittings, cables, equipment will be checked periodically. Temporary wiring will not be permitted to be installed inside the dumpsite area. No inflammable material including papers, Oils, wooden racks will be stored within 1 meter of any electrical fittings. No unauthorized person will be allowed to tamper with electrical fittings.
- Welding, Burning, cutting, Chipping, soldering work, etc. will only be carried out by authorized persons.
- Necessary compliance with various Statutory Guidelines and other relevant instructions as issued from time to time will be done by the contractor.
- The Safety Department will arrange to educate all concerned regarding operational hazards of non-compliance of the safety guidelines. They will also provide necessary guidance and support in proper implementation of the program. They will also arrange mock exercises periodically.
- The Safety Department will display important telephone numbers and instructions, in Mizo & English languages. The Security Control Room located at the dumpsite site will be equipped with the following:
- Sufficient number of copies of On-Site Disaster/Emergency Management Plan.
- Master plan of the dumpsite site indicating vital locations and possible sources of disaster.
- Important Telephone numbers
- Emergency lights (portable) and Wireless sets if required and possible).
- First Aid boxes

**Disaster Stage**

The most probable disaster which may occur at the dumpsite site is because of accidental leakage and fire. To control leakage and fire the following measures/precautions will be taken at the dumpsite site:

The guidelines as given below for the protection of fire will be followed:

- The dumpsite’s fire protection will consist of structural solutions, fire extinguishing systems and fire alarm systems. The fire extinguishing system will consist of the fire system with fire pumps, distribution pipelines, hydrants and fire hoses and the portable extinguishers.
- The fire alarm system will be a part of the primary systems and take care of the places which are unmanned or will not have any fixed fire extinguishing system.

- The major operation areas shall be equipped with fixed smoke detectors, CO2 extinguishers near the door in the control room.
- All the rooms in the office shall be equipped with fixed smoke detectors.
- The ventilation rooms shall be equipped with fixed smoke detectors. One CO2 extinguisher will be located near the door to the ventilation room.
- The fire alarm and detection system shall be designed, installed, maintained and tested according to relevant standards.
- The water for firefighting shall be stored in the fire water tank (water reservoir).
- CO2 fire extinguishers contain extinguishing carbon dioxide which either by it or under expected conditions of use gives off CO2 to prevent fire.
- Dry fire extinguishers contain an extinguishing medium which either by itself or under expected conditions of use will give fine powder to prevent fire to get oxygen.
- As soon as a fire takes place inside the premises of the dumpsite, action to be taken by various persons/officials.

**Post Disaster Stage**

After the incident, an incident report will be prepared regarding occurrence of event/losses incurred and recommendations thereof for restoration of normalcy.

**Reporting of Accidents**

Situation in totality will be studied thoroughly, investigated with respect to the cause of the incident, extent of loss of life and property and a detailed report prepared by the individual/team nominated by dumpsite site authorities for this purpose. Based on the investigation report, the rescue team would finalize time bound programmes for implementation of corrective measures proposed and regularly monitor the progress thereafter. Rescue, medical and welfare operations would be continued by the concerned agencies.

**Fire Standards and Facilities:**

Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.

Below equipment and their required quantities should be strategically positioned according to the site's specifications.

- Fire extinguisher (A, B, C powder): It will be used to immediately put off fire caused by wood, Paper and textiles, flammable liquids and flammable gases. Commonly can be placed anywhere inside the site
- Fire extinguisher (Foam spray): Mainly used to put off the fire caused by flammable liquids. It should be placed in diesel storage area, lubricant storage area and DG sets.
- Fire extinguisher ($Co_2$): Mainly used to put off the fire caused by Electrical short circuit. It should be placed near the control panel room/operation room.
- Fire bucket filled with sand: It should be placed near the diesel storage area

To ensure rapid response in case of a fire, it's essential to have a water tanker filled with water, equipped with a fire-fighting hose, readily accessible along with the portable motor. The presence of this equipped water tanker ensures timely and effective action during fire emergencies. All requirements in line with National / State regulations and as advised the Local Brigade shall be arranged & followed.

The following points to be considered for assessing the fire risk and procedure to mitigate it.

1. Identification of Fire Hazards: The first step involves identifying potential fire hazards in the premises. These hazards could include sources of ignition (e.g., electrical equipment), combustible materials (e.g., flammable liquids, paper, cardboard), and other factors that could contribute to the outbreak of a fire.
2. Assessment of Risk: Once the hazards are identified, the next step is to assess the level of risk associated with each hazard. This involves evaluating the likelihood of a fire occurring and the potential consequences if a fire were to break out.
3. Escape Routes: Since operational phase occurs in an open environment, the need for conventional escape routes in the event of a fire emergency may not be required.
4. Fire Safety Measures: The assessment reviews existing fire safety measures in place, such as fire alarms, firefighting equipment, and fire suppression systems. Proper assembly point is required in case of fire break out
5. Emergency Procedures: The assessment evaluates the effectiveness of emergency procedures and evacuation plans in the event of a fire, ensuring that workers can safely evacuate the premises.
6. Fire Training and Awareness: The assessment considers the level of fire safety training provided to workers and the awareness of fire hazards and evacuation procedures.
7. Record-Keeping: Detailed records of the assessment process, findings, and recommended actions are maintained for future reference and regulatory compliance.
8. Recommendations: Based on the assessment, the fire risk assessor provides recommendations for improving fire safety, which may include installing additional fire safety equipment, conducting training programmes, or implementing any changes to reduce fire risks.
9. Review and Updates: Fire and risk assessments should be regularly reviewed and updated to account for any changes in the premises or regulations.

Fire and risk assessments play a crucial role in preventing fires and minimizing their impact if they occur. They are particularly important for dumpsites and other places with a higher risk of fire hazards to ensure the safety and well-being of workers.

# ANNEXURE- III MAP SHOWING BASELINE MONITORING LOCATIONS OF KOTHAMANGALAM DUMPSITE



**GOOGLE IMAGE DEPICTING THE AAQ MONITORING LOCATIONS AT KOTHAMANGALAM DUMP SITE**



**GOOGLE IMAGE DEPICTING THE NOISE MONITORING LOCATIONS AT KOTHAMANGALAM DUMP SITE**




**GOOGLE IMAGE DEPICTING THE SURFACE & GROUND WATER AND LEACHATE MONITORING LOCATIONS AT K DUMP SITE**

KSWMP
KERALA SOLID WASTE MANAGEMENT PROJECT

# Feasibility Report

# Dumpsite Remediation

## Kothamangalam

Ernakulam District

KSWMP

GOVERNMENT OF KERALA

LSGD

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## Executive Summary

Kothamangalam Municipality is located on the eastern part of Ernakulam District. Even though the ULB has good practice of waste management, the primary environmental issue currently faced by municipal authorities revolves around a longstanding existing legacy waste dumpsite. Despite discontinuing the dumping activities, these dumpsites remain as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Consequently, these sites pose significant environmental, social, and economic challenges for the communities and ecosystems surrounding them. The SWM Rules 2016 directs all local bodies to identify the legacy dumpsites and to scientifically remediate them to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the project for the remediation of legacy waste dumpsites in the ULBs of Kerala. As part of the project, in phase 1 the existing dumpsite at Kothamangalam, ward 6, Kumbalathumury is proposed for remediation.

The Kothamangalam Municipality has an area of 40.41 sq.km with 31 wards. The municipality, with the financial and technical support of KSWMP, intends to remediate the existing legacy waste dumpsite located in around 2.13 acres of land in ward 6, Kumbalathumury and to recover land for future developmental activities. The Kumbalathumury dumpsite was used for dumping municipal solid waste from the year 1988 to 2018. The dumping of solid waste (biodegradable waste) was stopped once the ULB level windrow compost plant was set up. Considering the impending threat of fire hazards and leachate issues, the Municipal Council intends to take-up the remediation of legacy dumpsite as a priority and to utilize the remediated land for setting up other solid waste management facilities. Since the cessation of dumping activities in 2018, only sweeping waste (silt & inert) from towns and streets was dumped at the facility daily and has now been discontinued.

The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes. To assess the quantity & composition of legacy waste & also evaluate the environmental baseline of the dumpsite, samples from representative locations were collected and analysed for various parameters viz., physical and chemical analysis of Legacy waste, Soil, Air, Noise, leachate, Groundwater and Surface Water. As part of the study, detailed site investigations were carried out for; – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical and Environmental Analysis by M/s Poluchem laboratories.

From the results of the investigations, it is found that the waste is seen up to a depth of 3 m. The total estimated quantity of legacy waste is around 29,915 Cum.

As per the SWM Rules 2016, selection of an applicable method/type or technique for dumpsite remediation needs to be arrived from the Feasibility study carried out, and based on the detailed assessment of different parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite.

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by-products as per the requirements of the utilization/forward linkage. Based on the detailed assessment of the selection parameters, stationary trommel screening machineries shall be optimum for processing the legacy waste within the stipulated timeline of 31st March 2024.

The project attracts E2- Environmental category based on the project activities and status of the environment baseline. The project attracts moderate social risks based on the social mapping, transect walk and consultation with the people living around the proposed project site to assess the problems associated with the legacy waste dumpsite and the impact during the execution of the project.

The activities of bio-mining will be required approximately 5-6 months. An area of 2.6 acres will be reclaimed and will be utilized for setting up other solid waste management facilities. Total cost of the project is [redacted].

## 1.0 Introduction

The issue of municipal solid waste management in Urban India has become one of the foremost concerns during the last couple of decades.

The primary environmental issue currently faced by the municipal authorities in Kerala revolves around a longstanding existing legacy waste dumpsite. The state has a long history of more than three decades of continuous dumping of both bio- and non- biodegradable wastes. Though the waste dumping activity has been stopped, the dumpsite remains as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Improper management of such sites pose significant environmental, social, and economic challenges for the communities and ecosystems in the vicinity.

In view of the environmental and social issues connected with dumpsites, the SWM Rules 2016, directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the remediation projects of legacy waste dumpsites in the ULBs. As part of the project, in phase -1, the existing dumpsite of Kothamangalam ULB was proposed for remediation.

For arriving at a methodology for remediating the legacy waste in the dumpsites, as per the Project Implementation Manual, a feasibility study outlining the technical, economic, and socio- environmental factors has been carried out. As a result of the feasibility study that involved detailed field investigations & assessment, and market sounding, the method proposed for remediation of legacy waste dumpsite is biomining, which will ensure long-term sustainability and environmentally sound treatment, which is found technically feasible, economically viable, and socially acceptable. The details of various steps involved in the feasibility study are described in the following sections.

## 2.0 General Description about the Project

Kothamanglam, Ernakulam in the State of Kerala is experiencing the issues of treatment and disposal of MSW. The common solid waste management facility of the Kothamangalam Municipality is located within 2.6 acres of land in Kumbalathumury (10°4'45.75" N, 76°38'51.80" E). The legacy dumpsite is also located within this common solid waste processing facility. This is the only dumpsite present in the ULB.

This waste dumpsite at Kothamangalam needs to be remediated scientifically and the land is to be reclaimed for productive use. This feasibility report outlines the status including the environmental and social aspects. The feasibility report also examines various remediation options and suggests the most feasible option for the given context for the purpose of availing for the closure of the dumpsite by Kothamangalam Municipality.

## 3.0 Profile of ULB- Kothamangalam Municipality

### 3.1 Location

Kothamangalam Municipality is located in the eastern part of the Ernakulam district at latitude 10°4'44.15" N and longitude 76°38'52.12" E as as shown in **Figure. 3.1.** Kothamangalam town is linked by National Highway 85 to Ernakulam.



**Figure 3.1 Location Map of Kothamangalam ULB**

### 3.2 Demographic & Socio-Economic Status

The Kothamangalam municipality has a total population of 40,286 of which 20,150 are males while 20,136 are females as per report released by Census of India 2011 indicating a sex ratio is of 1,025 against state average of 1,084. The overall literacy rate of Kothamangalam Town is around 96%. The ULB portrays a literacy rate higher than state average of 94.00 %. The workforce participation details of Kothamangalam ULB is presented in Table below;

*Source: Census Data 2011*

**Table 3.1 Workforce Participation Details, Kothamangalam**

| Category | Total | Male | Female |
|---|---|---|---|
| Main Workers | 12,226 | 9,080 | 3,146 |
| Cultivators | 847 | 744 | 103 |
| Agriculture Labourer | 1,066 | 751 | 315 |
| Household Industries | 149 | 95 | 54 |
| Other Workers | 10,164 | 7,490 | 2,674 |
| Marginal Workers | 2,449 | 1,455 | 994 |
| Non-Working | 24,162 | 8,494 | 15,668 |

*Source: Census of India 2011*

### 3.3 Connectivity

Kothamangalam became a municipality in 1978 and is also a legislative assembly constituency in Ernakulam District. The Kothamangalam town is spread around the intersection of National Highway 544 (previously NH 47) and the Main Central Road (MC Road) which connects Kothamangalam to the state capital Thiruvananthapuram.

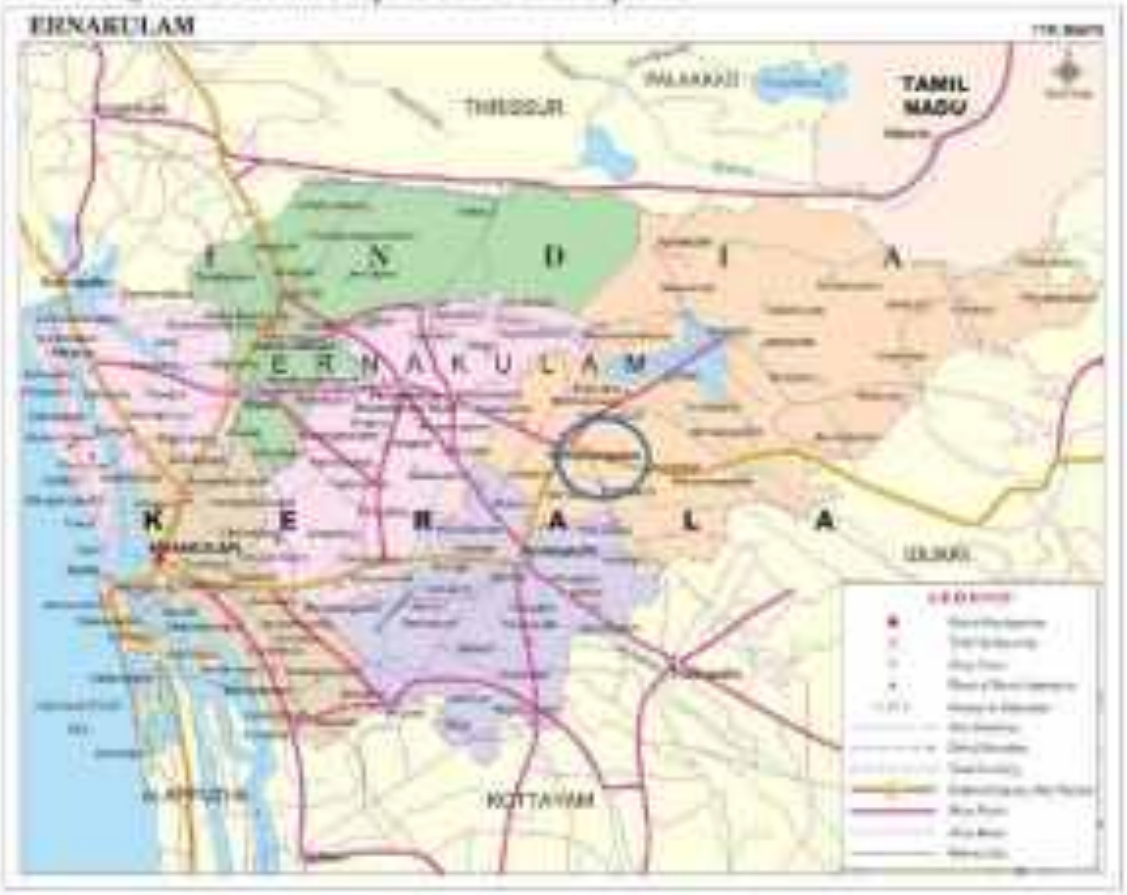



**Figure 3.2 Road Map of Ernakulam Showing Major Connectivity of Kothamangalam Town**

### 3.4 Climatic Condition

Kothamangalam has a tropical climate. As per Climate-Data.org, the average annual temperature is 27.8 °C in Kothamangalam. Precipitation here averages 3051 mm. The predominant wind directions are blowing from SW and WSW direction throughout the year.

### 3.5 Ground Water Level

The vicinity of the project area there are no households. The site is surrounded by rubber plantations. According to information published by the CGWB, the Government of India, the water level in Kothamangalam fluctuates from 3.53 to 6.54 MBGL.

### 3.6 Land use

Analysis of the existing land use is inevitable in understanding the predominant economic activities of an area and the availability of land for future economic activities. The current and future land use determines the quantum of waste that may be generated, the composition of waste and the direction of waste growth helps in planning the collection and transportation systems, decentralized processing facilities, transfer stations etc.

The land use data indicates a presence of over 62% agriculture, which indicates a ready market for city compost.

**Table 3.2 Land use Pattern of Kothamangalam Municipality**

| S. No | Land use | Area Ha | % |
|---|---|---|---|
| 1 | Residential Use | 1022 | 25.22 |
| 2 | Commercial Use | 35 | 0.87 |
| 3 | Public and Semi-public use | 85 | 2.13 |
| 4 | Industrial Use | 9 | 0.22 |
| 5 | Parks, Play Ground and Open space use | 53 | 1.33 |
| 6 | Agriculture | 2489 | 62.16 |
| 7 | Parking and Transportation use | 195 | 4.87 |
| 8 | Water bodies | 71.6 | 2.9 |
| | Total | 3959.6 | 100 |

*Source: CSP, Kothamangalam, 2009*

## 4.0 Detailed Description of the Dumpsite

### 4.1 Physical Feature of the Site

Kothamangalam dumpsite is existing within the common municipal solid waste management facility of Kothamangalam (with an aerial extent of 2.6 acre) located at Kumbalathummuy in ward No. 6. This dumpsite is approximately 6.0 km away from the centre of Kothamangalam town in western side with very few human inhabitations nearby. The geolocation of the dumpsite is 10° 4'45.75" N and 76°38'51.80" E

The exact date for start of the dumpsite was not available with the municipality; however approximately it had started in the year of 1988 (from consultations during field visit). Presently, the quantity of waste dumped at this site is about 29,915 cum as per the topographical survey records available with the ULB. As of now 2.13 Acres of the area is covered with solid waste. The Legacy waste is present about 3m below and 2.5m above the surrounding ground level. There are high chances of water being contaminated in this area due to leachate percolation.




**Figure 4.1 Photographs of Kothamangalam Dumpsite**

**Table 4.1 Salient Features of Kothamangalam Dump Site during Site Visit**

| Particulars | Details |
|---|---|
| Name of Dumpsite | Kumbalathummy Dumpsite |
| Location of Dumpsite | Ward No. 6 of the municipality |
| Co-ordinates of Dumpsite | Latitude :- 10° 4'45.75" N<br>Longitude :- 76°38'51.80" E |
| Distance from the central part of the town | 6.0 KM |
| Area of dumpsite | 2.6 Acres |
| Average height of dumpsite | 2.5m Above the ground level<br>3.0 m Below the ground level |
| Ownership of dumpsite land | Municipality |
| Distance from nearby features- residential, school, offices, temples, institutions, industry etc.) | Uninhabited area with rubber plantation surrounding |
| Start date of dumpsite | 1988 |
| Quantity of waste dumped per day | None |
| Utilities on site | Electricity connection is available |
| Details of manpower and vehicles available in dumpsite | 46 persons and 5 Vehicles |
| Site demarcated | Site is currently demarcated with a boundary wall. |
| Details of weighbridge available at dumpsite | No weighbridge at site |
| Interlinked Facilities | Near to the dumpsite MCF, RRF and Windrow Plant is working |

## 4.2 Surrounding Features of the Dumpsite

The immediate surrounding land use of the dumpsite is for rubber plantation. Within the 200 m radial vicinity there is one residential unit, and beyond the same, few households (5 to 7 numbers) present within the 500 m radial vicinity. The LV line is available at dumpsite, hence it is convenient for setting up the biomining facilities. Site had proper access through a 5 m wide road.

## 4.3 Information on Site Management

This section describes the current management of the dumpsite in terms of agency responsibility, profile of workers and numbers, nature of work the labour force is engaged in, Waste pickers and other categories of workers at the site.

**Agency responsible for current management of the dumpsite:** Dumpsite is present within the common solid waste management area of the Kothamangalam Municipality. Currently, the dumpsite is closed and is non-functional. An MCF, RRF and a windrow compost plant are working near to the dumpsite. The MCF is operated by the ULB whereas RRF is operated by ASM Enterprises who is appointed for recycling of dry waste. The Windrow compost plant is operated by ULB itself for processing the bio-waste collected mainly from common market few institutions and households.

**Profile of workers and numbers:** Total number of 46 HKS workers have been appointed on a daily basis for the operation of MCF and windrow plants and also for the waste collection.

**Nature of work the labour force in engaged:** HKS workers are involved in the collection of non-bio waste. The segregation and forward linkage of the non-bio waste is managed by ASM Enterprises. HKS is also involved in the collection of bio waste from the market, few institutions, and households. The collected bio waste is converted to compost by processing in windrow plants by the HKS.

**Waste pickers and other category of workers at the Site:** The waste collection from the ULB is executed through HKS. Non bio waste collected is processed at MCF/RRF through the agency ASM Enterprises.

## 4.4 Relevance in local or regional SWM plans

The 2.6 acres of land after reclamation may be productively used by the ULB as it deems fit. The ULB may consider its use as a waste recycling park in which case the non-biodegradable waste from the ULB shall be brought to this facility for sorting, recycling and processed for further use. The project may be funded under the KSWMP project.

## 4.5 Litigation status of the Site

There is no litigation against the site. Whereas there is environmental compensation of Rs.35 Lakh calculated for a period from 01.04.2023 to 28.02.2023 for the non-compliance of the SWM Rules 2016 under environment protection Act 1986 by Kerala State Pollution Control Board via Letter No. PCB/HO/Rules/SWM EKM/2018(Vol2)-B dtd 06.05.2023.

## 5.0 Scope of Work

Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at Kothamangalam includes the following steps.

- Conducting detailed field investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical, and Environmental Baseline Analysis by M/s Poluchem Laboratories.
- Assessment & Analysis of detailed investigation report submitted by the Laboratories.
- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.
- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the By-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation (100% land recovery – Biomining, capping, partially Biomining & Capping), Methods/Technologies (Stationary & Mobile- compact), Implementation mode, Forward linkages (Utilization/Management of By-products) and Environmental & Social categorization as per the ESMF developed for projects envisaged under KSWMP.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Delineation of baseline assessment, impact & risk assessment, mitigations measures, Environmental Management & monitoring plan, budget for EMP, EMOP, institutional responsibilities for implementing monitoring and reporting
- Social Safeguards - Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.
- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport,
- Environmental and social monitoring costs, Revenue from the project, Funding for project
- Project Implementation plan –contractual models and timelines.

## 5.1 Objectives

- To remediate the dumpsite by 31st March 2024.
- To reclaim 100% area and by eliminating the chances of dumpsite fires, leachate generation, and foul odour.
- To reduce greenhouse gas emissions, soil pollution, and groundwater contamination.

- To increase nearby social value and overall benefit to the citizens.

## 6.0 Detailed Investigation Strategy

### 6.1 Investigation Strategy

To understand the nature and composition of the legacy waste and the existing baseline environmental conditions, samples from waste, surface and groundwater, leachate, soil, air, and noise were collected considering the state and national guidelines. Samples were collected as mentioned below.

- Bore hole upto a depth of 10 m and collection of 3 (No.) sample from the soil at interval of 1.5 m depth.
- Waste analysis viz., leachate sample from 1 (No.) locations and physical analysis from (No.) location, and chemical analysis from 1 (No.) location.
- Environmental baseline analysis surface water 1 (No.) location and ground water samples from 2 (No.) location (Well Water Samples -1 up gradient, 1 down gradient) and Air sampling from 2 (No.) locations and noise sampling from 1 (No.) location.

### 6.2 Investigation Plan

The detailed investigations carried out for the legacy waste dumpsite is given in the table below:

**Table 6.1 Detailed Investigation Plan**

| Sr. No. | Parameters | Sampling Nos |
|---|---|---|
| 1 | **Geotechnical Investigation** | |
| A | Bore Holes up to 10m depth(1No./2Hectare) (as per CPHEEO) | 1 |
| B | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coeff of permeability, Strength compressibility (vertically-3 samples per borehole). | 1 |
| 2 | **Waste & Environmental Analysis** | |
| A | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM2016). Suspended solids, Dissolved solids(inorganic) Ph, Ammonical nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | 1 |
| B | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | 2 |
| C | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor. | 1 |
| D | Ground water (well water samples-1 up gradient, 2 down gradient)-(shallow and deep wells) Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, | 2 |

| Sr. No. | Parameters | Sampling Nos |
|---|---|---|
| | As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total coliform (IS 10500-2012). | |
| E | Surface water (pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, CN, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, Ecoli and Total coliforms (IS 10500-2012). | 1 |
| F | Ambient Air Quality (Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | 2 |
| G | Ambient Noise level [E(P)] for 24 hours. | 1 |

## 6.3 Sampling Methodology

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat/Long) were considered. The following table shows the strategic location details of samples selected for the detailed investigation.

**Table 6.1 Detailed Investigation Plan Executed for Waste Dumpsite at Kothamangalam**

| S.No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide $SO_2$, Nitrogen Dioxide $NO_2$, PM 2.5, PM 10, Ozone, Lead Pb, Carbon Monoxide (CO), Ammonia ($NH_3$), Benzene($C_6H_6$), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | Upwind direction in Northeast (NE) boundary of the dumpsite | The AAQ locations were chosen based on the Windrose data obtained for Kothamangalam. The most predominant wind direction is from SW and WSW. |
| | | | Downwind direction in Southwest (SW) boundary of the dumpsite | Down Stream Wind direction in line with windrows. |
| 2 | Noise (1 Location) | Ambient Noise level for 24 hours | Entrance of the dumpsite | Most vulnerable point in the site in regards of Noise quality is due to entry and exit of the waste loading and unloading vehicle. Please note that the site is devoid of proximity to any sensitive receptors within a 200 m radial circle. |

| S.No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 3 | Surface water (1 Location) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, $NO_3$, $SO_4$, Total Alkalinity, Total hardness, E-coli and Total coliforms (IS 10500-2012). | Nearby pond which is adjacent to the dumpsite. | No alternative surface water sources were identified during sampling. So adjacent pond sampling was considered. |
| 4 | Ground water (2 Locations) | Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, and Total Pesticides, Ecoli and Total coliform (IS 10500-2012). | Groundwater sampling location at 300 m distance in East direction | No alternative ground water sources were identified during sampling. |
| 5 | Bore Hole (1 location) | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS- Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coeff of permeability, Strength compressibility (vertically-3 samples per borehole). | Centre of the dumpsite | Volume of legacy wastes were found to be higher in the centre part of the dumpsite during investigation. So, the bore hole test was performed in the centre. |
| 6 | Waste & Environmental Analysis | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(morganic) Ph, Ammonical nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | South boundary direction within the dumpsite - one point | Based on contour mapping and cross section diagram, the leachate sampling location was identified as North (N)- 915 and East (E) - 975 points. |
| | | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | Within the dumpsite at 2 locations, one at East direction and at West direction. | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. So the two locations were considered for sampling. |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium(N- | | The legacy waste was found to be older and no access to the vehicular |

| S.No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| | | P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor | | movement, when compared to other parts of the dumpsite. So the two locations were considered for sampling. |

For the borehole investigation, the samples were collected by rotary drilling a 150mm bore hole using a fast rig attached to a drag bit. The soil drillings are removed by a circulating bentonite slurry which also aids in keeping the side walls stable. An SPT sampler was driven in to collect the representative samples, which is carefully packed in double walled polythene bags, sealed, and sent to laboratory for testing. Standard penetration tests were conducted on soil at every 1.5m depth and the number of blows to achieve 300mm penetration were noted. Fractions recovered from the mining of legacy waste were tested, especially for the presence of toxic metals and organic contaminants.

The total quantity of waste present in the waste dump is calculated based on the topographic study executed by ULB (for calculating quantum of waste above ground level) and the results of borehole investigation (for calculating the quantum of waste below ground level).

### 6.4 Analysis and Interpretation of Exploratory Data

The baseline condition of the waste dumpsite at Kothamangalam, has been assessed through the geotechnical investigation and Waste & Environmental baseline assessment executed through M/s Matter Material Testing & Research Laboratory (P) Ltd and M/s Poluchem Laboratories (P) Ltd respectively. The results of the topographical survey conducted by ULB in the year 2022 were also considered for the analysis. Results of topographic survey conducted by ULB, Geotechnical investigation report, waste and Environmental analysis are enclosed as **Annexures 1 to 4.**

The initial site visit was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd on 16th May 2023 along with the experts of TSC and PIUs. Field Geotechnical investigation to collect the soil samples after drilling through the legacy waste was started on 17th May 2023 and was completed on 23rd May 2023. Positioning of Air samplers & Noise monitoring equipment, sampling of surface/groundwater, leachate, and legacy waste were done on 06th June 2023 by M/s Poluchem Laboratories (P) Ltd.

#### 6.4.1 Details of Topographic Survey

Topographic survey was conducted by ULB itself in the year 2022 towards assessing the quantum of the waste present in the dumpsite above the ground level. The Topographical survey report is presented in **Annexure 1**. The inference of the Topographical survey is as follows.

- Topographical Survey Map shows Approximate 2.13 acres of land covered by waste dumping.

- Maximum height of waste dump above soil is 2.5 m
- Estimated waste volume above ground level is 21,295 cum which will constitute 22,999 T of waste (density of waste is 1.08T/cum as per the characterization study results presented in subsequent sections).

### 6.4.2 Geotechnical Exploratory Details

The geotechnical investigation at the dumpsite at Kumbhalathumuri, Kothamangalam, Ernakulam district was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was drilled through the waste into the ground using a rotary drilling method. The maximum depth of investigation was 8.30m (3.00 in waste after that 5.3m soil). SPT and collection of undisturbed soil samples were carried out at regular intervals within the ground. Various laboratory tests were carried out on the SPT and undisturbed soil samples. The full geotechnical report is appended as **Annexure 2**. The major inferences of the geotechnical investigations are as follows;

- In the borehole investigation it was asserted that the depth of waste column below ground level is 3.m.

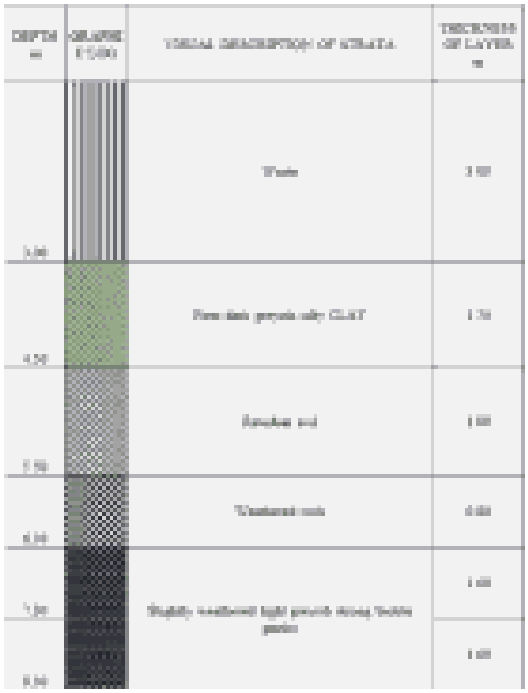


**Figure 6.1 Borehole Strata Obtained for Kothamangalam Dumpsite**

- The base soil has a plasticity index greater than 10 with clay and silt fractions account for more than 40%, which makes it suitable for the sub-base.
- The safe bearing capacity of the soil is 150 KPA, implying that the maximum height of fill may be about 15 m. During excavation, the side slopes should be maintained at 1 (V) and 3 (H).
- The Cation Exchange Capacity (CEC) of the soil is 11.03 meq/100gm.

### 6.4.3 Estimated Total Quantity of Waste

The total quantity of waste is estimated based on the contour/topography survey profile of the waste over the ground level and exploratory data of the bore log (Geotechnical investigations). As detailed under section 6.4.1, the estimated quantity of the waste above the ground level is **21,295 Cum**.

Quantity of waste below the ground level is estimated as **8,620 Cum**. The quantity of waste below ground level is based on assumptions and may vary as per actual site conditions. We recommend taking 4 more bore holes for estimating exact quantity or the assessment of quantity below ground level may be included in the contractor's scope.

Thus, the total legacy waste present in the Kothamanglam dumpsite is calculated as below.

**Table 6.2 Total Waste Quantification for Kothamanglam Dumpsite**

| Sl no | Name of Dumpsite | Quantity of Waste present above the Ground level | Quantity of Waste present below the Ground level | Total quantity of legacy waste to be managed |
|---|---|---|---|---|
| 1 | Kothamanglam | 21,295 Cum | 8,620 Cum | **29,915 Cum** |
| | | 22,999 T | 9,309 T | **32,308 T** |

### 6.4.4 Legacy Waste Characterization

The characteristics of the legacy waste were assessed by collecting 15kg sample. The legacy waste samples were collected on 09/08/2023 by M/s Matters lab (P) Ltd. The assessment of waste characteristics was done based on the results of the analysis. The details of the physical characteristics are provided in the tables below. The detailed legacy waste characterisation reports are enclosed as **Annexure 3**

**Table 6.3 Grain Size Analysis of Legacy Waste total weight of sample taken 15 kg)**

| Sieve Size (mm) | Percentage Retained |
|---|---|
| 80 | 10 |
| 37.5 | 6.9 |
| 10 | 27.4 |
| 4 | 19.1 |
| Pan | 36.6 |

**Table 6.4 Characterisation of Waste Material Retained in Each Sieve**

| Test/ Parameters | Waste Material Retained on each sieve in % | | | |
|---|---|---|---|---|
| | 80mm | 37.5 mm | 10mm | 4mm |
| Plastic Waste | 77.5 | 10.3 | 4 | Nil |
| Cloth | 1 | 0.1 | 0.5 | Nil |
| Glass | Nil | 4.4 | 4.1 | Nil |
| Wood | 0.5 | Nil | 10.9 | Nil |
| C&D | Nil | Nil | Nil | Nil |

| Test/ Parameters | Waste Material Retained on each sieve in % | | | |
|---|---|---|---|---|
| | 80mm | 37.5 mm | 10mm | 4mm |
| Bio Fraction | Nil | Nil | Nil | Nil |
| Gravel | Nil | 85.2 | 79.5 | 100 |
| Rubber | 21 | Nil | Nil | Nil |
| Metal | Nil | Nil | 1.0 | Nil |

**Table 6.5 By Product Composition**

| Particular | Percentage of Composition (%) |
|---|---|
| Recyclable | 15.21 |
| Inert | 29.12 |
| Bio Earth | 19.27 |
| Soil Enricher | 36.60 |

**Table 6.6 Physical Characteristics of Waste**

| Sl No | Parameter | Test Method | Unit | Value |
|---|---|---|---|---|
| 1 | Moisture@105°C | ASTM D 2216 | % | 15.98 |
| 2 | Bulk Density | USEPA | kg/m3 | 1089 |
| 3 | Density | USEPA | g/cm3 | 1.0466 |
| 4 | Calorific Value | ASTM D 5865 | K cal /kg | Nil |

**Table 6.7 Chemical Analysis**

| Sl No | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 7.26 |
| 02 | Biodegradable Factor | USEPA | % | 2.3 |
| 03 | Total carbon | USEPA 9060A | % | 4.7 |
| 04 | Phosphorus(P) | USEPA | % | 0.017 |
| 05 | Nitrogen(N) | USEPA | % | 0.24 |
| 07 | Potassium(K) | USEPA | % | 0.023 |
| 08 | C/N Ratio | USEPA | .. | 19.5:1 |
| 09 | Calorific Value | ASTM D 5865 | K cal/kg | Nil |

*Note : The average Nitrogen, Phosphorus and Potassium (NPK) content in the legacy waste samples picked from the site is 0.24, 0.017, 0.023, respectively by weight. Although the C/N ratio is >15, the actual nutrient values are far lesser than 0.8, 0.4 and 0.8 as specified by the Fertilizer Control Order (FCO) 1985 for city compost and hence cannot be used as compost. This could be due to the materials being exposed to sun and air over the years or that the carbon content may have leached into the ground through leachate during the rainy season. Another possible contributor to the reduced carbon levels could be multiple fire incidents at the site. Although the material has very less carbon content, the NPK value can be enriched by adding additives like poultry litter. The enriched material can be given to farmers or used for horticulture purposes. The material cannot be sold as organic compost in the present form due to very low carbon content. A comparison of the chemical nature of samples and FCO specified parameters is provided in the table below.*

| Parameter | Nitrogen (N) | Phosphorus (P) | Potassium (K) | Moisture | Organic Carbon | Bulk Density |
|---|---|---|---|---|---|---|
| As per FCO | 0.8 | 0.4 | 0.4 | 15% - 25% | 12% | <1 |
| Legacy Waste of Kothamangalam | 0.24 | 0.017 | 0.023 | 23.5 | 1.12 | 1147 |

**Table 6.8 Heavy Metal Analysis**

| Sl No | Parameters tested | Test Method | Unit | Result | USEPA Permissible |
|---|---|---|---|---|---|
| 1 | Iron (Fe) | USEPA 3050 | % | 2.4 | - |
| 2 | Arsenic (As) | USEPA 3050 | mg/kg | <0.1 | 41 USEPA, 12 Canada |
| 3 | Selenium (Se) | USEPA 3050 | mg/kg | <0.1 | 2 Canada |
| 4 | Nickel (Ni) | USEPA 3050 | mg/kg | 7.38 | 50 |
| 5 | Zinc (Zn) | USEPA 3050 | mg/kg | 15.71 | 1000 |
| 6 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 | 5 |
| 7 | Copper (Cu) | USEPA 3050 | mg/kg | 15.02 | 300 |
| 8 | Chromium (Cr) | USEPA 3050 | mg/kg | 9.33 | 50 |
| 9 | Lead (Pb) | USEPA 3050 | mg/kg | 9.8 | 100 |
| 10 | Mercury (Hg) | USEPA 3050 | mg/kg | <0.1 | 0.15 |
| 11 | Manganese (Mn) | USEPA 3050 | mg/kg | 36.5 | - |

Hence heavy metal contamination is not expected in the dumpsite. However, if heavy metal/ hazardous contamination is found in the recovered fractions at any stage of the works, the RFB should include necessary provisions for payment towards additional sampling of the recovered fraction and disposal to the KSPCB authorized hazardous waste management facility as per actual cost. The respective pre-set disposal costs of CHTSDF, as recommended by KSPCB, will be considered for such recovered fractions.

### 6.4.5. Soil Conditions of the Dumpsite

As it is an unlined dumpsite, there is a probability of finding traces of contaminant from waste and leachate in the underlying soil. Since it is an uncontrolled disposal site, the mixed waste contains different types of pollutants which may eventually have an impact on the soil. Results of soil analysis of the samples taken from the borehole in the Kumbalathummuri dumpsite is as shown below:

**Table 6.9: Chemical analysis of soil extracted from borehole at Kothamangalam dumpsite**

| Sl. No | Parameter | Result | US (NY State-Codes, rules and regulations) Industrial Use |
|---|---|---|---|
| 1 | Cadmium (Cd) mg/Kg | <5.0 | 60 |
| 2 | Chromium (Cr) mg/Kg | 166.7 | 800 (Hexavalent) 6800 (Trivalent) |
| 3 | Copper (Cu) mg/Kg | 83.8 | 10000 |
| 4 | Nickel (Ni) mg/Kg | 92.8 | 10000 |
| 5 | Lead (Pb) mg/Kg | 39.9 | 3900 |
| 6 | Zinc (Zn) mg/Kg | 573.9 | 10000 |

| | | | |
|---|---|---|---|
| 7 | Mercury (Hg) mg/Kg | <0.1 | 5.7 |
| 8 | Arsenic (As) mg/Kg | 2.0 | 16 |

While comparing results of the report with the US Industrial Use benchmark, it is observed that the values are significantly low and within the benchmark values. Bioremediation may be carried out to reduce traces of heavy metals in soil and for site clearance. Industrial land use may be promoted after bio-remediation of site. The location may be used as a site for the SWM facilities like Material Collection and Resource Recovery Facility. However, the solution may be considered after proper soil and groundwater investigation post dump-clearing stage.

### 6.4.6 Leachate Characterization and Quantification

There is no leachate collection/management system in the dumpsite. To address the concern of contamination of the groundwater and soil due to uncontrolled dumping, leachate samples are picked for analysis. The data is presented in **Annexure 4**. The data indicates that the TDS is about 1885 mg/l while the suspended solids is about 180 mg/l. The chlorides are high at 788.41 mg/l, while the COD, BOD are 320 mg/l and 120 mg/l respectively.

**Table 6.10 Leachate characteristics at Kothamanglam Dumpsite**

| Parameters tested | Test method | Results |
|---|---|---|
| Sampling Location | N-10 °04'.062" E -76°41'17.339 | |
| pH | IS 3025 (P) 11 –1983RA2017 | 7.09 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 1885 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 180 mg/l |
| Chloride as Cl- | IS 3025 (P) 32 – 1988RA2014 | 788.41 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 320 mg/l |
| B O D (3 days at 27O C) | IS 3025 (P) 44 – 1993 RA 2014 | 110 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 72.4 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 45.5 mg/l |
| Phenolic Compound asC6H5OH | IS 3025 (P) 43-1992 RA2014 | 6.3 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 4.5 mg/l |
| Cyanide as CN- | IS 3025(P) 27-1986RA2014 | BDL (MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL (MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL (MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL (MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 1.6 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL (MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 6.8 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL (MDL- 0.01 mg/l) |

*BDL- Below Detection Level, MDL- Minimum Detection Level*

All the heavy metals are significantly low or below detectable limits. The ground water quality results (presented under ESIA Section indicate that the dumpsite has not caused any major increase in pollution levels and the quality parameters are within the IS 10500:2012.

The remediation is proposed to be carried out during the dry season and hence the probability of rain is less. In case of rains and leachate generation, the leachate will be collected in a leachate collection tank and sprayed back to the windrow area for enriching the moisture and aiding the decomposition process in line with CPCB guidelines for management of legacy waste.

### 6.4.7 Environmental Baseline

The environmental baseline was assessed from the analytical results of air, surface & groundwater, noise, and leachate. The samples by M/s Polychem Laboratories (P) Ltd. The Environmental baseline was analyzed with reference to the lab analysis reports. The details of analysis & inferences are provided in the ESIA Section in **Annexure 4.**

### 6.4.8 Risk Assessment

**Surface Water:** Dumpsites can release pollutants into nearby surface water bodies through leachate, which is generated when rainwater or other liquids come into contact with the waste. Leachate can contain various contaminants such as heavy metals, organic compounds, and pathogens. Proper containment and management of leachate is essential to prevent water pollution.

The analysis of surface water reveals that all the parameters are within the acceptable limit, except it is slightly acidic and the dissolved oxygen content is less than prescribed limit, so also the BoD is greater than the allowable limit, indicating that the water contains organic load.

**Table 6.11 Risk Assessment- surface water**

| **Risk Assessment** | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite -BOD Higher than the acceptable limits |
| **Pathway** | Water/Run off |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | High BOD indicates the water is polluted and it is harmful to ecosystem. Also, it will make the water unfit for human and animal consumption. |

**Ground Water**: Pollutants from dumpsite can infiltrate into underlying groundwater, particularly if the dumpsite is not adequately lined or if waste disposal practices have caused contamination of the soil. Once pollutants enter the groundwater, they can spread over a wide

area, affecting drinking water sources. Remediation techniques often focus on preventing or minimizing further groundwater contamination.

The analysis of ground water samples taken at one location reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The pH of the sample analysis is 5.61, which is in a slightly acidic range which can make the water not fit for any industrial purpose as it is more corrosive.

**Table 6.12 Risk Assessment - Ground water**

| **Risk Assessment** | |
|---|---|
| **source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite - pH is acidic in nature |
| **Pathway** | Water, soil |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | Possible risk to human health are;<br>• Diarrhea<br>• Nausea and Vomiting<br>• Abdominal Pain<br>• Weakness<br>• Organ Damage<br>Possible risk to flora<br>It can decrease the availability of plant nutrients, such as phosphorus and molybdenum, and increases the availability of some elements to toxic levels, particularly aluminium and manganese. |

Air: Dumpsites may emit pollutants into the air through processes such as open burning of waste or the release of gases from decomposing organic materials. Airborne pollutants can include particulate matter, volatile organic compounds (VOCs), dioxins, and other hazardous substances. These pollutants can have adverse effects on air quality and human health. Measures to control and mitigate air pollution during dumpsite remediation include covering waste, implementing proper waste management practices viz., dust containment screens, etc. to be ensure.

**Table 6.13 Risk Assessment - Air**

| **Risk Assessment** | |
|---|---|
| **source** | Legacy waste Dumpsite |
| **Pollutant** | Within the limits |
| **Pathway** | Air |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |

| | |
|---|---|
| **Risk** | No Anticipated risk |

**Soil**: Dumpsites can contaminate the surrounding soil with a wide range of pollutants. Hazardous chemicals, heavy metals, and organic compounds can leach from the waste and accumulate in the soil, potentially posing risks to plants, animals, and humans.

**Table 6.14 Risk Assessment - Soil**

| **Risk Assessment** | |
|---|---|
| **source** | Legacy waste Dumpsite |
| **Pollutant** | Heavy metals |
| **Pathway** | Soil |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | Possible risk to human health: Soil that contain substance such as heavy metals which may be toxic to human can pass those substances on to human through crop uptake leading to unsafe foods.<br>Possible risks to animals: when farm animals consume the plant grown from contaminated soil it affected the health of animal<br>Possible risk to flora: Soil pollution may after plant metabolism and reduce crop yield, also the trees and plants that absorb the soil contaminants enter into the food chain |

**Bioaccumulation in Biota**: Pollutants from dumpsites can enter the food chain and bioaccumulate in plants and animals. As pollutants move up the food chain, their concentrations can increase, leading to potential health risks for humans and wildlife. Remediation efforts include restoring the land and minimizing the exposure of organisms to contaminated environments.

**Table 6.15 Risk Assessment - Bioaccumulation in Biota**

| **Risk Assessment** | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate and heavy metals |
| **Pathway** | Air, water, and soil |
| **Receptor** | Human, Animals, flora, and fauna |
| **Risk** | Possible risks to human health, animal flora and fauna<br>Accumulated of contaminants in plants and animals indirectly through food chain affects human health |

## 7.0. Evaluation of Remediation Techniques

Reclamation of existing unmanaged municipal waste dumpsites is becoming a key requirement for ULB's in India as unscientific and unplanned methods of waste disposal in non-engineered landfills have led to lot of environmental issues including soil and ground water contamination, uncontrolled landfill gas emissions into the atmosphere and exposure to disease vectors and scavengers. The Hon'ble NGT seized with these problems across the country has ordered that the respective authorities to remedy this at the earliest.

The dumpsites have emerged as pollution hubs, especially those situated in human settlements, as cities have grown over the decades. It has, therefore, become a necessity for the city authorities to remediate the existing dumpsites in an environmentally sound and economically viable manner.

Remediation of waste dumpsite is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

- Environment Enhancement - reduction in greenhouse gas emissions, soil pollution, ground water contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.
- Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in nearby real state value and rental values.
- Land - Dumpsite land becomes available for utilizing same for the establishment of other Waste Management Facilities.
- Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels.

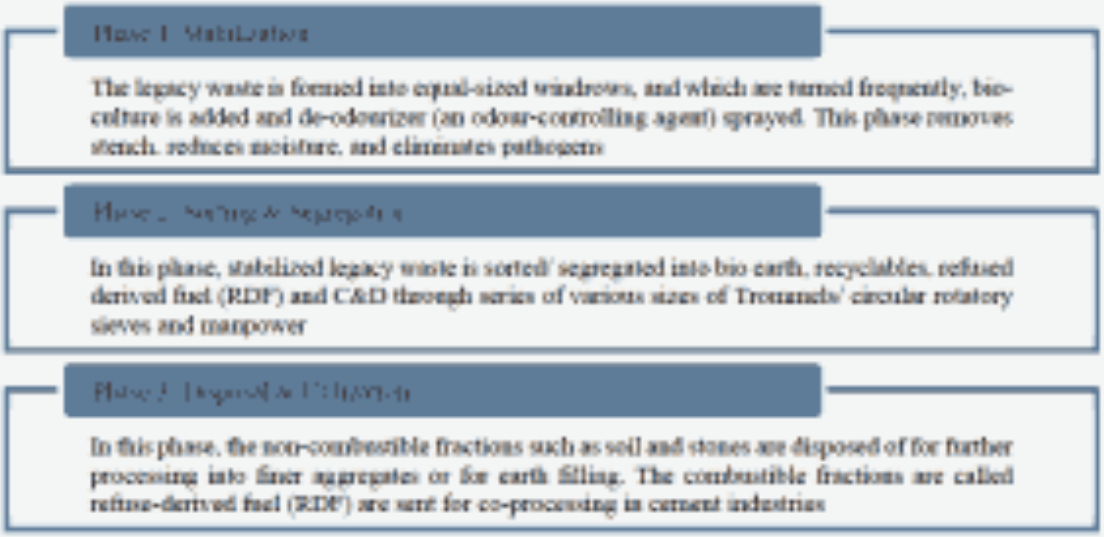
For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- A total station survey for assessment of volumetric quantity of legacy waste above the ground level.
- Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- History of the site, Physical features of site, as –is/current situation and compositional analysis of waste.
- Baseline study of heavy metals; subsurface soils and water; rainfall; soil type; surface hydrology; topography; wind direction etc. Shall be studied prior to bioremediation.
- Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area.

The details of the remediation techniques for the remediation of the legacy waste dumpsite remediation are as follows:

## 7.1 Bio-Mining – Reclamation/Recovery of Land 100%

Bio- mining is the scientific technique to extract materials of economic interest from legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) and followed by sustainable management through recycling, co-processing, road construction etc for the end use of the recovered fractions.




| | |
|---|---|
| Salient Features | • 100% land recovery, increase in value of land and available for public use/habitation with immediate effect.<br>• Ensures long-term sustainability and environmentally sound treatment of legacy waste and present lucrative revenue-generating opportunities.<br>• Bio products/aggregates generated from the process can be used as alternative construction material, fuel and recyclables.<br>• Compliance to SWM Rules and NGT orders.<br>• Improvement in aesthetics and quality of life & health. |
| Applicability | • The ownership is well defined.<br>• Working space is available in the dumpsite.<br>• Linkage for utilization by-products is available |

## 7.2 Capping Without Land Recovery

Capping is a scientific process of profiling legacy waste and covering with barrier layers consisting of soil, high density polyethylene (HDPE) liner, gas collection system surface drainage system, and a vegetative cover to minimize the percolation of rainwater into the cappped legacy waste.

| | |
|---|---|
| Salient Features | • The capped area becomes a green space and can be developed into parks/recreational areas post monitoring period.<br>• Capped area will be equipped with environmental monitoring systems for post-closure maintenance to monitor pollution levels in groundwater and surface-water sources and air (especially methane emissions) at least 15 years.<br>• Capped area needs to be inspected periodically for settlement due to physical, chemical, and biological transformation, leachate generation, erosion and naturally occurring invasion by deep-rooted vegetation.<br>• Recurring expenditure will be incurred for regular maintenance. On July 17, 2019 the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested bio- mining as environmentally safe and the most preferable approaches to dumpsite remediation.<br>• SWM rules do not permit habitation over it for at least 15 years because of the danger posed by toxic gases release by the waste. |
| Applicability | • Simple & robust, least expensive method among various available technologies |

## 7.3 Capping with Partial Land Recovery

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can be linked to relevant buyers and the inert material will be capped over lower footprints, with well-designed slopes to prevent further degradation of the environment.

The top layer of capped material may also be provided with gas collection wells and pipes to trap the methane and the collected gasses are typically passed through an oxidation layer of passive venting or flared. If the gas quantity is substantial then, power generation may be a possibility. The capped area should have drains to collect the surface water flow as well as any leachate that may be generated. Such leachate is collected and treated in leachate treatment plants.

The reclaimed land may be covered with loamy soil that has plants with high transpiration rates. The plants do not permit the ingress of water into the soil thereby reducing the possibility of leachate generation. The plants and soil microbes also behave as oxidation layer. The soil is compacted and maintained with gentle slopes with 1:3. Contour drains may be provided to divert the water away from the soil thereby preventing ponding of water. The reclaimed land may be covered with solar panels to generate renewable energy during the period of observation following the post closure.

| | |
|---|---|
| Salient Features | • The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.<br>• Ensures short -term sustainability and environmentally sound treatment of legacy waste.<br>• Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area |
| Applicability | • Legacy waste dumpsite area partial of steep terrain, inaccessible ravines and narrow valleys.<br>• Lack of linkage for disposal of inert<br>• Recovery land for public use is not a priority |

## 7.4 Selection of Remediation Option

Selection of the applicable method/type or technique is based on the factors like salient aspects & applicability of remediation types viz., Capping without land recovery, Bio-mining – reclamation/recovery of land 100% & capping with partial land recovery and also available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for 100% land recovery and forward linkages/utilization of processed aggregates/by-products.

Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. Moreover, as per Solid Waste Management Rules, 2016 and several National Green Tribunal (NGT) directives have mandated that urban local bodies opt for bio-mining over capping.

However, after the bioremediation, the municipality wants to use the land for setting up of Material Collection Facility and Resource Recovery Facility. Hence backfilling of the site with bio-earth and inert is planned.

For the execution of dumpsite bio-mining two strategies can be adopted.

- *In-situ biomining*: Here the biomining is carried out within the premises of the dumpsite after clearing the waste and reaching the original ground level or in level with the land

adjoining the dumpsite. The advantage is that only the finished products are moved out of the premises, inerts may be used for gradation and filling up low lying areas within the site, or in a newly developed sanitary landfill. This is quite economical when legacy waste quantities are significant. The possibility of gaseous emissions, noise and odor and formation of leachate exist as the processing takes place at the site. The location would remain affected for the time till all waste are processed.

- *Ex Situ biomining:* In small dumpsites, or where the area is a constraint, the entire waste is excavated and taken away to an alternate location for processing. The work in the dumpsite can be completed quickly and the disturbance due to the excavation can be minimized. The cost of transportation of the whole waste adds to the cost of bio-mining. But since the process plant can serve multiple locations, economies of scale may be achieved and may also compensate for the added transport cost.

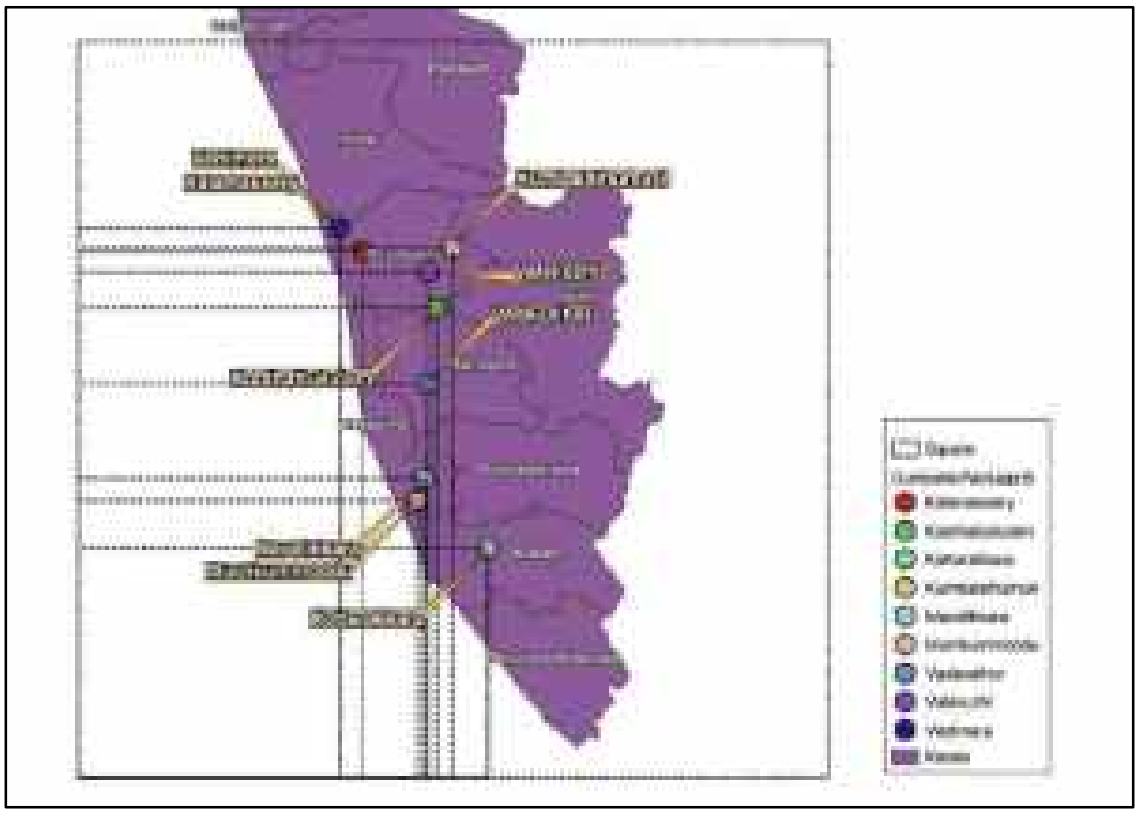


**Figure 7.1 Location of Other Dumpsites nearby**

## 8.0 Technical Description of the Selected Option

### 8.1 Methodology

The legacy waste dumpsite reclamation through bio-mining with recovery of land 100% involves

Phase 1: stabilization

Phase 2: sorting & segregation

Phase 3: disposal & utilization

Phase 4: Back filling of boulders and inerts

## 8.2 Selection of Machineries

The type of machinery, capacity, and type of screens to stabilize of the legacy waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) will depend on the physical site conditions including quantity & characteristics of legacy waste and utilization of the aggregates/ by-products/ recovered material.

The type of machinery available for the bio mining are as follows:

- Stationary screening machinery and
- Mobile/compact machinery

A Stationary trommel is a specialized piece of equipment used in legacy waste bioremediation processes to separate and classify solid waste materials. It is designed to efficiently screen, and sort different components of the waste based on size and other characteristics. Technical description of a Stationary Trommel used in legacy waste bioremediation are as follows:

- Structure: The Stationary trommel consists of a frame made of steel or other durable materials. It is designed to withstand the harsh conditions of waste treatment facilities. The frame supports a cylindrical drum that is inclined at an angle for optimal material flow.
- Drum: The drum is the main component of the Stationary Trommel and is typically made of perforated metal or mesh. It is cylindrical in shape and rotates on its axis using a motorized drive system. The drum's 3- 5 mtr diameter and 10 mtr length can vary depending on the specific requirements of the waste treatment process.
- Motor and Drive System: The Stationary Trommel is equipped with a motor and drive system that powers the rotation of the drum. The motor is typically electrically powered and is connected to the drum through a gearbox or direct drive mechanism. The rotational speed of the drum can be adjusted to optimize the screening process
- Inlet and Outlet: The Stationary Trommel has an inlet where the legacy waste is fed into the drum for processing. The waste material enters the drum at one end, typically assisted by a conveyor or loader. The screened waste material is discharged from the opposite end of the drum through an outlet.
- Screening Mechanism: As the drum rotates, the legacy waste inside it is subjected to a combination of tumbling and rolling actions. The perforated drum allows smaller-sized particles and materials to pass through, while larger items such as bulky waste, debris, and contaminants are retained inside the drum. The drum's perforation size can be customized to achieve the desired separation efficiency.
- Waste Sorting: The Stationary Trommel facilitates the separation of different components within the legacy waste. It effectively segregates organic waste, inert materials, recyclables, and other categories based on their size and physical properties. This sorting process prepares the waste for further treatment or disposal.

The Mobile Trommel is a technical apparatus utilized in legacy waste bioremediation processes. Its primary function is to separate and sort various types of waste materials, such as solid waste and organic matter, for effective bioremediation

***Structure***: The trommel consists of a cylindrical drum, typically made of heavy-duty metal, which is inclined at a slight angle. The drum is supported by a framework and set in motion by a motor or engine, causing it to rotate slowly. The rotation of the drum allows the waste materials to be fed into the trommel at one end, while simultaneously moving the materials along its length. Large screening area (9.5 sq m). Helps in good quality segregation & high productivity

***Screening Mechanism***: The Mobile Trommel incorporates various mechanical features to facilitate waste separation. As the waste enters the drum, it encounters a series of screens or perforations arranged along the length of the drum. These screens have different mesh sizes, which allow for the separation of different-sized particles. The smaller particles, such as sand or fine soil, pass through the screens and fall through openings at the bottom of the trommel, while larger materials, such as plastics or larger debris, are retained and carried along by the rotation of the drum.

***Separation System***: Additionally, the Mobile Trommel may be equipped with paddles or lifters mounted inside the drum. These paddles help to agitate and tumble the waste materials, assisting in the separation process by ensuring proper contact between the waste and the screens. They also help to break up clumps or aggregates, aiding in the release of trapped organic matter. Four different screen inclination angles for operations between 20°-35° are available for selection provides flexibility.

***Treatment Process***: In the context of legacy waste bioremediation, the Mobile Trommel plays a crucial role in preparing the waste for subsequent treatment steps. By separating the waste into different fractions based on particle size, it allows for targeted bioremediation processes. For example, the fine fraction may be subjected to aerobic or anaerobic composting, while the larger fraction can undergo mechanical or physical treatments.

***Transport***: Quick and easy folding of conveyor helps in quick setup time.

***Discharge height***: Wider conveyor and higher discharge heights help in making bigger stockpile and eliminates the frequent loader usages

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land 100%) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by- products as per the requirements of the utilization/forward linkage.

Based on the detailed assessment of the selection parameters listed above, the site conditions, legacy waste characteristics, statutory requirements etc, stationary trammel machine shall be the optimum screening machinery

## 8.3 System Requirements

The following are the infrastructural facilities required for setting up of machineries and equipment in biomining of a dumpsite. These are required irrespective of the option of in-situ or ex-situ processing.

- Fencing and secure entrance gate
- Security and reception office
- Weighing bridge
- Records room
- Laboratory
- Medical room
- Workers' area
- Parking for vehicles (heavy earth equipment, trucks, etc.) with tire washing facility.
- Administrative building
- Fire control unit (detailed methodology for fire management plan)
- Toilet–bath complex, with personnel protection equipment (PPE) storage room)
- Overhead water tank
- Leachate collection and treatment unit
- Environmental monitoring unit
- Segregation and processing area
- Temporary storage area for rejects, domestic hazardous waste and sanitary waste
- Material storage area
- Waste drying and windrow area.
- DG set

The total area required is about 900 sqm in an in-situ bio mining plant. The process shed needs to be a covered building. Temporary construction power at 440V needs to be obtained from KSEB. This can be easily availed as there is an existing electrical infrastructure passing through the site. A 440V, 125KVA needs to be established for the project. Water storage tanks needs to be provided for the duration of the project. The water may be supplied by tankers. Labour will reside in Kothamangalam and commute daily to the site, hence no labour sheds are envisaged during this project. The requirements are only indicative, and the contractor is

required to propose own design and capacity to complete the works in the stipulated time and standards.

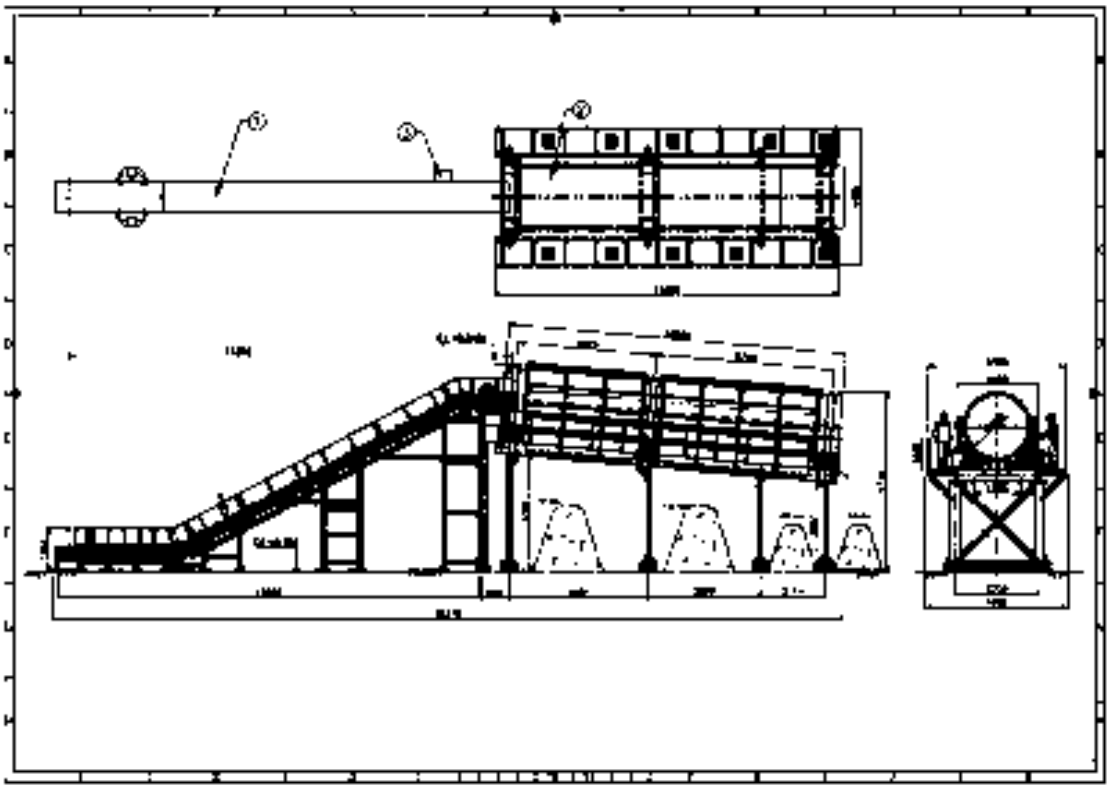


**Figure 8.1 Schematic of the Segregation System**

## 8.4 Site Reclamation Requirement

As detailed under section 6 the Kothamangalam Dumpsite have waste spread of Approx. 2.13 acres of land with a max of waste dump height 2.5 m from the ground level. Estimated volume of waste above the ground level is: 21,295 cum which will be around 22,999 MT by taking density as 1.089 T/cum

*(Source: Topographical survey result for the Kothamangalam Dumpsite conducted in the year 2022 by ULB)*

In the borehole investigation it was asserted that the depth of waste column below ground level is 3 m and the quantity of waste below ground level is estimated 8620 Cum as detailed under section 6.

*(Source: Borehole investigation survey conducted by KSWMP through Matter Labs for the Kothamangalam Dumpsite on June 2023)*

Since the ULB intends to use the land recovered after bioremediation, backfilling of the boulders and inert material obtained after the bio-mining is inevitable.

## 9.0 Scope of Disposal including Location of Disposal for RDF, Bio Soils, C & D Waste, And Others as Per Local Demands

### 9.1 Utilization of By Products

The details of the utilization of aggregates/by–products screened out by processing of the stabilized legacy waste are provided in the table below.

**Table 9.1 By Product Composition**

| By-products | Percentage Composition | Quantity (Cum) | Utilization/Linkage/Usage |
|---|---|---|---|
| RDF | 14.94 | 4,469.50 | RDF will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel. |
| Recyclable | 0.27 | 81.97 | Recyclables will be sold to authorized recyclers. |
| Inert | 48.39 | 14,474.47 | Can be utilized for filling at the site itself. |
| Compost cum Soil Enricher | 36.60 | 10,948.89 | Can be used as a soil enricher and given to farmers. The same cannot be sold as fertilizer unless it is enriched with carbon content to meet the standards suggested by FCO for city compost. |

The **Table 9.1** details the expected recovered items in line with the investigation results present. However, during the execution stage, the bidder is required to analyse each recovered fraction at least every 15 days and report submitted to the concerned authority. It is to be noted that the RFB document should cover necessary clause in this regard.

Based on the chemical analysis the waste material has less than 4.7% total carbon as compared to the 12% suggested by the Fertiliser Control Order (FCO). The screened compost materials having size less than 4 mm shall be heaped to form windrows, the compost should be enriched to the FCO standards and its amendments from time to time. The materials shall be tested for carbon content and NPK values during execution of works, the materials may be sold to farmers depending on the test outcomes. If the compost materials are not meeting with the standards, the same shall be used as bio-earth/ soil enricher for refilling within site itself.

Inert is coarse fraction (10mm to -35mm) received from the landfill mining of MSW. It is comprising stones, construction debris, ceramics, some decomposed organic matter. This is helpful in backfilling in the site or can be used as a subgrade material for highways, low land filling. It can also be used as cover for landfills.

RDF / SCF consists largely of combustible components of such wastes, as non-recyclable plastics (not including PVC), paper cardboard, cotton, labels, and other corrugative materials. These fractions are separated by different processing steps, such as screening, air classification, ballistic separation, separation of ferrous and non-ferrous materials, glass, stones and other foreign materials and sometimes shredding into a uniform size, in order to produce a

homogenous material which can be used as substitute for fossil fuels in e.g. cement plants, lime plants, coal fired power plants or as reduction agent in steel furnaces. The calorific value of the RDF should be higher than 1500kcal/kg for co-processing.

The RDF fraction from the site, once dried and shredded can be compacted and carried for disposal to RDF / SCF power plants or cement factories which can use this material in their kiln for burning if it meets the specification for SC/RDF.

The nearest cement industry that can accept the RDF / SCF from Kothamangalam City is located near Trichy, Tamil Nadu at a of 355 kms from the Dumpsite site. The other sites are at Karnataka between 740 km to 1074 km, while cements plants at Andhra are at 740 km to 900 kms.

**Table 9.2 Distance to potential RDF / SCF users**

| Name of the cement plant | Location | State | Distance from Kochi (KM) |
|---|---|---|---|
| Dalmia Bharath | Ariyalur | Tamilnadu | 458 |
| Dalmia Bharath | Dalmiapuram | Tamilnadu | 355 |
| ACC | Wadi | Karnataka | 1,075 |
| Chettinad | Karikazhi | Tamilnadu | 315 |
| Chettinad | Kallur | Tamilnadu | 386 |
| Dalmia Bharath | Belagavi | Karnataka | 956 |
| JK Cement | Muddapur | Karnataka | 965 |
| Dalmia Bharath | Kadapa | Karnataka | 739 |
| Bharathi VICAT | Kalburgi | Karnataka | 1,074 |
| JSW | Kurnool | Andhra Pradesh | 901 |
| Bharathi VICAT | Kadapa | Andhra Pradesh | 739 |
| Ultratech | Tadiparri | Andhra Pradesh | 815 |
| Zuari | Yerraguntla | Andhra Pradesh | 877 |

## 10.0 Estimated Project Cost

The details of the estimated cost for bio-mining the legacy waste dumpsite is provided in the table below:

**Table 10.1 Details of Estimated Project Cost**

| Sl. No. | Activity | Rate/ m3 | Quantity (m3) | Amount (INR) | Details |
|---|---|---|---|---|---|
| 1 | **Bio-mining Operations** | | | | |
| a | Processing the Waste | [redacted] | | [redacted] | Rate adopted from Calculation from Suchitwa Mission (DSR 2018 including baling) |
| 2 | **Disposal Cost** | | | | |
| a | Disposal of RDF | [redacted] | [redacted] | [redacted] | The average distance to cement factories works out to be 400 km. [redacted] |

| Sl. No. | Activity | Rate/ m3 | Quantity (m3) | Amount (INR) | Details |
|---|---|---|---|---|---|
| b | Disposal of Compost/ Soil enricher | [redacted] | [redacted] | [redacted] | Considering the disposal cost of [redacted] (market rate) |
| c | Sale of recyclables | [redacted] | [redacted] | [redacted] | Cost of disposal of recyclable is considered at [redacted] |
| d | Disposal of Inert | [redacted] | [redacted] | [redacted] | Considering the disposal cost of [redacted] (market rate) |
| | Total (1+2) | | | [redacted] | |
| | E& S Safeguards | | | [redacted] | |
| | Contractors Profit and Overheads at 15% | | | [redacted] | |
| | Net Cost | | | [redacted] | |
| | Grand Total (considering avg cost index of 1.35 based on DSR 2018) | | | [redacted] | |
| | Cost per m3 | | | [redacted] | |

*Note: It is to be noted that the total quantity of the waste is assessed based on the investigation test results and variation in the quantity of the same is expected during the execution stage. Hence RFB should include sufficient clauses to incorporate this expected quantity variation under the rate quoted by the contractor.*

### 10.1 Revenue from the Project

The anticipated sources of revenue from the processing of the legacy waste dumpsite are by sale Bio earth & C&D waste, organic compost, RDF and recyclables. But due to the following reasons mentioned below no revenue from the project is considered

- RDF is utilized as fuel (co – processing) in the cement industries, presently most cement industries are only accepting the RDF at free cost and transportation cost to be borne by the ULB/ contractor.
- The uncertainty of quantity and quality of the recyclables from legacy dumpsite due to burnt or crushed or disintegrated, rusted and additional money is required for cleaning of the recyclables for saleable.
- Paucity of time and limited storage space.

### 10.2 Funding for Project

The estimated cost of INR [redacted] for the project Dumpsite Remediation of legacy waste at Kothamangalam. The sources and funding pattern is given below:

**Table 10.2 Sources of funds in Crores**

| Sl no | Item wise funding pattern | | | |
|---|---|---|---|---|
| | Item | External (70%) (INR) | State Govt.(30%) (INR) | Total Cost (INR) |
| 1 | Dumpsite remediation for the Kothamangalam | [redacted] | [redacted] | [redacted] |

## 11.0 Project Implementation Plan

Kothamangalam Municipality intends to complete this project as early as possible. However, considering the time required for mobilisation, installation, sieving and handling recoverable etc, a time frame of about 06 months is considered.

### 11.1 Timeline

The broad timeline for the execution of this project is given below:

**Table 11.1 Project Timeline**

| TIMELINE CHART FOR EXECUTION | | | | | | | |
|---|---|---|---|---|---|---|---|
| S. No | Task Name | M 1 | M 2 | M 3 | M 4 | M 5 | M 6 |
| 1 | Planning & Mobilization | ■ | | | | | |
| 2 | Foundation & Civil Works (Cover Shed installation) for machineries, Hiring & Installation of Machineries, Electrical Works | ■ | ■ | ■ | ■ | ■ | ■ |
| 3 | Excavation of Legacy Waste | | ■ | ■ | ■ | | |
| 4 | Site Development for Windrows & Leachate Collection | | | ■ | ■ | ■ | ■ |
| 5 | Windrow Formation & Spraying of Bio culture | | | | ■ | ■ | ■ |
| 6 | Sieving Operations | | | | | ■ | ■ |
| 7 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | | | | ■ | ■ |
| 8 | Project Closure Activities:<br>Levelling of Reclaimed Land using Bio-soil<br>Handover the available infrastructure at site to the ULB<br>Closure Report Submission to ULB. | | | | | | ■ |

## 11.2 Contract Model

***Execution Method:***

Design, Build, Operate and disposal/Management of by-products/aggregates with -zero residues and 100% land recovery. The work shall be carried out in compliance with SWM Rules 2016 and CPCB Guidelines for the disposal of legacy waste 2019.

***Working Model***

- 100% work to outsourced to selected private contractor
- TSC will assess the quantity of waste and the ULB will hand over the land for setting up the facility to the Contractor.
- Electricity connection to be under contractor's scope.
- Electricity charges for the usage of the plant to be paid by contractor
- ULB may facilitate the disposal/Utilization of By-products and contractor is responsibility for disposal of RDF, recyclables, and aggregates.

*Note: The authority has put stringent selection criteria and it is expected that the onboarded contractor has sufficient experience and qualified technically to avoid contract failure. The client will have a proactive contract management and monitoring system in place to address any potential issues for successful completion of the contract*

## 12.0 Benefits of the Project

The project benefits of dumpsite remediation at Kothamangalam are:

- Reclamation of Land: An area of 2.6 acres will be reclaimed which can be used for resetting SWM facilities of ULB or any other use deemed fit by the ULB.
- Environmental Protection: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By clearing up contaminated site, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity
- Health Improvement: Remediation projects reduce pollution risks, leading to improved public health outcomes and a reduction in water borne and airborne diseases.
- Enhanced Water Quality: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to the safe water.
- Aesthetic and Social Benefits: Remediation of legacy waste dumpsite can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents.
- Operational & Life cycle Aspects - Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through bio-mining process.

## 13. Conclusion

- The activities of the bio-mining will require 5-6 months. An area of 2.6 acres will be reclaimed and will be used for setting up other solid waste management facilities/ or any other use deemed fit by the ULB in future.
- The land will be reclaimed and recovered through the biomining process, and this will done by ensuring environmental and social safeguards.
- For the optimum screening of the 29,915 m3 of legacy waste, mobile / compact screening machinery shall be used.
- Favourable site conditions for bio-mining:
    - Optimum width of the road is available for movement of the vehicles.
    - Electrical power infrastructure viz., power lines & electrical transformer is available adjacent to the boundary of the dumpsite.
    - Piped water supply and a storage of water tank 5000 liters are available at the dumpsite.
- The project activity requires "Site Authorization, Consent to Establish and Consent to Operate" from KSPCB
- The implementation/execution of the project activities shall be conforming to SWM Rules 2016, CPCB 2018 guidelines for legacy waste management, NGT orders, KSPCB norms, World Bank guidelines and KSWMP ESMF and other regulatory rules & norms Environmental & Social safeguards:
    - The project attracts E2 Environmental category based on the project activities and status of the environment baseline.
    - Site specific Environmental Assessment and Environmental Management Plan has been developed.
    - The project attracts moderate risk social category based on the social mapping & transect walk to understand the settlements/habitations/establishments etc., and consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.
- Total cost of the project is Rs [redacted].

# Annexures

| | |
|---|---|
| Annexure 1 | Topographical Survey Report |
| Annexure 2 | Geotechnical Survey Report |
| Annexure 3 | Waste Characterization Report |
| Annexure 4 | Waste and Environmental Baseline Assessment Report |
| Annexure 5 | Site Plan |
| Annexure 6 | Site Operation Plan |
| Annexure 7 | Environmental & Social Impact Assessment Report |

## SUBMITTED

A detailed contour mapping survey of the dump site located at Kumbalathumury in Ward No-06 of Kothamangalam Municipality was conducted to quantify the legacy waste deposited over years.

The survey was carried out using total station (make-Leica) for precise details. The total voumne of legacy waste is calculated by using the software tool **G Survey CAD**. The total volume of the legacy dump is found to be **21295.462 cubic metres** which is spread over in an area of 8620 square metres. For the survey and qunatification purpose, the entire area was divided into eight different plots and the volumes of each plot was assessed individually.

The detailed drawing, contour map and quantity calculations are enclosed herewith.

Eldhose Paul
Assistant Engineer

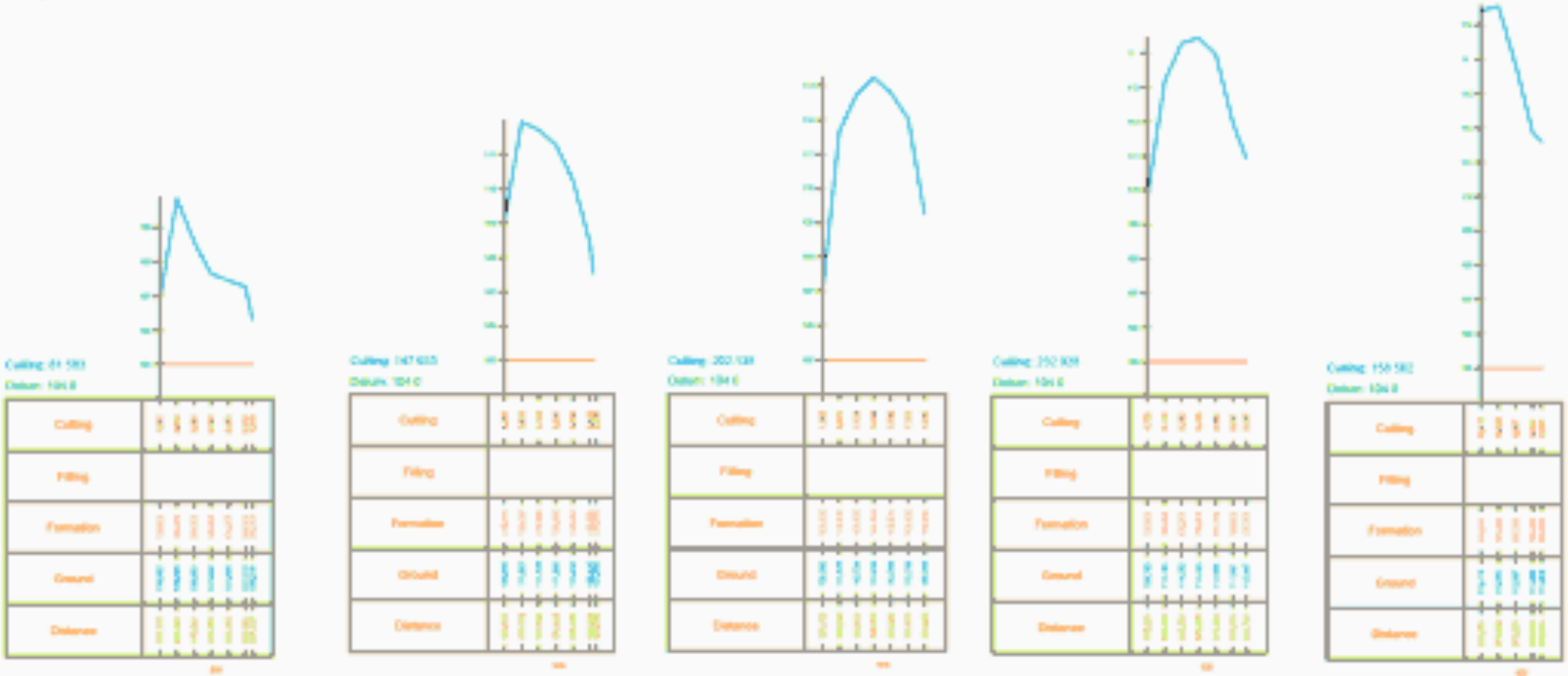
Kothamangalam
17/12/2022

Scanned with OKEN Scanner


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1

# C --S DIAGRAM

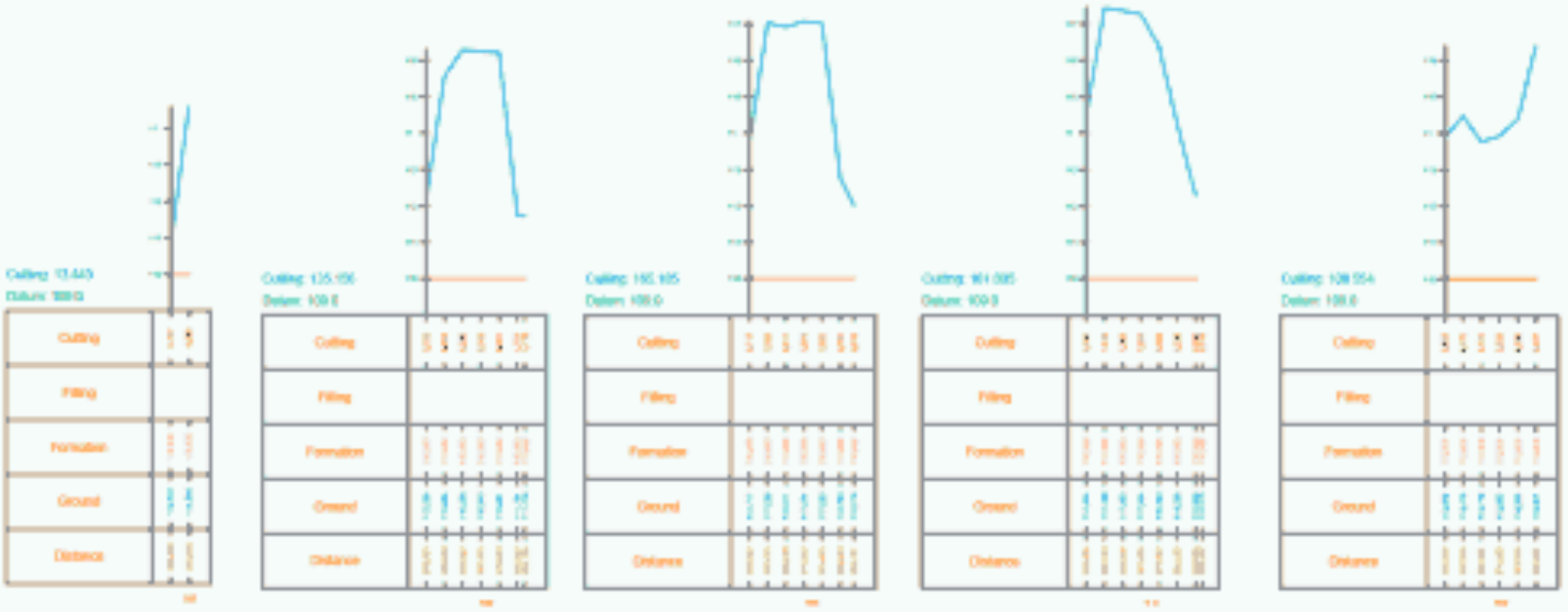


## Volume Report

| Sl. No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 905.000 | - | 0.000 | 27.039 | 81.583 | 0.000 | 40.792 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 910.000 | 905.000 | 5.000 | 25.952 | 147.653 | 81.583 | 114.618 | 573.090 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 915.000 | 910.000 | 5.000 | 29.866 | 202.138 | 147.653 | 174.896 | 874.478 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 920.000 | 915.000 | 5.000 | 28.780 | 232.928 | 202.138 | 217.533 | 1087.665 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 925.000 | 920.000 | 5.000 | 17.694 | 158.502 | 232.928 | 195.715 | 978.575 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 3513.808 | | | | 0.000 |

2

# C --S DIAGRAM

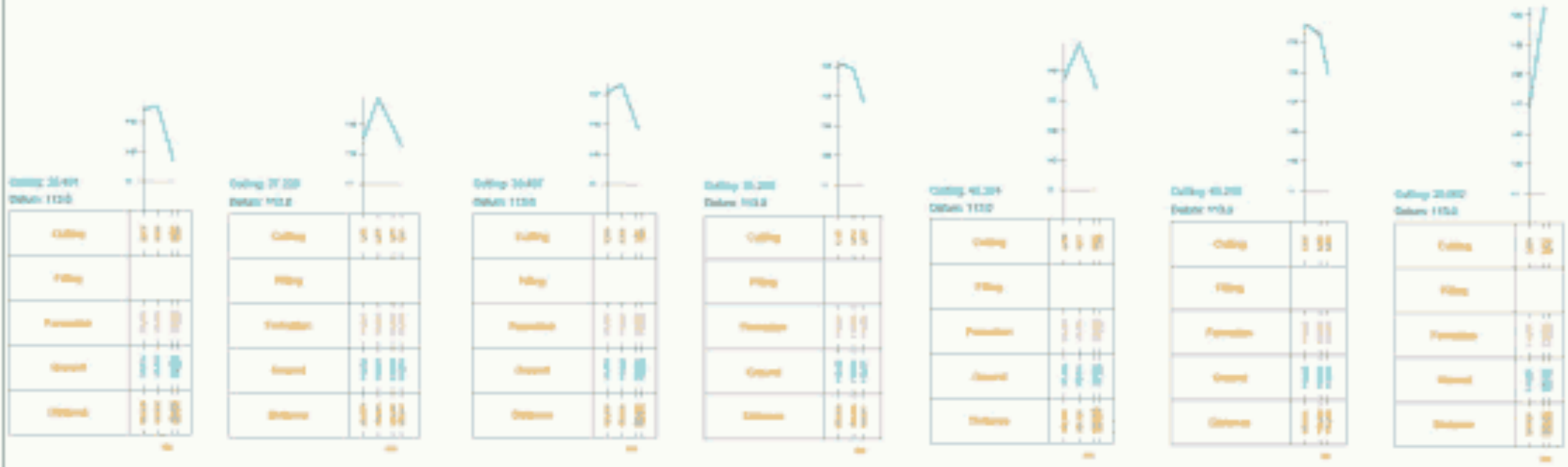



## Volume Report

| Sl. No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 925.000 | - | 0.000 | 5.000 | 13.443 | 0.000 | 6.722 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 930.000 | 925.000 | 5.000 | 27.159 | 135.156 | 13.443 | 74.300 | 371.498 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 935.000 | 930.000 | 5.000 | 28.701 | 165.185 | 135.156 | 150.171 | 750.853 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 940.000 | 935.000 | 5.000 | 30.242 | 181.005 | 165.185 | 173.095 | 865.475 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 945.000 | 940.000 | 5.000 | 32.745 | 197.619 | 181.005 | 189.312 | 946.560 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 950.000 | 945.000 | 5.000 | 25.000 | 108.554 | 197.619 | 153.087 | 765.433 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 3699.819 | | | | 0.000 |

3

# C -- S DIAGRAM

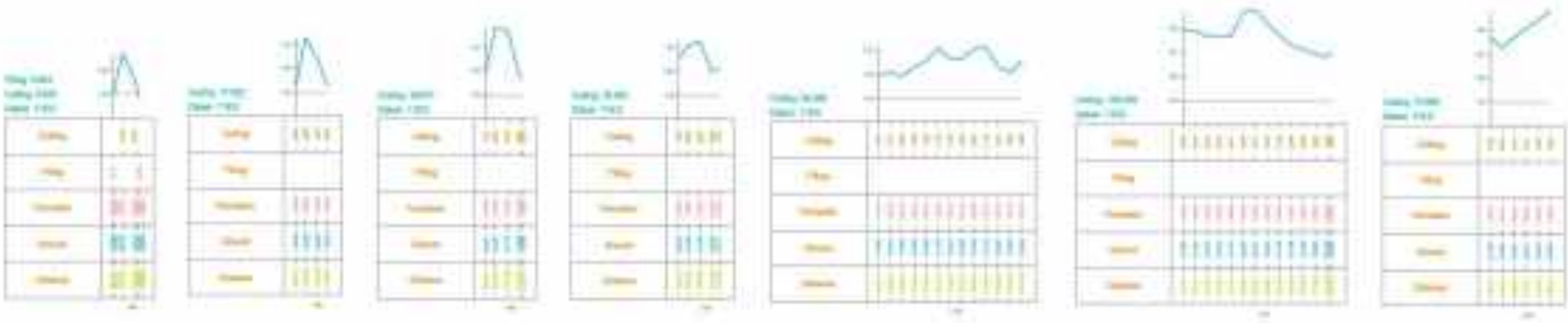


## Volume Report

| SL No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 950.000 | - | 0.000 | 10.108 | 20.491 | 0.000 | 10.246 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 955.000 | 950.000 | 5.000 | 12.866 | 27.226 | 20.491 | 23.859 | 119.293 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 960.000 | 955.000 | 5.000 | 10.614 | 30.487 | 27.226 | 28.857 | 144.283 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 965.000 | 960.000 | 5.000 | 8.341 | 31.284 | 30.487 | 30.886 | 154.428 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 970.000 | 965.000 | 5.000 | 10.619 | 45.284 | 31.284 | 38.284 | 191.420 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 975.000 | 970.000 | 5.000 | 7.832 | 40.219 | 45.284 | 42.752 | 213.758 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7 | 980.000 | 975.000 | 5.000 | 5.350 | 25.062 | 40.219 | 32.641 | 163.203 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | | **Total** | | | **986.385** | | | | **0.000** |

4

# C – S DIAGRAM



## Volume Report

| SL No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 985.000 | - | 0.000 | 11.217 | 9.685 | 0.000 | 4.843 | 0.000 | 0.044 | 0.000 | 0.022 | 0.000 |
| 2 | 990.000 | 985.000 | 5.000 | 13.019 | 17.602 | 9.685 | 13.644 | 68.218 | 0.000 | 0.044 | 0.022 | 0.110 |
| 3 | 995.000 | 990.000 | 5.000 | 14.820 | 30.977 | 17.602 | 24.290 | 121.448 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 1000.000 | 995.000 | 5.000 | 16.620 | 28.492 | 30.977 | 29.735 | 148.673 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 1005.000 | 1000.000 | 5.000 | 59.870 | 90.300 | 28.492 | 59.396 | 296.980 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 1010.000 | 1005.000 | 5.000 | 61.850 | 168.859 | 90.300 | 129.580 | 647.898 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7 | 1015.000 | 1010.000 | 5.000 | 25.000 | 73.669 | 168.859 | 121.264 | 606.320 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 1889.537 | | | | 0.110 |

5

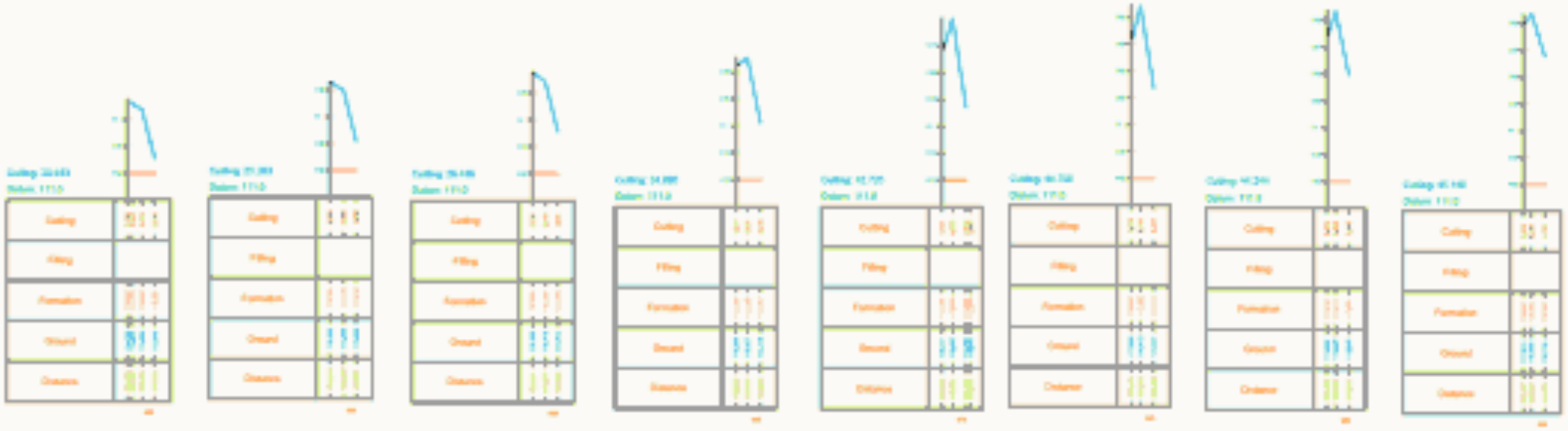
# C --S DIAGRAM




## Volume Report

| Sl. No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 990.000 | - | 0.000 | 7.473 | 4.721 | 0.000 | 2.361 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 995.000 | 990.000 | 5.000 | 7.113 | 8.751 | 4.721 | 6.736 | 33.680 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 1000.000 | 995.000 | 5.000 | 6.753 | 13.588 | 8.751 | 11.170 | 55.848 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 1005.000 | 1000.000 | 5.000 | 6.393 | 19.445 | 13.588 | 16.517 | 82.583 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 1010.000 | 1005.000 | 5.000 | 6.033 | 21.130 | 19.445 | 20.288 | 101.438 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 1015.000 | 1010.000 | 5.000 | 5.673 | 22.044 | 21.130 | 21.587 | 107.935 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 381.484 | | | | 0.000 |

# C --S DIAGRAM

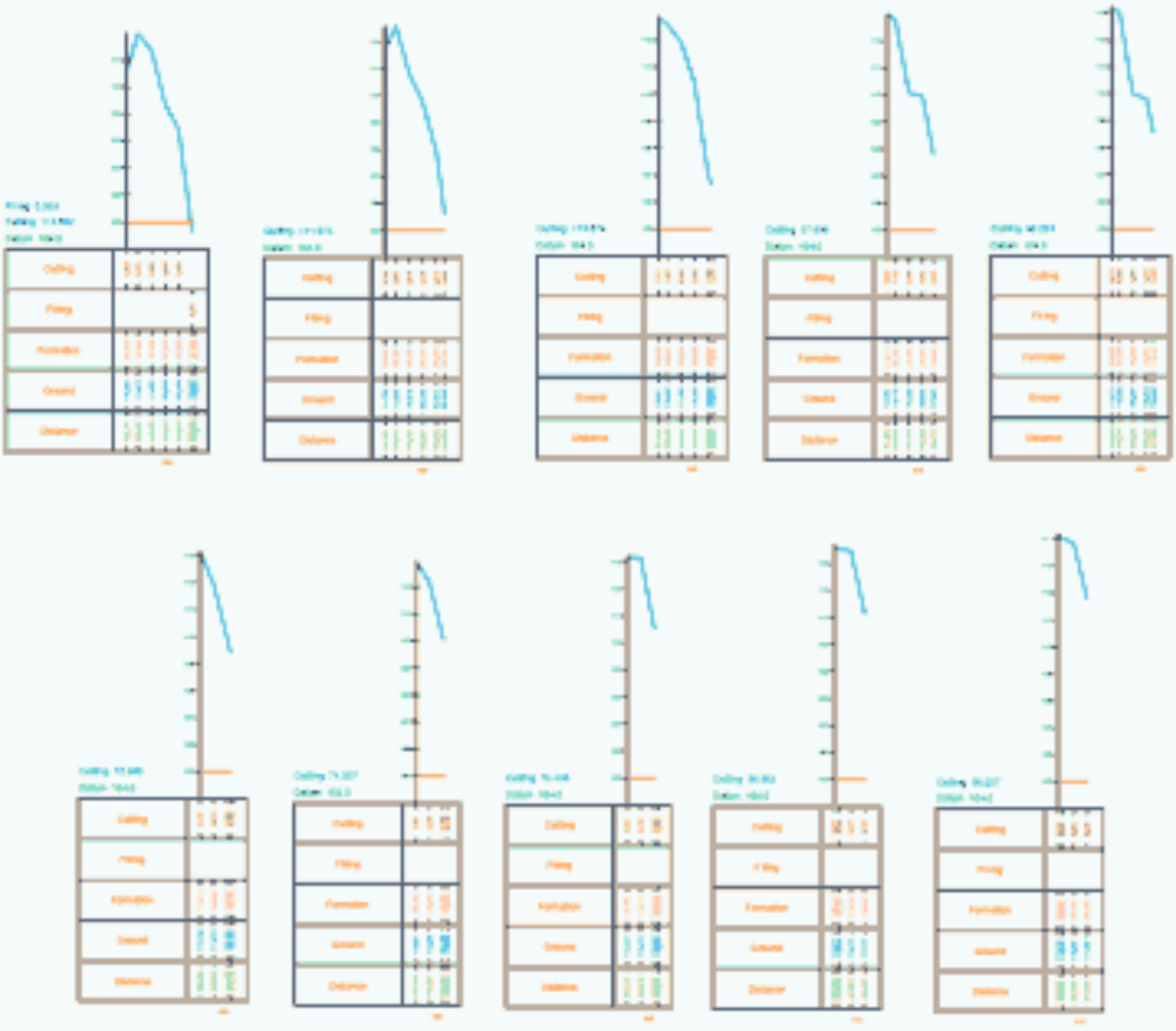


## Volume Report

| Sl. No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 950.000 | - | 0.000 | 10.119 | 20.453 | 0.000 | 10.227 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 955.000 | 950.000 | 5.000 | 9.661 | 25.208 | 20.453 | 22.831 | 114.153 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 960.000 | 955.000 | 5.000 | 9.362 | 28.438 | 25.208 | 26.823 | 134.115 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 965.000 | 960.000 | 5.000 | 9.131 | 34.880 | 28.438 | 31.659 | 158.295 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 970.000 | 965.000 | 5.000 | 8.916 | 42.725 | 34.880 | 38.803 | 194.013 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 975.000 | 970.000 | 5.000 | 8.555 | 44.706 | 42.725 | 43.716 | 218.578 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7 | 980.000 | 975.000 | 5.000 | 8.194 | 44.244 | 44.706 | 44.475 | 222.375 | 0.000 | 0.000 | 0.000 | 0.000 |
| 8 | 985.000 | 980.000 | 5.000 | 7.833 | 45.148 | 44.244 | 44.696 | 223.480 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 1265.009 | | | | 0.000 |

# C –S DIAGRAM

7

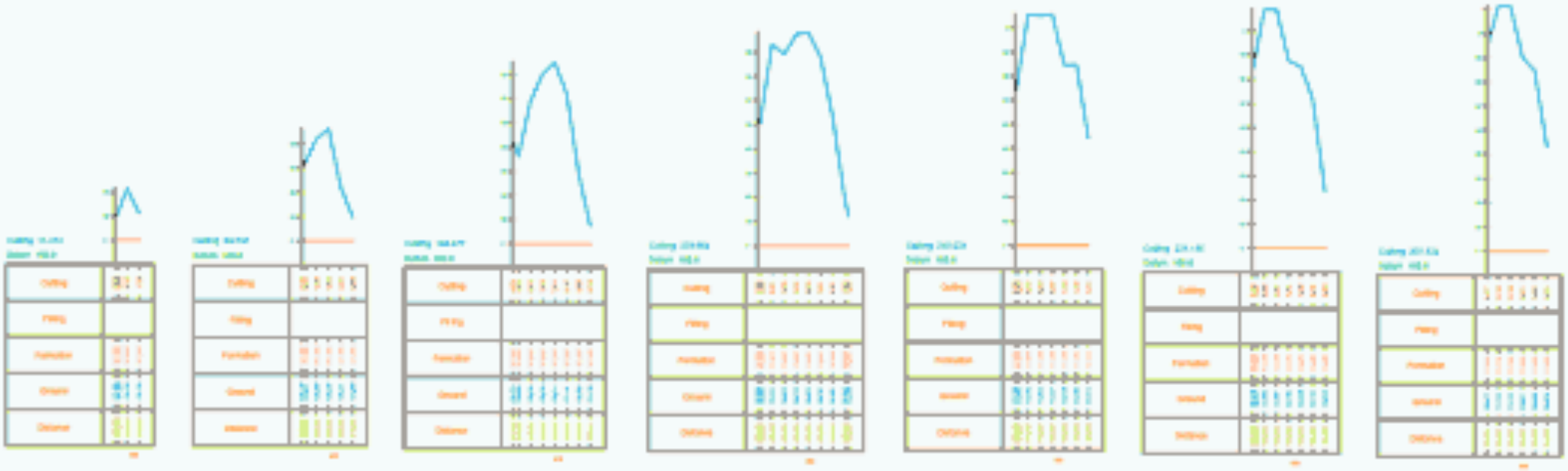


## Volume Report

| Sl. No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 920.000 | - | 0.000 | 24.263 | 113.852 | 0.000 | 56.926 | 0.000 | 0.093 | 0.000 | 0.047 | 0.000 |
| 2 | 920.000 | 900.000 | 5.000 | 21.861 | 111.974 | 113.852 | 112.913 | 564.563 | 0.000 | 0.093 | 0.047 | 0.233 |
| 3 | 900.000 | 905.000 | 5.000 | 19.439 | 113.874 | 111.974 | 112.924 | 564.620 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 905.000 | 910.000 | 5.000 | 17.334 | 97.696 | 113.874 | 105.785 | 528.925 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 920.000 | 915.000 | 5.000 | 15.395 | 90.223 | 97.696 | 93.960 | 469.798 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 925.000 | 920.000 | 5.000 | 11.316 | 73.880 | 90.223 | 81.956 | 409.780 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7 | 930.000 | 925.000 | 5.000 | 10.397 | 71.007 | 72.689 | 71.948 | 359.740 | 0.000 | 0.000 | 0.000 | 0.000 |
| 8 | 935.000 | 930.000 | 5.000 | 10.233 | 76.495 | 71.007 | 73.751 | 368.755 | 0.000 | 0.000 | 0.000 | 0.000 |
| 9 | 940.000 | 935.000 | 5.000 | 11.141 | 86.984 | 76.495 | 82.700 | 413.498 | 0.000 | 0.000 | 0.000 | 0.000 |
| 10 | 945.000 | 940.000 | 5.000 | 10.656 | 90.027 | 86.984 | 89.466 | 447.328 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 4135.059 | | | | 0.233 |

8

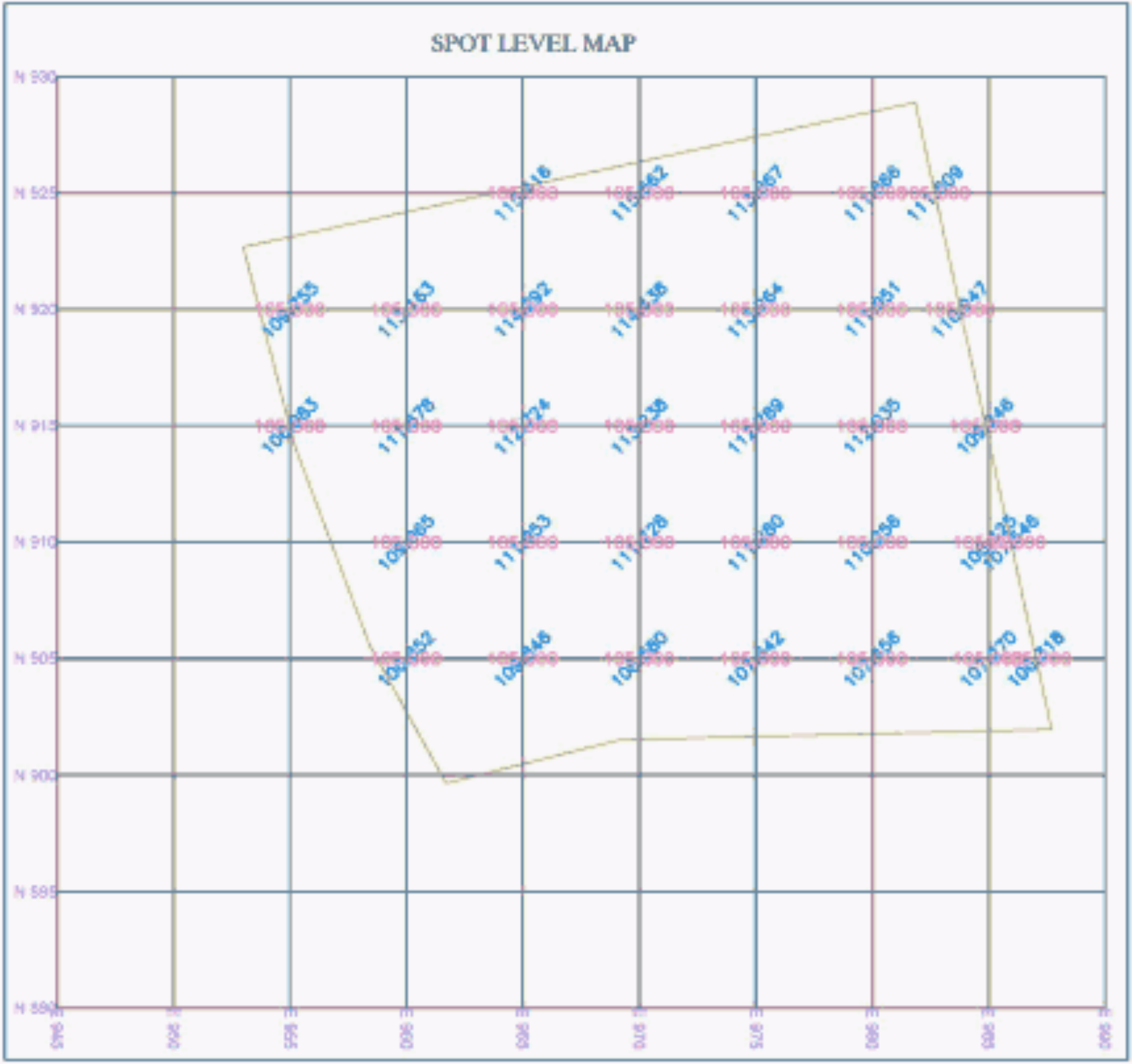
## C –5 DIAGRAM



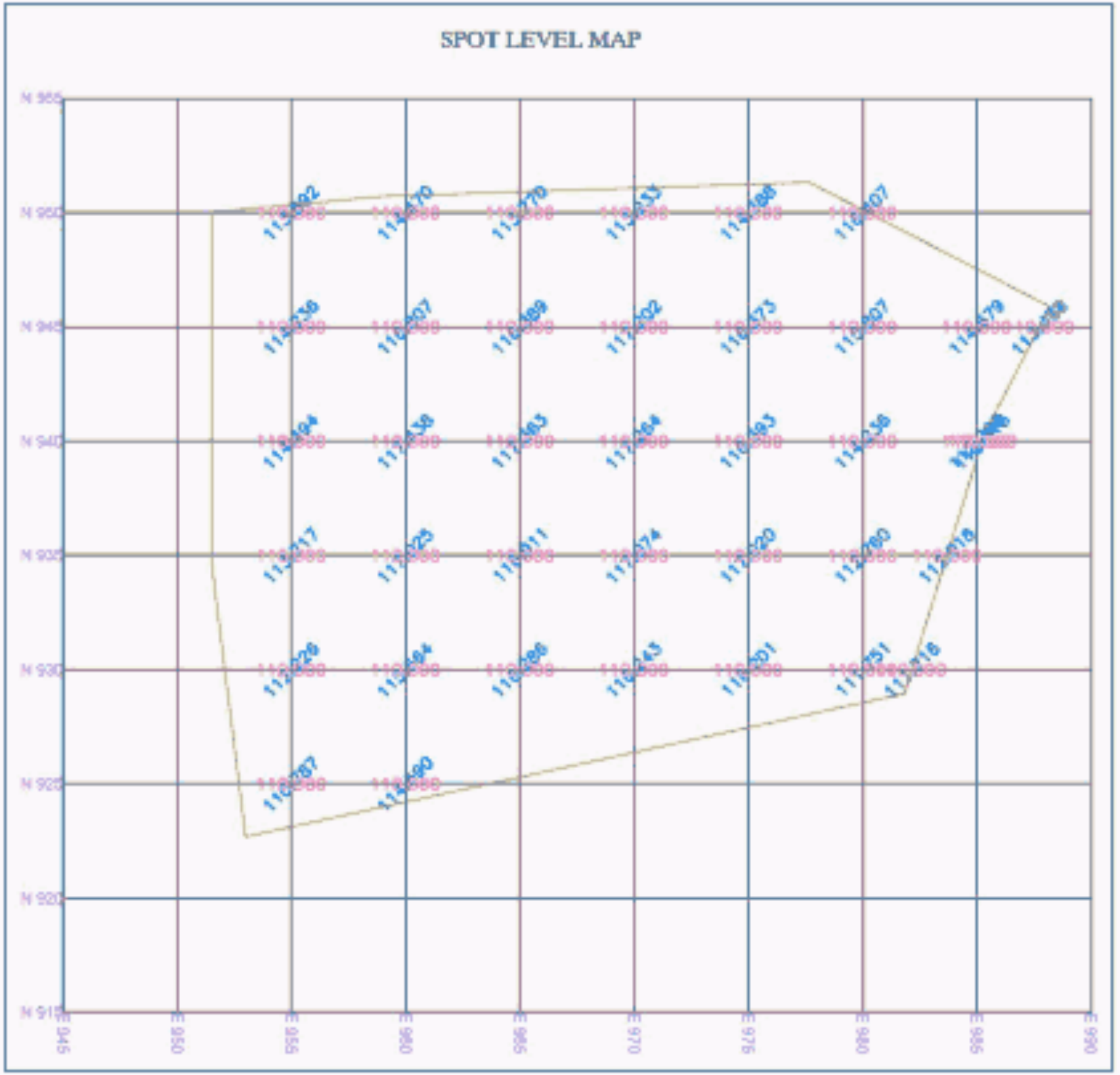
## Volume Report

| Sl. No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 865.000 | - | 0.000 | 10.000 | 15.474 | 0.000 | 7.737 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 870.000 | 865.000 | 5.000 | 21.179 | 69.597 | 15.474 | 42.536 | 212.678 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 875.000 | 870.000 | 5.000 | 32.026 | 166.877 | 69.597 | 118.237 | 591.185 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 880.000 | 875.000 | 5.000 | 37.540 | 259.664 | 166.877 | 213.271 | 1066.353 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 885.000 | 880.000 | 5.000 | 30.526 | 248.034 | 259.664 | 253.849 | 1269.245 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 890.000 | 885.000 | 5.000 | 30.098 | 231.156 | 248.034 | 239.595 | 1197.975 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7 | 895.000 | 890.000 | 5.000 | 24.671 | 207.634 | 231.156 | 219.395 | 1096.975 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 5434.411 | | | | 0.000 |

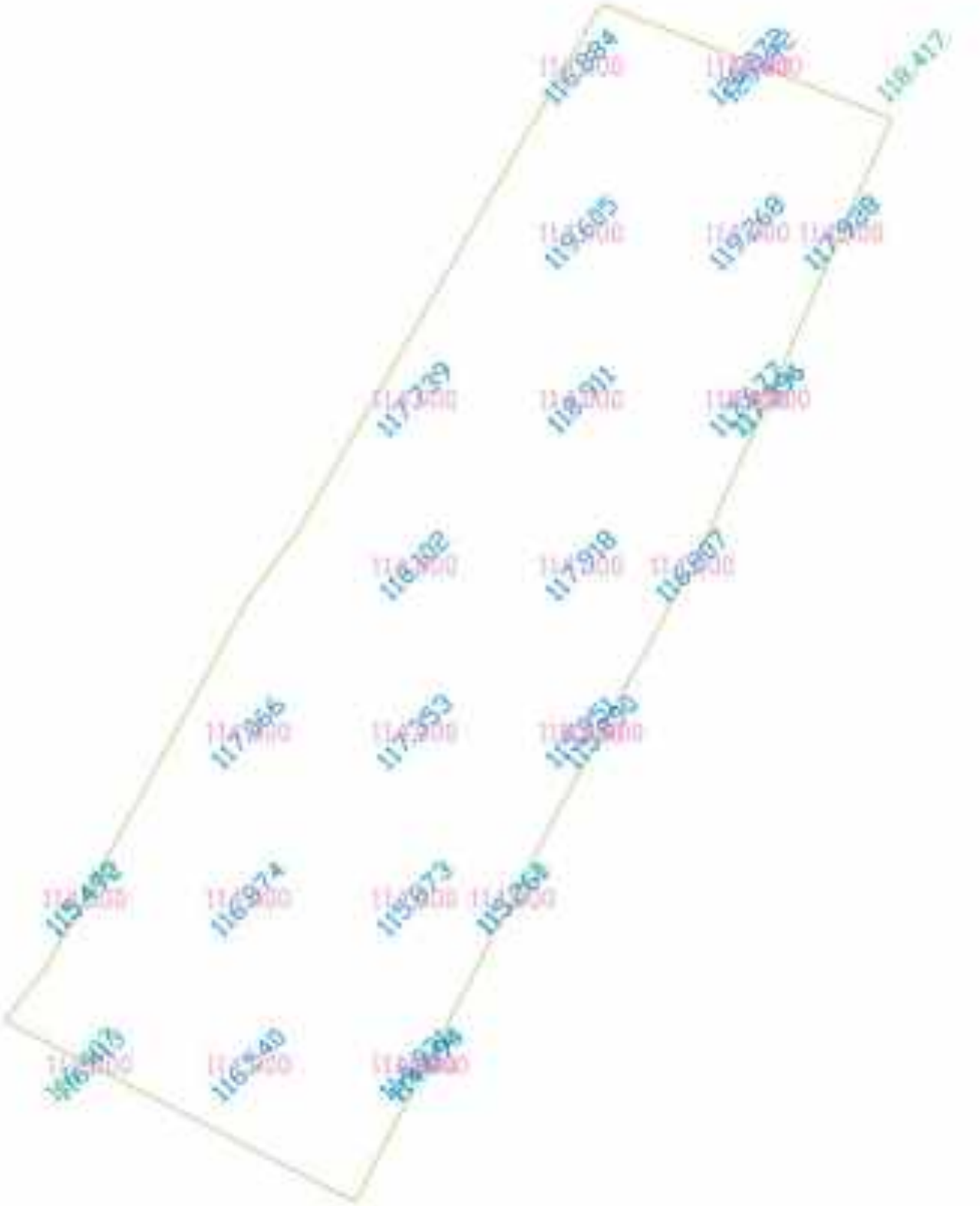
# SPOT LEVEL MAP



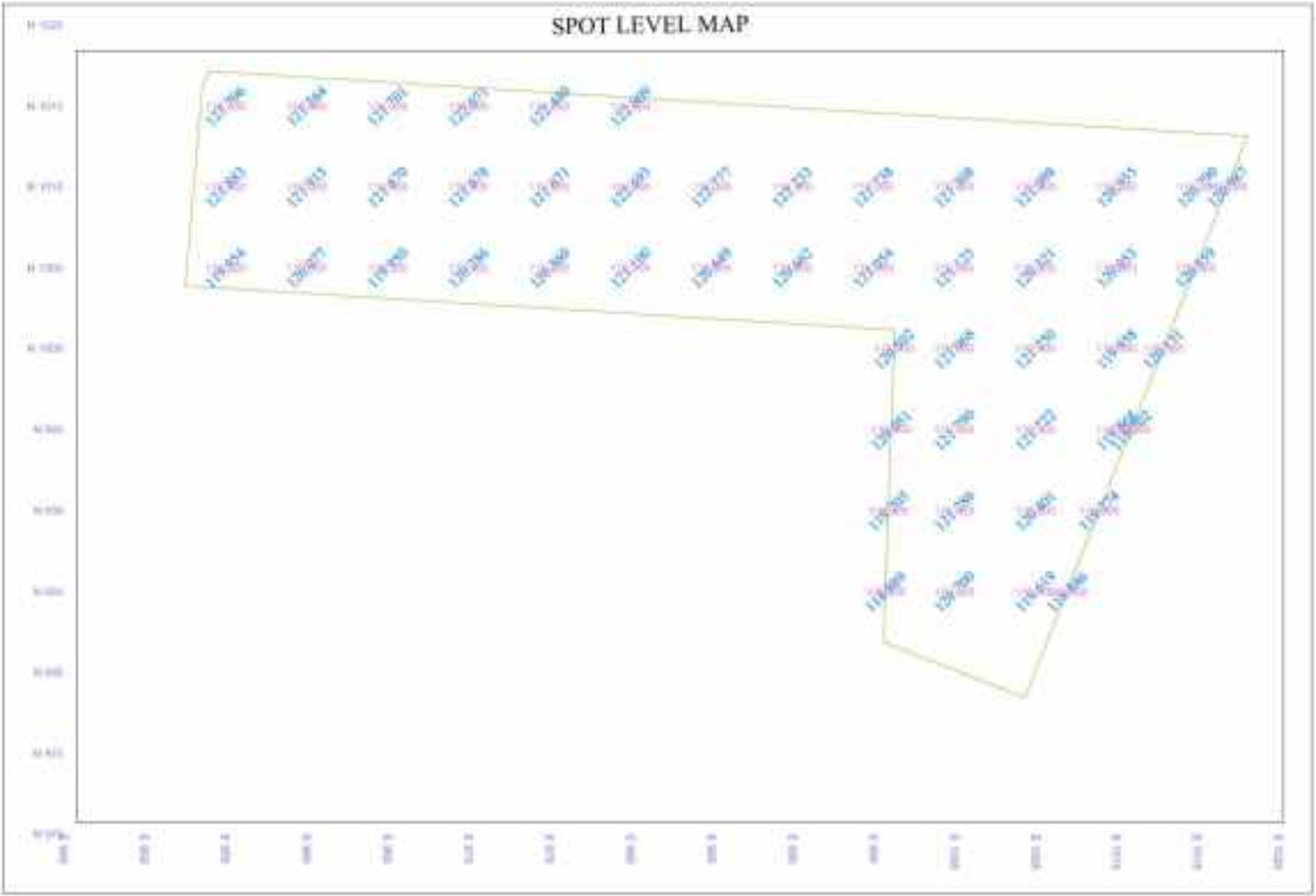
# SPOT LEVEL MAP



# SPOT LEVEL MAP

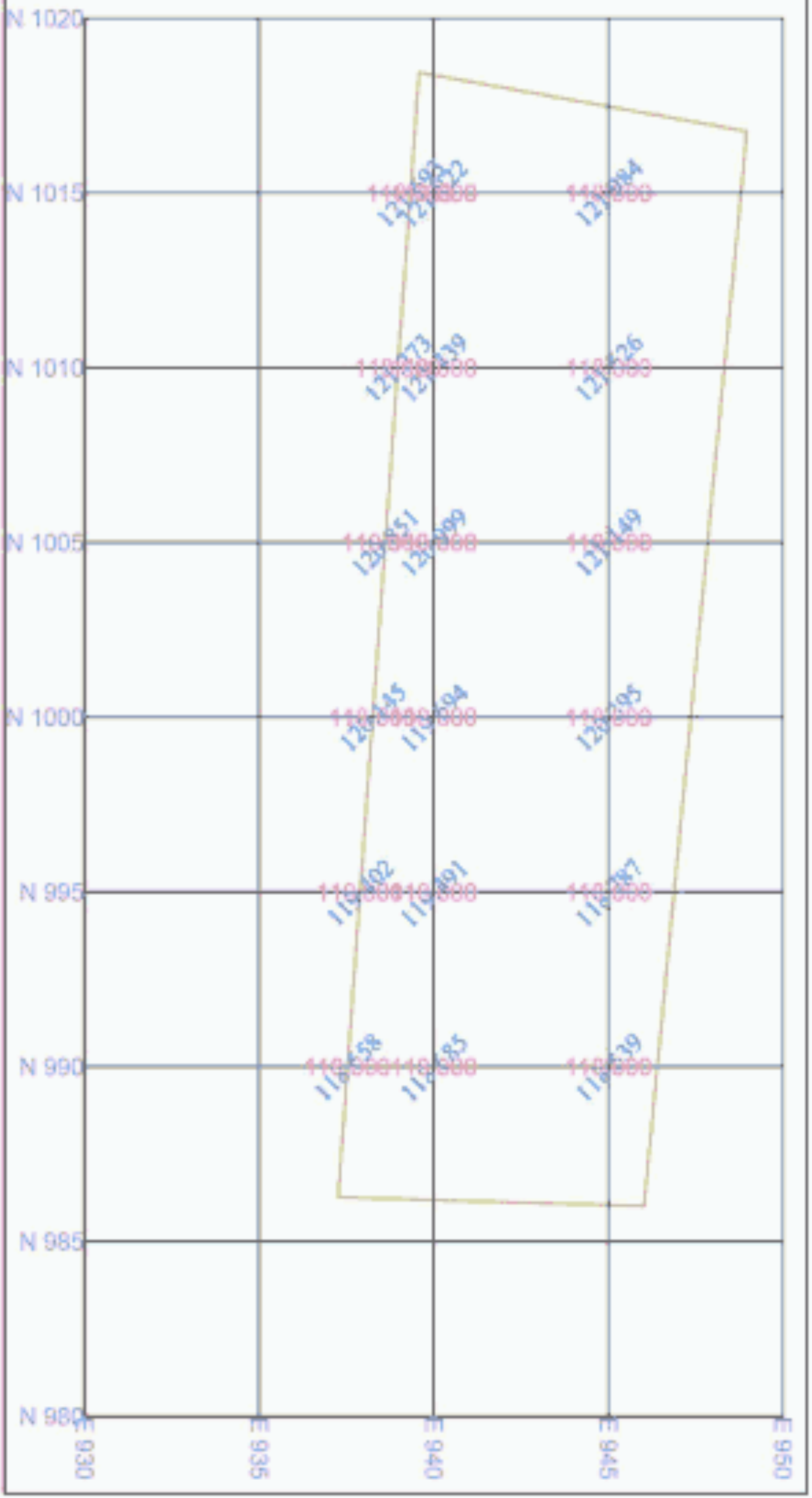


# SPOT LEVEL MAP



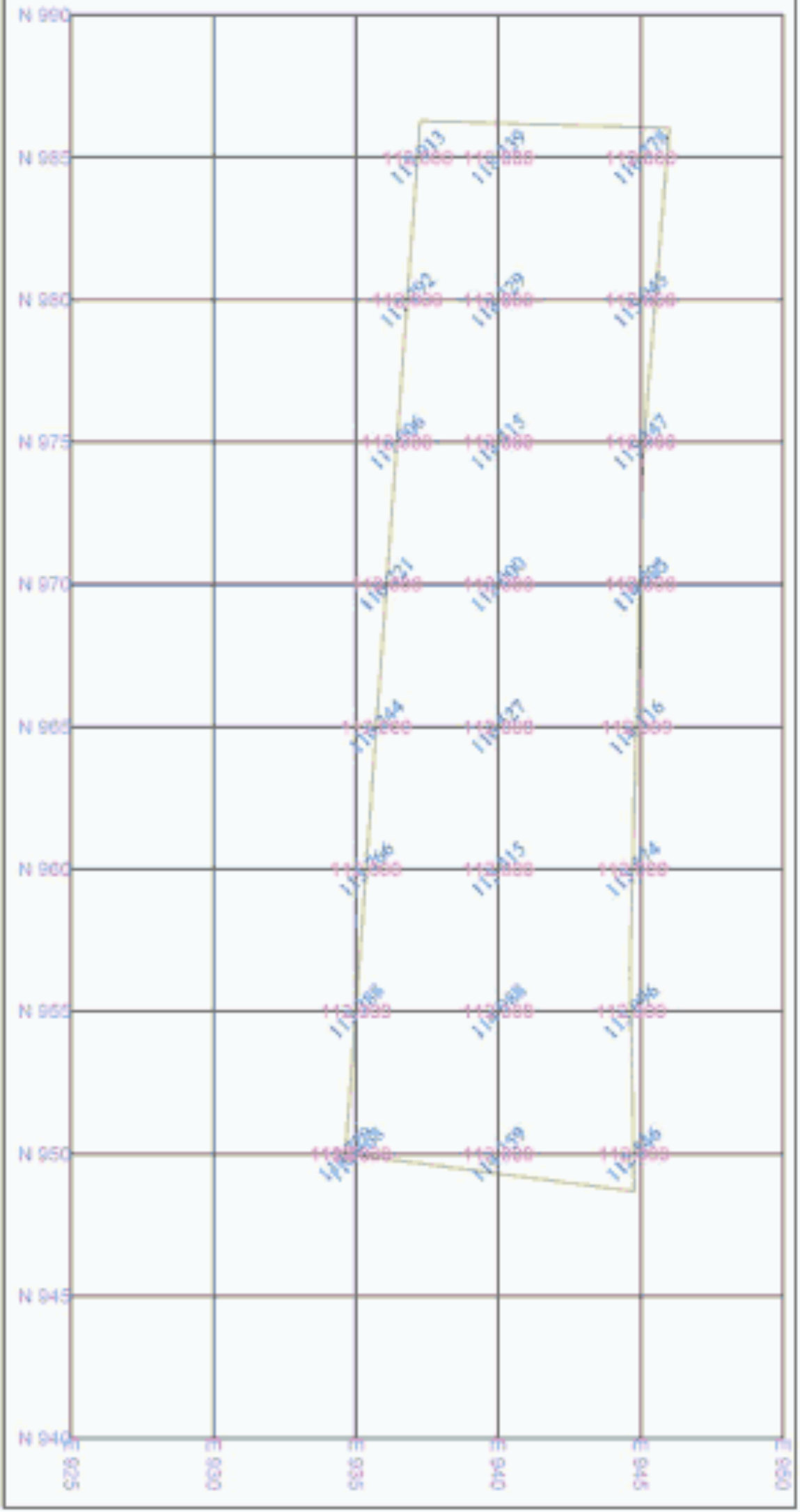
5

# SPOT LEVEL MAP



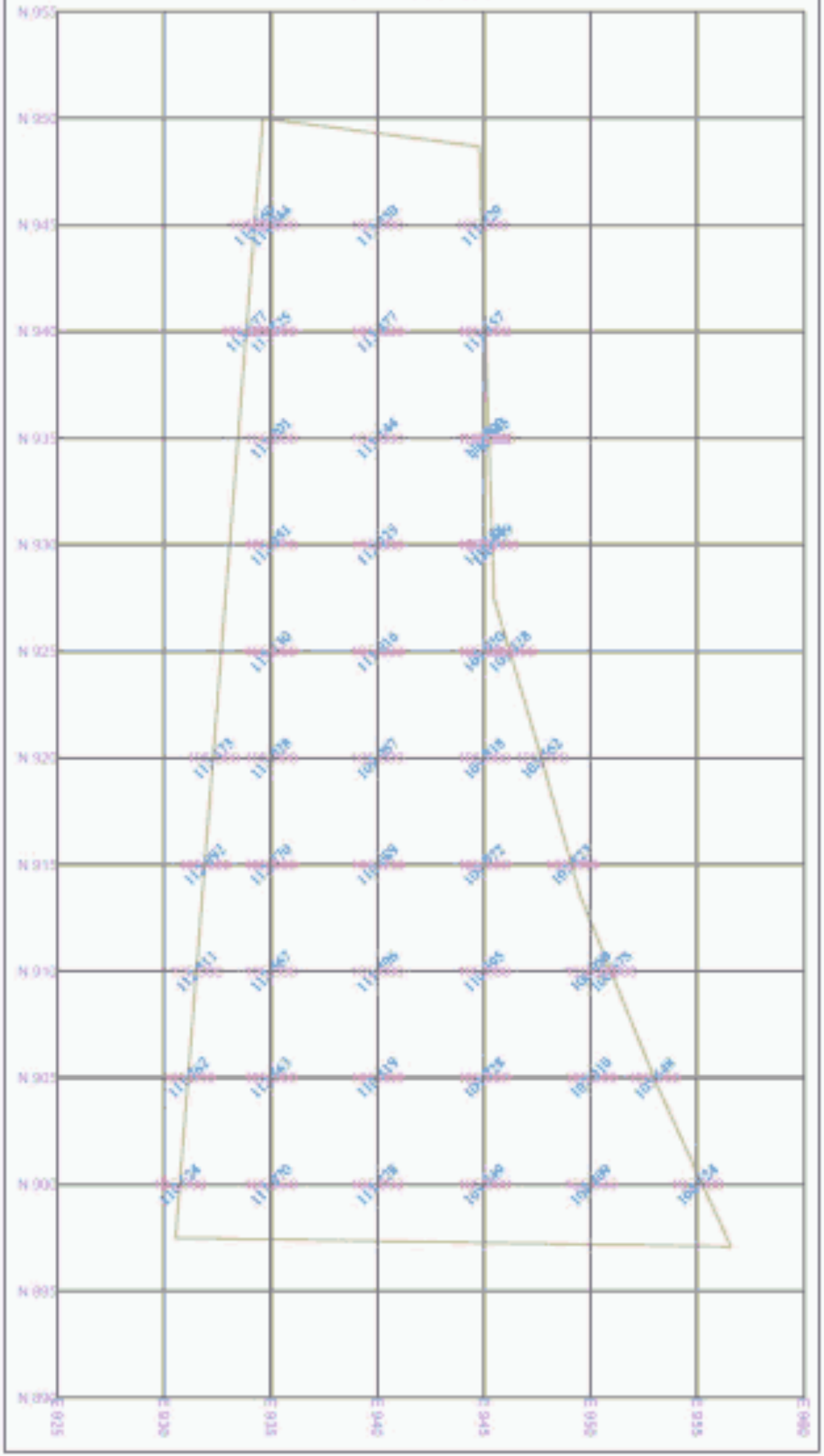
6

# SPOT LEVEL MAP

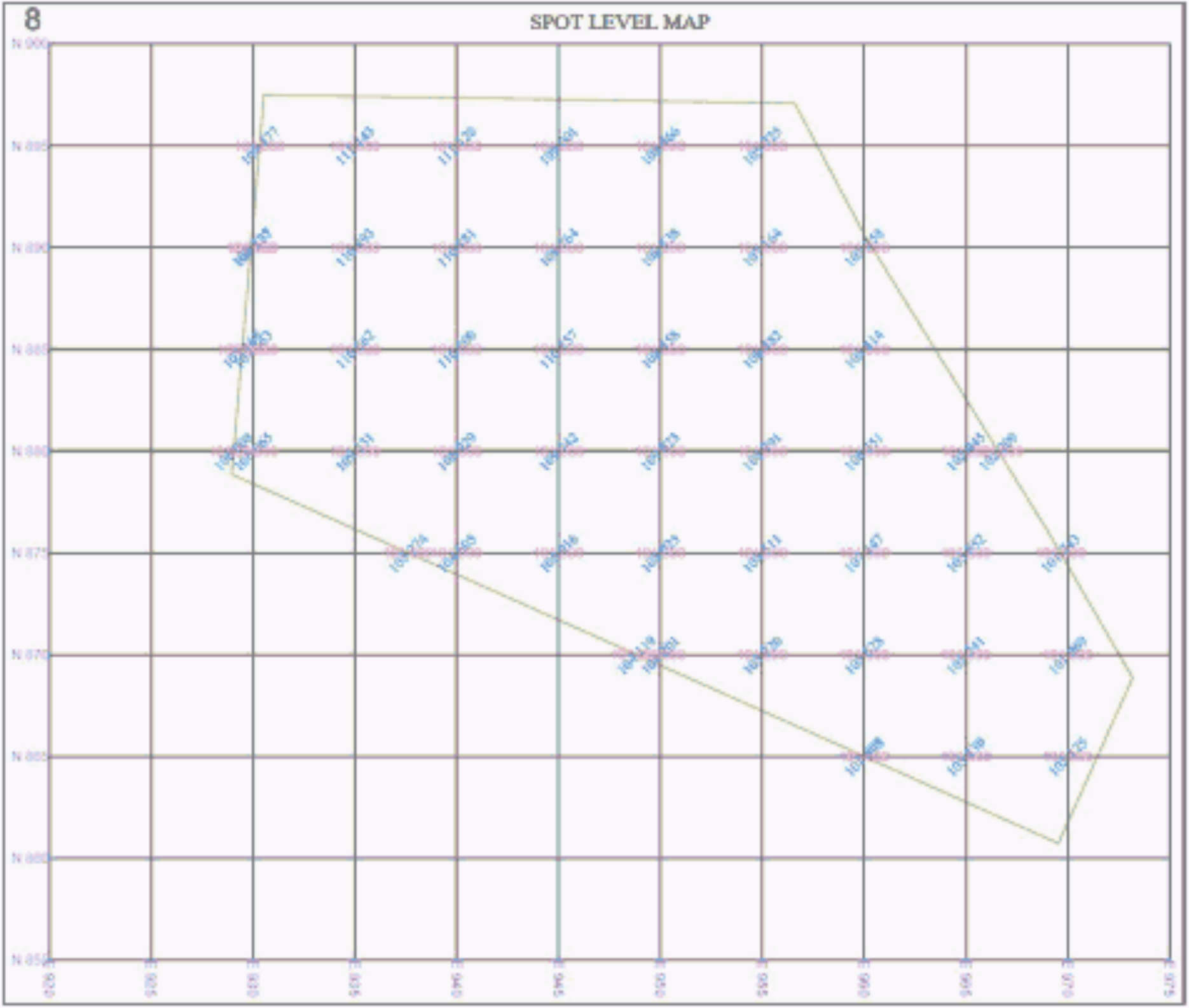


7

# SPOT LEVEL MAP



# SPOT LEVEL MAP



## Area Report

| Sl. No. | Distance | Ground | Formation | Cutting Area | | | | Filling Area | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cutting | Avg | Width | Area | Filling | Avg | Width | Area |
| | Meters | Meters | Meters | Meters | Meters | Meters | Sq. Meters | Meters | Meters | Meters | Sq. Meters |
| **Section: 905.000** | | | | | | | | | | | |
| 1 | 960.000 | 906.852 | 105.000 | 1.852 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 965.000 | 909.846 | 105.000 | 4.846 | 3.3490 | 5.000 | 16.745 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 970.000 | 908.580 | 105.000 | 3.580 | 4.2130 | 5.000 | 21.065 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 975.000 | 907.642 | 105.000 | 2.642 | 3.1110 | 5.000 | 15.555 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 980.000 | 907.456 | 105.000 | 2.456 | 2.5490 | 5.000 | 12.745 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 985.000 | 907.270 | 105.000 | 2.270 | 2.3630 | 5.000 | 11.815 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 987.039 | 906.318 | 105.000 | 1.318 | 1.7940 | 2.039 | 3.658 | 0.000 | 0.0000 | 2.039 | 0.000 |
| | | | **Total** | | | | 81.583 | | | | 0.000 |
| **Section: 910.000** | | | | | | | | | | | |
| 1 | 960.000 | 909.065 | 105.000 | 4.065 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 965.000 | 911.953 | 105.000 | 6.953 | 5.5090 | 5.000 | 27.545 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 970.000 | 911.728 | 105.000 | 6.728 | 6.8405 | 5.000 | 34.203 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 975.000 | 911.280 | 105.000 | 6.280 | 6.5040 | 5.000 | 32.520 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 980.000 | 910.256 | 105.000 | 5.256 | 5.7680 | 5.000 | 28.840 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 985.000 | 908.425 | 105.000 | 3.425 | 4.3405 | 5.000 | 21.703 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 985.953 | 907.546 | 105.000 | 2.546 | 2.9855 | 0.953 | 2.847 | 0.000 | 0.0000 | 0.953 | 0.000 |
| | | | **Total** | | | | 147.656 | | | | 0.000 |
| **Section: 915.000** | | | | | | | | | | | |
| 1 | 955.000 | 906.983 | 105.000 | 1.983 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.000 | 911.678 | 105.000 | 6.678 | 4.3305 | 5.000 | 21.653 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 965.000 | 912.724 | 105.000 | 7.724 | 7.2010 | 5.000 | 36.005 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 970.000 | 913.238 | 105.000 | 8.238 | 7.9810 | 5.000 | 39.905 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 975.000 | 912.789 | 105.000 | 7.789 | 8.0135 | 5.000 | 40.068 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 980.000 | 912.000 | 105.000 | 7.035 | 7.4120 | 5.000 | 37.060 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 984.866 | 909.246 | 105.000 | 4.246 | 5.6405 | 4.866 | 27.447 | 0.000 | 0.0000 | 4.866 | 0.000 |
| | | | **Total** | | | | 202.136 | | | | 0.000 |
| **Section: 920.000** | | | | | | | | | | | |
| 1 | 955.000 | 909.755 | 105.000 | 4.755 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.000 | 913.163 | 105.000 | 8.163 | 6.4590 | 5.000 | 32.295 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 965.000 | 914.292 | 105.000 | 9.292 | 8.7275 | 5.000 | 43.638 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 970.000 | 914.438 | 105.000 | 9.438 | 9.3650 | 5.000 | 46.825 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 975.000 | 913.964 | 105.000 | 8.964 | 9.2010 | 5.000 | 46.005 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 980.000 | 911.951 | 105.000 | 6.951 | 7.9575 | 5.000 | 39.788 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 983.780 | 910.947 | 105.000 | 5.947 | 6.4490 | 3.780 | 24.377 | 0.000 | 0.0000 | 3.780 | 0.000 |
| | | | **Total** | | | | 232.928 | | | | 0.000 |
| **Section: 925.000** | | | | | | | | | | | |
| 1 | 965.000 | 915.416 | 105.000 | 10.416 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 970.000 | 915.562 | 105.000 | 10.562 | 10.4890 | 5.000 | 52.445 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 975.000 | 913.667 | 105.000 | 8.867 | 9.7145 | 5.000 | 48.573 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 980.000 | 911.866 | 105.000 | 6.866 | 7.8665 | 5.000 | 39.333 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 982.694 | 911.609 | 105.000 | 6.609 | 6.7375 | 2.694 | 18.151 | 0.000 | 0.0000 | 2.694 | 0.000 |
| | | | **Total** | | | | 158.502 | | | | 0.000 |

## Area Report

| Sl. No. | Distance | Ground | Formation | Cutting Area | | | | Filling Area | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cutting | Avg | Width | Area | Filling | Avg | Width | Area |
| | Meters | Meters | Meters | Meters | Meters | Meters | Sq. Meters | Meters | Meters | Meters | Sq. Meters |
| **Section: 925.000** | | | | | | | | | | | |
| 1 | 955.000 | 910.787 | 110.000 | 0.787 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.000 | 914.590 | 110.000 | 4.590 | 2.6885 | 5.000 | 13.443 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | **Total** | | | | 13.443 | | | | 0.000 |
| **Section: 930.000** | | | | | | | | | | | |
| 1 | 955.000 | 912.226 | 110.000 | 2.226 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.000 | 915.564 | 110.000 | 5.564 | 3.8950 | 5.000 | 19.475 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 965.000 | 914.286 | 110.000 | 4.286 | 4.9250 | 5.000 | 24.625 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 970.000 | 916.243 | 110.000 | 6.243 | 6.2645 | 5.000 | 31.323 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 975.000 | 916.201 | 110.000 | 6.201 | 6.2220 | 5.000 | 31.110 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 980.000 | 913.751 | 110.000 | 3.751 | 3.9760 | 5.000 | 19.880 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 982.159 | 911.716 | 110.000 | 1.716 | 1.7335 | 2.159 | 3.743 | 0.000 | 0.0000 | 2.159 | 0.000 |
| | | | **Total** | | | | 135.156 | | | | 0.000 |
| **Section: 935.000** | | | | | | | | | | | |
| 1 | 955.000 | 913.717 | 110.000 | 3.717 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.000 | 917.025 | 110.000 | 7.025 | 5.3710 | 5.000 | 26.855 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 965.000 | 916.911 | 110.000 | 6.911 | 6.9680 | 5.000 | 34.840 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 970.000 | 917.074 | 110.000 | 7.074 | 6.9925 | 5.000 | 34.963 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 975.000 | 917.020 | 110.000 | 7.020 | 7.0470 | 5.000 | 35.235 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 980.000 | 912.760 | 110.000 | 2.760 | 4.8900 | 5.000 | 24.450 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 983.701 | 912.018 | 110.000 | 2.018 | 2.3890 | 3.701 | 8.842 | 0.000 | 0.0000 | 3.701 | 0.000 |
| | | | **Total** | | | | 165.185 | | | | 0.000 |
| **Section: 940.000** | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 955.000 | 114.494 | 110.000 | 4.494 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.000 | 117.438 | 110.000 | 7.438 | 5.9660 | 5.000 | 29.830 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 965.000 | 117.363 | 110.000 | 7.363 | 7.4005 | 5.000 | 37.003 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 970.000 | 117.264 | 110.000 | 7.264 | 7.3135 | 5.000 | 36.568 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 975.000 | 116.393 | 110.000 | 6.393 | 6.8285 | 5.000 | 34.143 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 980.000 | 114.236 | 110.000 | 4.236 | 5.3145 | 5.000 | 26.573 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 985.000 | 112.296 | 110.000 | 2.296 | 3.2660 | 5.000 | 16.330 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 8 | 988.242 | 112.313 | 110.000 | 2.313 | 2.3015 | 0.242 | 0.558 | 0.000 | 0.0000 | 0.242 | 0.000 |
| | | | | Total | | | 181.005 | | | | 0.000 |
| Section: 945.000 | | | | | | | | | | | |
| 1 | 955.000 | 114.736 | 110.000 | 4.736 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.000 | 116.807 | 110.000 | 6.807 | 5.7715 | 5.000 | 28.858 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 965.000 | 116.389 | 110.000 | 6.389 | 6.5980 | 5.000 | 32.990 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 970.000 | 117.202 | 110.000 | 7.202 | 6.7955 | 5.000 | 33.978 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 975.000 | 116.373 | 110.000 | 6.373 | 6.7875 | 5.000 | 33.938 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 980.000 | 115.807 | 110.000 | 5.807 | 6.0900 | 5.000 | 30.450 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 985.000 | 114.679 | 110.000 | 4.679 | 5.2450 | 5.000 | 26.215 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 8 | 987.745 | 113.474 | 110.000 | 3.474 | 4.0765 | 2.745 | 11.190 | 0.000 | 0.0000 | 2.745 | 0.000 |
| | | | | Total | | | 197.619 | | | | 0.000 |
| Section: 950.000 | | | | | | | | | | | |
| 1 | 955.000 | 113.892 | 110.000 | 3.892 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.000 | 114.470 | 110.000 | 4.470 | 4.1810 | 5.000 | 20.905 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 965.000 | 113.770 | 110.000 | 3.770 | 4.1200 | 5.000 | 20.600 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 970.000 | 113.933 | 110.000 | 3.933 | 3.8515 | 5.000 | 19.258 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 975.000 | 114.388 | 110.000 | 4.388 | 4.1605 | 5.000 | 20.803 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 980.000 | 116.407 | 110.000 | 6.407 | 5.3975 | 5.000 | 26.988 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | | Total | | | 108.554 | | | | 0.000 |

## Area Report

| Sl. No. | Distance | Ground | Formation | Cutting Area | | | | Filling Area | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cutting | Avg | Width | Area | Filling | Avg | Width | Area |
| | Meters | Meters | Meters | Meters | Meters | Meters | Sq. Meters | Meters | Meters | Meters | Sq. Meters |
| Section: 930.000 | | | | | | | | | | | |
| 1 | 980.235 | 116.413 | 114.000 | 2.413 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 985.000 | 116.540 | 114.000 | 2.540 | 2.4765 | 4.765 | 11.801 | 0.000 | 0.0000 | 4.765 | 0.000 |
| 3 | 990.000 | 114.831 | 114.000 | 0.831 | 1.6855 | 5.000 | 8.428 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 990.343 | 114.694 | 114.000 | 0.694 | 0.7625 | 0.343 | 0.262 | 0.000 | 0.0000 | 0.343 | 0.000 |
| | | | | Total | | | 20.491 | | | | 0.000 |
| Section: 935.000 | | | | | | | | | | | |
| 1 | 980.079 | 115.492 | 114.000 | 1.492 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 985.000 | 116.874 | 114.000 | 2.874 | 2.1830 | 4.921 | 10.743 | 0.000 | 0.0000 | 4.921 | 0.000 |
| 3 | 990.000 | 115.873 | 114.000 | 1.873 | 2.3735 | 5.000 | 11.868 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 992.945 | 115.361 | 114.000 | 1.361 | 1.5670 | 2.945 | 4.615 | 0.000 | 0.0000 | 2.945 | 0.000 |
| | | | | Total | | | 27.226 | | | | 0.000 |
| Section: 940.000 | | | | | | | | | | | |
| 1 | 985.000 | 117.066 | 114.000 | 3.066 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 990.000 | 117.353 | 114.000 | 3.353 | 3.2095 | 5.000 | 16.048 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 995.000 | 115.951 | 114.000 | 1.951 | 2.6520 | 5.000 | 13.260 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 995.614 | 115.890 | 114.000 | 1.890 | 1.9205 | 0.614 | 1.179 | 0.000 | 0.0000 | 0.614 | 0.000 |
| | | | | Total | | | 30.487 | | | | 0.000 |
| Section: 945.000 | | | | | | | | | | | |
| 1 | 990.000 | 118.102 | 114.000 | 4.102 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 995.000 | 117.918 | 114.000 | 3.918 | 4.0100 | 5.000 | 20.050 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 998.341 | 116.807 | 114.000 | 2.807 | 3.3625 | 3.341 | 11.234 | 0.000 | 0.0000 | 3.341 | 0.000 |
| | | | | Total | | | 31.284 | | | | 0.000 |
| Section: 970.000 | | | | | | | | | | | |
| 1 | 980.000 | 117.739 | 114.000 | 3.739 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 985.000 | 118.911 | 114.000 | 4.911 | 4.3250 | 5.000 | 21.625 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 1000.000 | 117.677 | 114.000 | 3.677 | 4.2940 | 5.000 | 21.470 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 1000.619 | 117.196 | 114.000 | 3.196 | 3.5365 | 0.619 | 2.189 | 0.000 | 0.0000 | 0.619 | 0.000 |
| | | | | Total | | | 45.284 | | | | 0.000 |
| Section: 975.000 | | | | | | | | | | | |
| 1 | 985.000 | 119.605 | 114.000 | 5.605 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 1000.000 | 119.268 | 114.000 | 5.268 | 5.4365 | 5.000 | 27.183 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 1002.812 | 117.938 | 114.000 | 3.938 | 4.6030 | 2.812 | 13.036 | 0.000 | 0.0000 | 2.812 | 0.000 |
| | | | | Total | | | 40.219 | | | | 0.000 |
| Section: 980.000 | | | | | | | | | | | |
| 1 | 985.000 | 116.884 | 114.000 | 2.884 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 1000.000 | 120.272 | 114.000 | 6.272 | 4.5780 | 5.000 | 22.890 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 1000.350 | 120.142 | 114.000 | 6.142 | 6.2070 | 0.350 | 2.177 | 0.000 | 0.0000 | 0.350 | 0.000 |
| | | | | Total | | | 25.062 | | | | 0.000 |

## Area Report

| Sl. No. | Distance | Ground | Formation | Cutting Area | | | | Filling Area | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cutting | Avg | Width | Area | Filling | Avg | Width | Area |

| | Meters | Meters | Meters | Meters | Meters | Meters | Sq. Meters | Meters | Meters | Meters | Sq. Meters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Section: 985.000 | | | | | | | | | | | |
| 1 | 995.734 | 118.889 | 119.000 | 0.000 | 0.0000 | 0.000 | 0.000 | 0.111 | 0.0000 | 0.000 | 0.000 |
| 2 | 995.995 | 119.000 | 119.000 | 0.000 | 0.0000 | 0.261 | 0.000 | 0.000 | 0.0595 | 0.261 | 0.014 |
| 3 | 1000.000 | 120.700 | 119.000 | 1.700 | 0.8500 | 4.005 | 3.404 | 0.000 | 0.0000 | 4.005 | 0.000 |
| 4 | 1005.000 | 119.619 | 119.000 | 0.619 | 1.1595 | 5.000 | 5.798 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 1006.562 | 119.000 | 119.000 | 0.000 | 0.3095 | 1.562 | 0.483 | 0.000 | 0.0000 | 1.562 | 0.000 |
| 6 | 1006.951 | 118.846 | 119.000 | 0.000 | 0.0000 | 0.389 | 0.000 | 0.154 | 0.0770 | 0.389 | 0.030 |
| | | | | Total | | | 9.685 | | | | 0.044 |
| Section: 990.000 | | | | | | | | | | | |
| 1 | 995.912 | 119.205 | 119.000 | 0.205 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 1000.000 | 121.286 | 119.000 | 2.286 | 1.2455 | 4.088 | 5.092 | 0.000 | 0.0000 | 4.088 | 0.000 |
| 3 | 1005.000 | 120.401 | 119.000 | 1.401 | 1.8435 | 5.000 | 9.218 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 1008.931 | 119.274 | 119.000 | 0.274 | 0.8375 | 3.931 | 3.292 | 0.000 | 0.0000 | 3.931 | 0.000 |
| | | | | Total | | | 17.602 | | | | 0.000 |
| Section: 995.000 | | | | | | | | | | | |
| 1 | 996.091 | 120.051 | 119.000 | 1.051 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 1000.000 | 121.790 | 119.000 | 2.790 | 1.9205 | 3.909 | 7.507 | 0.000 | 0.0000 | 3.909 | 0.000 |
| 3 | 1005.000 | 121.722 | 119.000 | 2.722 | 2.7560 | 5.000 | 13.780 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 1010.000 | 119.868 | 119.000 | 0.868 | 1.7950 | 5.000 | 8.975 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 1010.911 | 119.782 | 119.000 | 0.782 | 0.7960 | 0.911 | 0.715 | 0.000 | 0.0000 | 0.911 | 0.000 |
| | | | | Total | | | 30.977 | | | | 0.000 |
| Section: 1000.000 | | | | | | | | | | | |
| 1 | 996.270 | 120.502 | 119.000 | 1.502 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 1000.000 | 121.068 | 119.000 | 2.068 | 1.7850 | 3.730 | 6.658 | 0.000 | 0.0000 | 3.730 | 0.000 |
| 3 | 1005.000 | 121.250 | 119.000 | 2.250 | 2.1590 | 5.000 | 10.795 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 1010.000 | 119.958 | 119.000 | 0.958 | 1.6040 | 5.000 | 8.020 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 1012.890 | 120.131 | 119.000 | 1.131 | 1.0945 | 2.890 | 3.019 | 0.000 | 0.0000 | 2.890 | 0.000 |
| | | | | Total | | | 28.492 | | | | 0.000 |
| Section: 1005.000 | | | | | | | | | | | |
| 1 | 955.000 | 119.954 | 119.000 | 0.954 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.000 | 120.077 | 119.000 | 1.077 | 1.0155 | 5.000 | 5.078 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 965.000 | 119.950 | 119.000 | 0.950 | 1.0135 | 5.000 | 5.068 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 970.000 | 120.286 | 119.000 | 1.286 | 1.1180 | 5.000 | 5.590 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 975.000 | 120.560 | 119.000 | 1.560 | 1.4230 | 5.000 | 7.115 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 980.000 | 121.100 | 119.000 | 2.100 | 1.8300 | 5.000 | 9.150 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 985.000 | 120.649 | 119.000 | 1.649 | 1.8745 | 5.000 | 9.373 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 8 | 990.000 | 120.642 | 119.000 | 1.642 | 1.6455 | 5.000 | 8.228 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 9 | 995.000 | 121.054 | 119.000 | 2.054 | 1.8580 | 5.000 | 9.290 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 10 | 1000.000 | 121.925 | 119.000 | 2.125 | 2.0895 | 5.000 | 10.448 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 11 | 1005.000 | 120.321 | 119.000 | 1.321 | 1.7230 | 5.000 | 8.615 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 12 | 1010.000 | 120.063 | 119.000 | 1.063 | 1.1870 | 5.000 | 5.935 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 13 | 1014.870 | 120.559 | 119.000 | 1.559 | 1.3060 | 4.870 | 6.360 | 0.000 | 0.0000 | 4.870 | 0.000 |
| | | | | Total | | | 90.300 | | | | 0.000 |
| Section: 1010.000 | | | | | | | | | | | |
| 1 | 955.000 | 121.883 | 119.000 | 2.883 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.000 | 121.915 | 119.000 | 2.915 | 2.8990 | 5.000 | 14.495 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 965.000 | 121.670 | 119.000 | 2.670 | 2.7925 | 5.000 | 13.963 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 970.000 | 121.678 | 119.000 | 2.678 | 2.6740 | 5.000 | 13.370 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 975.000 | 121.671 | 119.000 | 2.671 | 2.6745 | 5.000 | 13.373 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 980.000 | 122.693 | 119.000 | 3.693 | 3.1820 | 5.000 | 15.910 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 985.000 | 122.777 | 119.000 | 3.777 | 3.7350 | 5.000 | 18.675 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 8 | 990.000 | 122.233 | 119.000 | 3.233 | 3.5050 | 5.000 | 17.525 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 9 | 995.000 | 121.738 | 119.000 | 2.738 | 2.9855 | 5.000 | 14.928 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 10 | 1000.000 | 121.308 | 119.000 | 2.308 | 2.5230 | 5.000 | 12.615 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 11 | 1005.000 | 121.098 | 119.000 | 2.098 | 2.2030 | 5.000 | 11.015 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 12 | 1010.000 | 120.955 | 119.000 | 1.955 | 2.0265 | 5.000 | 10.133 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 13 | 1015.000 | 120.790 | 119.000 | 1.790 | 1.8725 | 5.000 | 9.363 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 14 | 1016.850 | 120.987 | 119.000 | 1.987 | 1.8885 | 1.850 | 3.494 | 0.000 | 0.0000 | 1.850 | 0.000 |
| | | | | Total | | | 168.859 | | | | 0.000 |
| Section: 1015.000 | | | | | | | | | | | |
| 1 | 955.000 | 121.706 | 119.000 | 2.706 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.000 | 121.264 | 119.000 | 2.264 | 2.4850 | 5.000 | 12.425 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 965.000 | 121.701 | 119.000 | 2.701 | 2.4825 | 5.000 | 12.413 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 970.000 | 122.071 | 119.000 | 3.071 | 2.8860 | 5.000 | 14.430 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 975.000 | 122.440 | 119.000 | 3.440 | 3.2555 | 5.000 | 16.278 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 980.000 | 122.809 | 119.000 | 3.809 | 3.6245 | 5.000 | 18.123 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | | Total | | | 73.669 | | | | 0.000 |

## Area Report

| Sl. No. | Distance | Ground | Formation | Cutting Area | | | | Filling Area | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cutting | Avg | Width | Area | Filling | Avg | Width | Area |
| | Meters | Meters | Meters | Meters | Meters | Meters | Sq. Meters | Meters | Meters | Meters | Sq. Meters |
| Section: 990.000 | | | | | | | | | | | |
| 1 | 937.527 | 118.658 | 118.000 | 0.658 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 118.685 | 118.000 | 0.685 | 0.6715 | 2.473 | 1.661 | 0.000 | 0.0000 | 2.473 | 0.000 |
| 3 | 945.000 | 118.539 | 118.000 | 0.539 | 0.6120 | 5.000 | 3.060 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | | Total | | | 4.721 | | | | 0.000 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Section: 775.000 | | | | | | | | | | | |
| 1 | 937.887 | 119.402 | 118.000 | 1.402 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 119.491 | 118.000 | 1.491 | 1.4465 | 2.113 | 3.056 | 0.000 | 0.0000 | 2.113 | 0.000 |
| 3 | 945.000 | 118.787 | 118.000 | 0.787 | 1.1390 | 5.000 | 5.695 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | Total | | | | 8.751 | | | | 0.000 |
| Section: 1000.000 | | | | | | | | | | | |
| 1 | 938.247 | 120.145 | 118.000 | 2.145 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 119.694 | 118.000 | 1.694 | 1.9195 | 1.753 | 3.365 | 0.000 | 0.0000 | 1.753 | 0.000 |
| 3 | 945.000 | 120.395 | 118.000 | 2.395 | 2.0445 | 5.000 | 10.223 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | Total | | | | 13.588 | | | | 0.000 |
| Section: 1000.000 | | | | | | | | | | | |
| 1 | 938.607 | 120.851 | 118.000 | 2.851 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 120.999 | 118.000 | 2.999 | 2.9250 | 1.393 | 4.075 | 0.000 | 0.0000 | 1.393 | 0.000 |
| 3 | 945.000 | 121.149 | 118.000 | 3.149 | 3.0740 | 5.000 | 15.370 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | Total | | | | 8.751 | | | | 0.000 |
| Section: 1000.000 | | | | | | | | | | | |
| 1 | 938.967 | 121.273 | 118.000 | 3.273 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 121.439 | 118.000 | 3.439 | 3.3560 | 1.033 | 3.467 | 0.000 | 0.0000 | 1.033 | 0.000 |
| 3 | 945.000 | 121.626 | 118.000 | 3.626 | 3.5325 | 5.000 | 17.663 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | Total | | | | 8.751 | | | | 0.000 |
| Section: 1000.000 | | | | | | | | | | | |
| 1 | 939.327 | 121.693 | 118.000 | 3.693 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 121.822 | 118.000 | 3.822 | 3.7575 | 0.673 | 2.529 | 0.000 | 0.0000 | 0.673 | 0.000 |
| 3 | 945.000 | 121.984 | 118.000 | 3.984 | 3.9030 | 5.000 | 19.515 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | Total | | | | 13.588 | | | | 0.000 |

## Area Report

| Sl. No. | Distance | Ground | Formation | Cutting Area | | | | Filling Area | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cutting | Avg | Width | Area | Filling | Avg | Width | Area |
| | Meters | Meters | Meters | Meters | Meters | Meters | Sq. Meters | Meters | Meters | Meters | Sq. Meters |
| Section: 950.000 | | | | | | | | | | | |
| 1 | 934.639 | 114.729 | 112.000 | 2.729 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 939.000 | 114.668 | 112.000 | 2.668 | 2.6985 | 0.361 | 0.974 | 0.000 | 0.0000 | 0.361 | 0.000 |
| 3 | 940.000 | 114.359 | 112.000 | 2.359 | 2.5135 | 5.000 | 12.568 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 944.758 | 112.546 | 112.000 | 0.546 | 1.4525 | 4.758 | 6.911 | 0.000 | 0.0000 | 4.758 | 0.000 |
| | | | Total | | | | 13.588 | | | | 0.000 |
| Section: 950.000 | | | | | | | | | | | |
| 1 | 935.000 | 115.288 | 112.000 | 3.288 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 114.988 | 112.000 | 2.988 | 3.1380 | 5.000 | 15.690 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 944.661 | 113.096 | 112.000 | 1.096 | 2.0420 | 4.661 | 9.518 | 0.000 | 0.0000 | 4.661 | 0.000 |
| | | | Total | | | | 13.588 | | | | 0.000 |
| Section: 1000.000 | | | | | | | | | | | |
| 1 | 935.361 | 115.786 | 112.000 | 3.786 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 115.415 | 112.000 | 3.415 | 3.5905 | 4.639 | 16.656 | 0.000 | 0.0000 | 4.639 | 0.000 |
| 3 | 944.723 | 113.574 | 112.000 | 1.574 | 2.4945 | 4.723 | 11.782 | 0.000 | 0.0000 | 4.723 | 0.000 |
| | | | Total | | | | 13.588 | | | | 0.000 |
| Section: 950.000 | | | | | | | | | | | |
| 1 | 935.722 | 116.244 | 112.000 | 4.244 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 116.527 | 112.000 | 4.527 | 4.3855 | 4.278 | 18.761 | 0.000 | 0.0000 | 4.278 | 0.000 |
| 3 | 944.853 | 114.116 | 112.000 | 2.116 | 3.3215 | 4.853 | 16.119 | 0.000 | 0.0000 | 4.853 | 0.000 |
| | | | Total | | | | 13.588 | | | | 0.000 |
| Section: 950.000 | | | | | | | | | | | |
| 1 | 936.084 | 116.721 | 112.000 | 4.721 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 118.000 | 112.000 | 5.000 | 5.3605 | 3.916 | 20.992 | 0.000 | 0.0000 | 3.916 | 0.000 |
| 3 | 944.982 | 114.705 | 112.000 | 2.705 | 4.3525 | 4.982 | 21.684 | 0.000 | 0.0000 | 4.982 | 0.000 |
| 4 | 945.000 | 114.693 | 112.000 | 2.693 | 2.6990 | 0.018 | 0.049 | 0.000 | 0.0000 | 0.018 | 0.000 |
| | | | Total | | | | 42.725 | | | | 0.000 |
| Section: 775.000 | | | | | | | | | | | |
| 1 | 936.445 | 117.006 | 112.000 | 5.006 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 118.415 | 112.000 | 6.415 | 5.7105 | 3.555 | 20.301 | 0.000 | 0.0000 | 3.555 | 0.000 |
| 3 | 945.000 | 115.347 | 112.000 | 3.347 | 4.6810 | 5.000 | 24.405 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | Total | | | | 44.706 | | | | 0.000 |
| Section: 950.000 | | | | | | | | | | | |
| 1 | 936.806 | 117.292 | 112.000 | 5.292 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 118.329 | 112.000 | 6.329 | 5.8105 | 3.194 | 18.559 | 0.000 | 0.0000 | 3.194 | 0.000 |
| 3 | 945.000 | 115.945 | 112.000 | 3.945 | 5.1370 | 5.000 | 25.685 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | Total | | | | 44.244 | | | | 0.000 |
| Section: 1000.000 | | | | | | | | | | | |
| 1 | 937.167 | 117.913 | 112.000 | 5.913 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 118.339 | 112.000 | 6.329 | 6.1210 | 2.833 | 17.395 | 0.000 | 0.0000 | 2.833 | 0.000 |
| 3 | 945.000 | 116.778 | 112.000 | 4.778 | 5.5585 | 5.000 | 27.793 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | Total | | | | 45.751 | | | | 0.000 |

# Area Report

| Sl. No. | Distance | Ground | Formation | Cutting Area | | | | Filling Area | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cutting | Avg | Width | Area | Filling | Avg | Width | Area |
| | Meters | Meters | Meters | Meters | Meters | Meters | Sq. Meters | Meters | Meters | Meters | Sq. Meters |
| Section: 900.000 | | | | | | | | | | | |
| 1 | 930.737 | 110.624 | 105.000 | 5.624 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 935.000 | 111.970 | 105.000 | 6.970 | 6.2970 | 4.263 | 26.844 | 0.000 | 0.0000 | 4.263 | 0.000 |
| 3 | 940.000 | 111.328 | 105.000 | 6.328 | 6.6490 | 5.000 | 33.245 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 945.000 | 109.349 | 105.000 | 4.349 | 5.3385 | 5.000 | 26.693 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 950.000 | 108.409 | 105.000 | 3.409 | 3.8790 | 5.000 | 19.395 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 954.503 | 105.000 | 105.000 | 0.000 | 1.7045 | 4.503 | 7.675 | 0.000 | 0.0000 | 4.503 | 0.000 |
| 7 | 955.000 | 104.624 | 105.000 | 0.000 | 0.0000 | 0.497 | 0.000 | 0.376 | 0.1880 | 0.497 | 0.093 |
| | | | Total | | | | 113.852 | | | | 0.093 |
| Section: 905.000 | | | | | | | | | | | |
| 1 | 931.127 | 111.762 | 105.000 | 6.762 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 935.000 | 112.563 | 105.000 | 7.563 | 7.1625 | 3.873 | 27.740 | 0.000 | 0.0000 | 3.873 | 0.000 |
| 3 | 940.000 | 110.819 | 105.000 | 5.819 | 6.6910 | 5.000 | 33.455 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 945.000 | 109.728 | 105.000 | 4.728 | 5.2735 | 5.000 | 26.368 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 950.000 | 107.910 | 105.000 | 2.910 | 3.8190 | 5.000 | 19.095 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 951.988 | 105.648 | 105.000 | 0.648 | 1.7790 | 1.988 | 5.316 | 0.000 | 0.0000 | 1.988 | 0.000 |
| | | | Total | | | | 111.974 | | | | 0.000 |
| Section: 910.000 | | | | | | | | | | | |
| 1 | 931.918 | 112.811 | 105.000 | 7.811 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 935.000 | 112.567 | 105.000 | 7.567 | 7.6890 | 3.482 | 26.773 | 0.000 | 0.0000 | 3.482 | 0.000 |
| 3 | 940.000 | 111.896 | 105.000 | 6.896 | 7.2315 | 5.000 | 36.158 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 945.000 | 110.395 | 105.000 | 5.395 | 6.1455 | 5.000 | 30.728 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 950.000 | 108.989 | 105.000 | 3.989 | 4.6920 | 5.000 | 18.460 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 950.927 | 106.678 | 105.000 | 1.678 | 2.8335 | 0.927 | 1.733 | 0.000 | 0.0000 | 0.927 | 0.000 |
| | | | Total | | | | 113.874 | | | | 0.000 |
| Section: 915.000 | | | | | | | | | | | |
| 1 | 931.908 | 112.992 | 105.000 | 7.992 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 935.000 | 112.770 | 105.000 | 7.770 | 7.6890 | 3.092 | 24.360 | 0.000 | 0.0000 | 3.092 | 0.000 |
| 3 | 940.000 | 110.089 | 105.000 | 5.089 | 6.4295 | 5.000 | 32.148 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 945.000 | 109.972 | 105.000 | 4.972 | 5.0305 | 5.000 | 25.153 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 949.112 | 107.823 | 105.000 | 2.823 | 3.8975 | 4.112 | 16.027 | 0.000 | 0.0000 | 4.112 | 0.000 |
| | | | Total | | | | 97.696 | | | | 0.000 |
| Section: 920.000 | | | | | | | | | | | |
| 1 | 932.298 | 113.173 | 105.000 | 8.173 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 935.000 | 113.028 | 105.000 | 8.028 | 8.1006 | 2.702 | 21.888 | 0.000 | 0.0000 | 2.702 | 0.000 |
| 3 | 940.000 | 109.987 | 105.000 | 4.987 | 6.5075 | 5.000 | 32.538 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 945.000 | 109.818 | 105.000 | 4.818 | 4.9025 | 5.000 | 24.513 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 947.693 | 108.562 | 105.000 | 3.562 | 4.1900 | 2.693 | 11.284 | 0.000 | 0.0000 | 2.693 | 0.000 |
| | | | Total | | | | 111.974 | | | | 0.000 |
| Section: 930.000 | | | | | | | | | | | |
| 1 | 935.000 | 113.130 | 105.000 | 8.130 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 111.916 | 105.000 | 6.916 | 7.5230 | 5.000 | 32.615 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 945.000 | 109.920 | 105.000 | 4.920 | 5.9180 | 5.000 | 29.590 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 946.316 | 109.428 | 105.000 | 4.428 | 4.6740 | 1.316 | 5.484 | 0.000 | 0.0000 | 1.316 | 0.000 |
| | | | Total | | | | 72.689 | | | | 0.000 |
| Section: 935.000 | | | | | | | | | | | |
| 1 | 935.000 | 112.951 | 105.000 | 7.951 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 112.225 | 105.000 | 7.225 | 7.5880 | 5.000 | 37.940 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 945.000 | 110.188 | 105.000 | 5.188 | 6.2065 | 5.000 | 31.033 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 945.397 | 110.059 | 105.000 | 5.059 | 5.1235 | 0.397 | 2.034 | 0.000 | 0.0000 | 0.397 | 0.000 |
| | | | Total | | | | 71.007 | | | | 0.000 |
| Section: 940.000 | | | | | | | | | | | |
| 1 | 935.000 | 113.201 | 105.000 | 8.201 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 113.144 | 105.000 | 8.144 | 8.1725 | 5.000 | 40.863 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 3 | 945.000 | 110.590 | 105.000 | 5.590 | 6.8670 | 5.000 | 34.335 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 945.233 | 110.565 | 105.000 | 5.565 | 5.5775 | 0.233 | 1.297 | 0.000 | 0.0000 | 0.233 | 0.000 |
| | | | Total | | | | 76.495 | | | | 0.000 |
| Section: 945.000 | | | | | | | | | | | |
| 1 | 931.859 | 113.677 | 105.000 | 8.677 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 935.000 | 113.525 | 105.000 | 8.525 | 8.6010 | 1.141 | 9.814 | 0.000 | 0.0000 | 1.141 | 0.000 |
| 3 | 940.000 | 113.477 | 105.000 | 8.477 | 8.5010 | 5.000 | 42.505 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 945.000 | 111.157 | 105.000 | 6.157 | 7.3170 | 5.000 | 36.585 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | Total | | | | 88.904 | | | | 0.000 |
| Section: 945.000 | | | | | | | | | | | |
| 1 | 934.249 | 114.168 | 105.000 | 9.169 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 935.000 | 114.044 | 105.000 | 9.044 | 9.1065 | 0.751 | 6.839 | 0.000 | 0.0000 | 0.751 | 0.000 |
| 3 | 940.000 | 113.850 | 105.000 | 8.850 | 8.9470 | 5.000 | 44.735 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 944.905 | 111.829 | 105.000 | 6.829 | 7.8395 | 4.905 | 38.453 | 0.000 | 0.0000 | 4.905 | 0.000 |
| | | | Total | | | | 90.027 | | | | 0.000 |

| Sl. No. | Distance | Ground | Formation | Cutting Area | | | | Filling Area | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Meters | Meters | Meters | Cutting Meters | Avg Meters | Width Meters | Area Sq. Meters | Filling Meters | Avg Meters | Width Meters | Area Sq. Meters |
| Section: 865.000 | | | | | | | | | | | |
| 1 | 960.000 | 901.805 | 101.000 | 0.805 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 960.013 | 901.808 | 101.000 | 0.808 | 0.8065 | 0.013 | 0.010 | 0.000 | 0.0000 | 0.013 | 0.000 |
| 3 | 965.000 | 903.130 | 101.000 | 2.130 | 1.4690 | 4.987 | 7.326 | 0.000 | 0.0000 | 4.987 | 0.000 |
| 4 | 970.000 | 902.125 | 101.000 | 1.125 | 1.6275 | 5.000 | 8.138 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | | Total | | | 15.474 | | | | 0.000 |
| Section: 870.000 | | | | | | | | | | | |
| 1 | 948.821 | 904.819 | 101.000 | 3.119 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 950.000 | 904.201 | 101.000 | 3.201 | 3.1600 | 1.179 | 3.726 | 0.000 | 0.0000 | 1.179 | 0.000 |
| 3 | 955.000 | 905.220 | 101.000 | 4.220 | 3.7105 | 5.000 | 18.553 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 960.000 | 905.628 | 101.000 | 4.628 | 4.4240 | 5.000 | 22.120 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 965.000 | 903.241 | 101.000 | 2.241 | 3.4345 | 5.000 | 17.173 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 970.000 | 901.969 | 101.000 | 0.969 | 1.6050 | 5.000 | 8.025 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | | Total | | | 69.597 | | | | 0.000 |
| Section: 875.000 | | | | | | | | | | | |
| 1 | 937.615 | 905.274 | 101.000 | 4.274 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 940.000 | 904.605 | 101.000 | 3.605 | 3.9395 | 2.385 | 9.396 | 0.000 | 0.0000 | 2.385 | 0.000 |
| 3 | 945.000 | 904.916 | 101.000 | 3.916 | 3.7605 | 5.000 | 18.803 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 950.000 | 908.025 | 101.000 | 7.025 | 5.4705 | 5.000 | 27.353 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 955.000 | 908.511 | 101.000 | 7.511 | 7.2680 | 5.000 | 36.340 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 960.000 | 907.147 | 101.000 | 6.147 | 6.8290 | 5.000 | 34.145 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 965.000 | 903.852 | 101.000 | 2.852 | 4.4995 | 5.000 | 22.498 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 8 | 969.641 | 901.743 | 101.000 | 0.743 | 1.7975 | 4.641 | 8.342 | 0.000 | 0.0000 | 4.641 | 0.000 |
| | | | | Total | | | 166.477 | | | | 0.000 |
| Section: 880.000 | | | | | | | | | | | |
| 1 | 929.047 | 905.008 | 101.000 | 5.008 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 930.000 | 905.065 | 101.000 | 5.065 | 5.0365 | 0.953 | 4.800 | 0.000 | 0.0000 | 0.953 | 0.000 |
| 3 | 935.000 | 909.331 | 101.000 | 8.331 | 6.6980 | 5.000 | 33.490 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 940.000 | 908.929 | 101.000 | 7.929 | 8.1300 | 5.000 | 40.650 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 945.000 | 909.742 | 101.000 | 8.742 | 8.3355 | 5.000 | 41.678 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 950.000 | 909.823 | 101.000 | 8.823 | 8.7825 | 5.000 | 43.913 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 955.000 | 908.791 | 101.000 | 7.791 | 8.3070 | 5.000 | 41.535 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 8 | 960.000 | 905.351 | 101.000 | 5.351 | 6.5710 | 5.000 | 32.855 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 9 | 965.000 | 902.945 | 101.000 | 1.945 | 3.6480 | 5.000 | 18.240 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 10 | 966.587 | 902.309 | 101.000 | 1.309 | 1.5770 | 1.587 | 2.503 | 0.000 | 0.0000 | 1.587 | 0.000 |
| | | | | Total | | | 239.664 | | | | 0.000 |
| Section: 885.000 | | | | | | | | | | | |
| 1 | 929.474 | 907.966 | 101.000 | 6.166 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 930.000 | 907.363 | 101.000 | 6.363 | 6.2645 | 0.526 | 3.295 | 0.000 | 0.0000 | 0.526 | 0.000 |
| 3 | 935.000 | 910.562 | 101.000 | 9.562 | 7.9625 | 5.000 | 39.813 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 940.000 | 910.500 | 101.000 | 9.500 | 9.5310 | 5.000 | 47.655 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 945.000 | 910.537 | 101.000 | 9.537 | 9.5185 | 5.000 | 47.593 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 950.000 | 908.458 | 101.000 | 7.458 | 8.5075 | 5.000 | 42.538 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 955.000 | 908.482 | 101.000 | 7.482 | 7.4700 | 5.000 | 37.350 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 8 | 960.000 | 905.414 | 101.000 | 4.414 | 5.9480 | 5.000 | 29.740 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | | Total | | | 248.034 | | | | 0.000 |
| Section: 890.000 | | | | | | | | | | | |
| 1 | 929.902 | 908.315 | 101.000 | 7.315 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 930.000 | 908.332 | 101.000 | 7.332 | 7.3260 | 0.098 | 0.718 | 0.000 | 0.0000 | 0.098 | 0.000 |
| 3 | 935.000 | 910.893 | 101.000 | 9.893 | 8.6150 | 5.000 | 43.075 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 940.000 | 910.881 | 101.000 | 9.881 | 9.8870 | 5.000 | 49.435 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 945.000 | 908.764 | 101.000 | 7.764 | 8.8225 | 5.000 | 44.113 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 950.000 | 908.538 | 101.000 | 7.538 | 7.6510 | 5.000 | 38.255 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 7 | 955.000 | 907.964 | 101.000 | 6.964 | 6.8510 | 5.000 | 34.255 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 8 | 960.000 | 903.358 | 101.000 | 2.358 | 4.2610 | 5.000 | 21.305 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | | Total | | | 231.156 | | | | 0.000 |
| Section: 895.000 | | | | | | | | | | | |
| 1 | 930.329 | 909.477 | 101.000 | 8.477 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.0000 | 0.000 | 0.000 |
| 2 | 935.000 | 911.963 | 101.000 | 10.163 | 9.3100 | 4.671 | 43.487 | 0.000 | 0.0000 | 4.671 | 0.000 |
| 3 | 940.000 | 911.928 | 101.000 | 10.128 | 10.1355 | 5.000 | 50.678 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 4 | 945.000 | 909.001 | 101.000 | 8.001 | 9.0645 | 5.000 | 45.323 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 5 | 950.000 | 908.466 | 101.000 | 7.466 | 7.7335 | 5.000 | 38.668 | 0.000 | 0.0000 | 5.000 | 0.000 |
| 6 | 955.000 | 905.325 | 101.000 | 4.325 | 5.8955 | 5.000 | 29.478 | 0.000 | 0.0000 | 5.000 | 0.000 |
| | | | | Total | | | 207.634 | | | | 0.000 |

## Volume Report

| Sl. No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 905.000 | - | 0.000 | 27.099 | 81.383 | 0.000 | 40.702 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 910.000 | 905.000 | 5.000 | 29.952 | 147.853 | 81.383 | 114.618 | 573.090 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 915.000 | 910.000 | 5.000 | 29.866 | 202.138 | 147.853 | 174.996 | 874.978 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 920.000 | 915.000 | 5.000 | 28.780 | 232.918 | 202.138 | 217.533 | 1087.665 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 925.000 | 920.000 | 5.000 | 17.694 | 158.302 | 232.918 | 195.715 | 978.575 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 3513.308 | | | | 0.000 |

## Volume Report

| Sl. No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 925.000 | - | 0.000 | 5.000 | 13.443 | 0.000 | 6.722 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 930.000 | 925.000 | 5.000 | 27.159 | 135.156 | 13.443 | 74.300 | 371.498 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 935.000 | 930.000 | 5.000 | 28.701 | 169.185 | 135.156 | 152.171 | 760.853 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 940.000 | 935.000 | 5.000 | 30.142 | 184.605 | 169.185 | 176.895 | 884.475 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 945.000 | 940.000 | 5.000 | 32.745 | 197.619 | 184.605 | 189.312 | 946.560 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 950.000 | 945.000 | 5.000 | 25.800 | 108.554 | 197.619 | 153.087 | 765.433 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 3699.819 | | | | 0.000 |

## Volume Report

| Sl No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 950.000 | - | 0.000 | 10.108 | 20.491 | 0.000 | 10.246 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 955.000 | 950.000 | 5.000 | 12.866 | 27.236 | 20.491 | 23.859 | 119.293 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 960.000 | 955.000 | 5.000 | 10.614 | 30.447 | 27.236 | 28.857 | 144.283 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 965.000 | 960.000 | 5.000 | 8.341 | 31.284 | 30.447 | 30.866 | 154.328 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 970.000 | 965.000 | 5.000 | 10.619 | 45.284 | 31.284 | 38.284 | 191.420 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 975.000 | 970.000 | 5.000 | 7.832 | 40.219 | 45.284 | 42.752 | 213.758 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7 | 980.000 | 975.000 | 5.000 | 5.150 | 25.062 | 40.219 | 32.641 | 163.203 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 986.285 | | | | 0.000 |

## Volume Report

| Sl No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 985.000 | - | 0.000 | 11.217 | 9.685 | 0.000 | 4.843 | 0.000 | 0.044 | 0.000 | 0.022 | 0.000 |
| 2 | 990.000 | 985.000 | 5.000 | 13.019 | 17.602 | 9.685 | 13.644 | 68.218 | 0.000 | 0.044 | 0.022 | 0.110 |
| 3 | 995.000 | 990.000 | 5.000 | 14.820 | 30.977 | 17.602 | 24.290 | 121.448 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 1000.000 | 995.000 | 5.000 | 16.620 | 38.495 | 30.977 | 34.736 | 148.679 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 1005.000 | 1000.000 | 5.000 | 59.870 | 90.300 | 38.495 | 79.398 | 396.990 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 1010.000 | 1005.000 | 5.000 | 61.850 | 168.839 | 90.300 | 129.580 | 647.898 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7 | 1015.000 | 1010.000 | 5.000 | 25.000 | 73.669 | 168.839 | 121.264 | 606.320 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 1989.517 | | | | 0.110 |

## Volume Report

| Sl No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 990.000 | - | 0.000 | 7.475 | 4.721 | 0.000 | 2.361 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 995.000 | 990.000 | 5.000 | 7.113 | 8.751 | 4.721 | 6.736 | 33.680 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 1000.000 | 995.000 | 5.000 | 6.753 | 13.588 | 8.751 | 11.170 | 55.848 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 1005.000 | 1000.000 | 5.000 | 6.393 | 19.445 | 13.588 | 16.517 | 82.583 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 1010.000 | 1005.000 | 5.000 | 6.033 | 21.130 | 19.445 | 20.288 | 101.438 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 1015.000 | 1010.000 | 5.000 | 5.673 | 22.844 | 21.130 | 21.987 | 109.935 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 383.484 | | | | 0.000 |

## Volume Report

| Sl No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 950.000 | - | 0.000 | 10.119 | 20.453 | 0.000 | 10.227 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 955.000 | 950.000 | 5.000 | 9.661 | 25.208 | 20.453 | 22.831 | 114.153 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 960.000 | 955.000 | 5.000 | 9.362 | 28.439 | 25.208 | 26.823 | 134.115 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 965.000 | 960.000 | 5.000 | 9.151 | 34.880 | 28.439 | 31.659 | 158.295 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 970.000 | 965.000 | 5.000 | 8.916 | 42.725 | 34.880 | 38.803 | 194.013 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 975.000 | 970.000 | 5.000 | 8.555 | 44.706 | 42.725 | 43.716 | 218.578 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7 | 980.000 | 975.000 | 5.000 | 8.194 | 44.244 | 44.706 | 44.475 | 222.375 | 0.000 | 0.000 | 0.000 | 0.000 |
| 8 | 985.000 | 980.000 | 5.000 | 7.833 | 45.148 | 44.244 | 44.696 | 223.480 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 1265.009 | | | | 0.000 |

## Volume Report

| Sl No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | | Filling Volume | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 985.000 | - | 0.000 | 11.217 | 9.685 | 0.000 | 4.843 | 0.000 | 0.044 | 0.000 | 0.022 | 0.000 |
| 2 | 905.000 | 900.000 | 5.000 | 28.861 | 119.974 | 113.852 | 112.913 | 564.565 | 0.000 | 0.093 | 0.047 | 0.233 |
| 3 | 910.000 | 905.000 | 5.000 | 19.439 | 113.874 | 111.974 | 112.924 | 564.620 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 915.000 | 910.000 | 5.000 | 17.304 | 97.696 | 113.874 | 105.785 | 528.925 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 920.000 | 915.000 | 5.000 | 19.399 | 90.223 | 97.696 | 93.960 | 469.798 | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | 925.000 | 920.000 | 5.000 | 18.216 | 72.889 | 90.223 | 81.556 | 407.780 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7 | 930.000 | 925.000 | 5.000 | 19.397 | 71.007 | 72.889 | 71.948 | 359.740 | 0.000 | 0.000 | 0.000 | 0.000 |
| 8 | 935.000 | 930.000 | 5.000 | 19.233 | 76.495 | 71.007 | 73.751 | 368.755 | 0.000 | 0.000 | 0.000 | 0.000 |
| 9 | 940.000 | 935.000 | 5.000 | 18.141 | 88.904 | 76.495 | 82.700 | 413.498 | 0.000 | 0.000 | 0.000 | 0.000 |
| 10 | 945.000 | 940.000 | 5.000 | 10.656 | 90.017 | 88.904 | 89.466 | 447.328 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | Total | | | | 4125.009 | | | | 0.233 |

## Volume Report



Nurse Question of Legacy Woman

crucial Area Glass

MatterLab

Report Number: **ML/GT/2863/229/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE B OF KSWMP AT KUMBALATHUMURI, KOTHAMANGALAM, ERNAKULAM DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | IPE Global Ltd. |
| Address | : | 2nd Floor, 16/3878-3879, Kavanatt Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact Person | : | Mr. Ranbir Dey |
| Project No | : | GT-245 |
| Project Name | : | Geotechnical examination of dumpsite under package B of KSWMP at Kumbalathumuri, Kothamangalam, Ernakulam District. |
| Owner | : | KSWMP |
| Project Location | : | Kumbalathumuri, Kothamangalam, Ernakulam District |
| Tel / Fax No | : | - |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 05-08-2023 | 1st Submission | Dr. Gautham Adapa | |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Dr. Jimmy Thomas | Geotechnical Expert, Consultant, MatterLab | |
| Approved by: | Freddy Soman | General Manager, MatterLab | |

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2 SCOPE OF WORK ..... 3

3 OBSERVATIONS FROM SITE VISIT ..... 4

4 GEOTECHNICAL INVESTIGATIONS ..... 4

5 LABORATORY ANALYSIS ..... 7

6 SUMMARY ..... 8

## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results

# 1 INTRODUCTION

Matter Material Testing and Research Laboratory Pvt. Ltd has been set-up as a result of increased demand locally from various industries for a multidisciplinary testing, materials consultancy & investigation facility in alignment with global standards and technology advancements. MatterLab is an independent professional and technical services provider to all who are concerned with quality and performance of materials & products.

IPE Global Ltd. which provides technical support consultancy services to the Urban local bodies in different municipalities for the Kerala State Waste Management Project (KSWMP) has entrusted the geotechnical investigative works as part of their DPR study for the remediation of dumpsite in Kumbhalathumuri, Kothamangalam, Ernakulam district to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was bored using a rotary drill. The initial site visit was done on 23rd May 2023. During the site visit, it was observed that the dumpsite is situated on an elevated terrain (a small hill) without any inhabitants around the dumpsite. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 06th June 2023 and was completed on 09th June 2023. Standard Penetration test (SPT) was conducted within the borehole as required. Representative and undisturbed soil samples were collected to conduct relevant laboratory tests to acquire the necessary parameters. This report presents results of the geotechnical investigation of the ground encountered after drilling through the waste at the dumpsite.

# 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil samples and performing necessary laboratory tests on the collected samples to obtain the desired parameters of the ground profile.
- Preparation of report with laboratory test results.

## 3 OBSERVATIONS FROM SITE VISIT

Matterlab has deputed a team from our geotechnical department along with Mr. Ajit Kumar Nayan and Mr. Ravi Kumar of IPE Global during the fourth week of May 2023, in order to collect the information regarding the site prior to mobilizing the equipment for drilling.

The location of the dumpsite is situated on an small hill without any inhabitants around the dumpsite.



**Figure 1** : Location of the borehole drilled at the dumpsite.

## 4 GEOTECHNICAL INVESTIGATIONS

### 4.1 Rotary drilling

Rotary drilling technique was adopted for advancing and cleaning out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste in the landfill.

### 4.2 Drilling equipment

Mechanical rotary drilling machine was used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The borehole of 150mm diameter was formed using a drag bit (Soil Cutter) in soil. The drag bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by drilling mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

### 4.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as representative samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

**Extraction of Cores:**

The core samples were extracted from the core barrels in a manner to prevent disturbances to the core. All the pieces of cores were sequentially numbered from top to bottom. Arrows indicating the lower end of the piece are marked on each core. Rock classification in terms of weathering and state of fractures and strength is carried out in the following manner. Tabulations given in below explain it briefly.

**Table 1: Rock Classification**

| Terms | Description | Grade |
|---|---|---|
| Fresh | No visible sign of rock material weathering; perhaps slight discoloration on Minor discontinuity surfaces. | I |
| Slightly Weathered | Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discoloured by weathering. | II |
| Moderately Weathered | Less than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as core stones. | III |
| Highly Weathered | More than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as core stones | IV |
| Disintegrated Rock | All rock material is decomposed and / or disintegrated to soil. The original mass structure is still largely intact. | V |
| Residual Soil | All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported. | VI |

-As per IS 4464-1985 (Reaffirmed 2004)

It should be understood that all grades of weathering may not be seen in a given rock mass and that in some cases a particular grade may be present to a very small extent. Distribution of the various weathering grades of rock material in the rock mass may be related to the porosity of the rock material and the presence of open discontinuities of all types in the rock mass.

**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log the commencement and completion date, location of borehole, elevation of top and bottom of boring, ground water table, boundaries of each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelog is attached as **Appendix-I.**

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant Standard Codes. A summary of laboratory tests carried out is shown below in **Table 1** and the complete results of laboratory testing are presented in **Appendix II**.

**Table 1: Details of various laboratory tests and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 1 | Soil | Grain-Size Analysis | IS: 2720(Part-4)-1985 |
| 2 | | Atterberg's Limit | IS: 2720(Part-5)-1976 |
| 3 | | MDD/OMC(Light Compaction) | IS:2720(Part-7)-1980 |
| 4 | | Direct Shear | IS:2720(part-130-1986 |
| 5 | | Permeability | IS :2720 (Part-17)-1986 |
| 6 | | Consolidation | IS:2720(Part-15)-1986 |
| 7 | | Moisture Content | BS:1377-(Part-2)-1990 |
| 8 | | Bulk Density & Dry Density | BS:1377-(Part-2)-1990 |
| 9 | | Cation Exchange Capacity | USDA No. 16 |
| 10 | Rock | Point Load Test | ISRM suggested Method |
| 11 | | Water Absorption | IS: 1124 - 1974 |
| 12 | | SSD specific gravity | ISRM suggested Method |
| | | Dry specific gravity | |

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 13 | Rock | Rock density | ISRM suggested Method |
| 14 | | Mohrs' Hardness | Using Mohrs' scale |



(a)



(b)



(c)



(d)

**Figure 2** : Laboratory tests performed at MatterLab.

## 6 SUMMARY

The geotechnical investigation of the original ground below the waste at the dumpsite at Kumbhalathumuri, Kothamangalam, Ernakulam district was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a

single borehole was drilled through the waste into the ground using a rotary drilling method. The maximum depth of investigation was 8.30m (3.00 in waste and 5.3m in the ground). SPT and collection of undisturbed soil samples were carried out at regular intervals within the ground. Various laboratory tests were carried out on the SPT and undisturbed soil samples.

It was observed from the laboratory results and samples obtained from SPT and the undisturbed samples collected, that the ground encountered below the dumped waste was a 1.5m thick sandy clay layer, followed by a 1.0m thick layer of residual soil which is underlain by a 0.8m thick weathered rock followed by a highly weathered strong biotite gneiss with an average core recovery of 20% for the depth of cutting of 2.0m. As per the information provided by the client, the waste in the dumpsite needs to be excavated, segregated using a few machinery and the inert material left after the bio-mining needs to be dumped within the site. As informed by the client, during the process of bio-mining the waste would be excavated from one feasible location of the site and transferred to another location of the site. During these operations, any temporary storage waste in the form of heaps should be carried out ensuring the stability of the sloping face of the waste. It is suggested that for slopes with height ≤ 1.5 m the angle of face should not be steeper than 45°. For slopes of height greater than 1.5 m the slope should be limited to 30° to horizontal or flatter. It is not advisable to use slope heights > 5 m without a proper stability analysis. If the inert material is being disposed at the site with no further plans of transporting it or transferring it, it is recommended to compact the material into layers using an 8-10 T roller with compacted lift thickness not exceeding 300 mm. It is important to perform stability analysis for different stages of excavation by including the operations of machines during the process of excavation, as the dumpsite is situated on a hilly terrain. It is suggested to do a geological survey to have a complete understanding of the subsurface profile of the dumpsite.

**The Safe Bearing Capacity (SBC)** is calculated as per IS 6403:1981 (Reaffirmed 2021). For any temporary structures planned at the site, the **recommended allowable bearing pressure** for isolated footings at a minimum depth of 1.0 m below **original ground level** is **150 kPa.** For any slope stability calculations involving the natural ground, the parameters presented in the summary sheet of laboratory results can be used.

The above recommendations are made based on the subsoil profile and laboratory test results obtained on the samples collected from the site. If there is any variation in soil profile during execution, fresh recommendation may be obtained from M/s Matter Material Testing & Research Laboratory (P) Ltd. or from a qualified and experienced geotechnical engineer.

# APPENDIX-I

# BORELOGS

Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT** | **: Geotechnical Investigation at Dumpsite in Kumbalathumuri, Kothamangalam** | **SHEET NO.** | **: 1 of 1** | **START DATE** | **: 06/06/2023** |
| **CLIENT** | **: IPE Global** | **BORE DIAMETER (mm)** | **: 150** | **END DATE** | **: 09/06/2023** |
| **Proposed Structure** | **: Dumpsite** | **BORING TYPE** | **: Rotary** | **REDUCED LEVEL (m)** | **: -** |
| **LOCATION** | **: Kumbalathumuri, Kothamangalam, Ernakulam district** | **TERMINATION DEPTH (m)** | **: 8.3** | **EASTING (m)** | **: 76.6476001** |
| **BOREHOLE NO.** | **: BH-01** | **WATER LEVEL** | **:** | **NORTHING (m)** | **: 10.0797278** |

| DEPTH m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM N1 | BLOW COUNT/15CM N2 | BLOW COUNT/15CM N3 | SPT N VALUE | DEPTH V/S N VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.00 | | Waste | 3.00 | | | | | | | | |
| 4.50 | | Firm dark greyish silty CLAY | 1.50 | 3.0<br>3.5<br>4.0 | SPT-1<br>UDS-1<br>UDS-2 | 2 | 3 | 3 | | | |
| 5.50 | | Residual soil | 1.00 | 4.5<br>5.0 | SPT-2<br>SPT-3 | >50<br>20 | -<br>38 | -<br>>50 | | | Balance-18cm<br>Balance-15cm |
| 6.30 | | Weathered rock | 0.80 | 6.0<br>6.3 | SPT-4<br>SPT-5 | 22<br>>50 | 36<br>- | >50<br>- | | | Refusal |
| 7.30 | | Slightly weathered light greyish strong biotite gneiss | 1.00 | | RC-1 | | | | | | CR 12%<br>RQD NIL |
| 8.30 | | | 1.00 | | RC-2 | | | | | | CR 29%<br>RQD NIL |
| | | **Bore hole terminated at the depth of 8.3m below top of waste (5.3m below original ground)** | | | | | | | | | |

Abbreviations
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
CR- Core Recovery, RQD- Rock Quality Designation

Sd/-
Site Supervisor

# APPENDIX-II

# LABORATORY TEST RESULTS

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# SUMMARY OF LABORATORY TEST RESULTS

**Report Number : ML23/R-02006 Report Date:27/06/2023**

**Project : Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam, Ernakulam District**

**Borehole ID : BH-01**

| N value | MatterLab ref. | Depth (m) | Type of sample (SPT/UDS/RC) | Soil description | IS Classification | Atterberg Limit | | | Grain size distribution | | | | | | | Maximum dry density, gm/cc | Optimum moisture content, % | Bulk Density, gm/cc | Dry density, gm/cc | Moisture content, % | Cohesion (c), kPa | Internal friction angle, ° | Permeability, cm/s | Unconfined compressive strength, kPa | Rock cores | | | | | | | | Consolidation | | | | Chemical |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit,% | Plastic Limit,% | Plasticity Index | Coarse Gravel,% | Fine Gravel,% | Coarse Sand,% | Medium Sand,% | Fine Sand,% | Silt,% | Clay,% | | | | | | | | | | Core recovery (%) | RQD (%) | Point load (MPa) | Water Absorption (%) | SSD specific gravity, gm/cc | Dry specific gravity, gm/cc | Rock density (kg/m³) | Mohs Hardness | Initial Void ratio | Preconsolidation pressure, kPa | Compression Index, $C_c$ | Recompression Index, $C_r$ | Cation exchange capacity (meq/100gm) |
| 6 | ML23/W-02006/S1 | 3.0 | SPT | Clayey sand / Sandy clay | SC/CI | 40 | 21 | 19 | | 5 | 8 | 24 | 18 | 18 | 27 | | | | | | | | | | | | | | | | | | | | | |
| | ML23/W-02006/S2 | 3.5 | UDS | Clayey sand / Sandy clay | SC/CI | 36 | 20 | 16 | | 3 | 8 | 23 | 21 | 16 | 29 | | | 2.11 | 1.87 | 13 | 5 | 30 | 3.00 E-05 | | | | | | | | | 0.502 | 109 | 0.14 | 0.003 | |
| | ML23/W-02006/S3 | 4.0 | UDS | | | | | | | | | | | | | 1.71 | 16 | 2.03 | 1.77 | 15 | | | | 420 | | | | | | | | | | | | |
| >50 | ML23/W-02006/S4 | 4.5 | SPT | Poorly graded sand with silt | SP-SC | 46 | 22 | 24 | | 13 | 12 | 42 | 24 | 9 | | | | | | | | | | | | | | | | | | | | | | 11.03 |
| | ML23/W-02006/S5 | 6.3 to 7.3 | RC | Slightly weathered light greyish strong biotite gneiss | | | | | | | | | | | | | | | | | | | | | 12 | NIL | 0.7 | 1.3 | 2.60 | 2.57 | 2560 | 4.5 | | | | | |
| | ML23/W-02006/S6 | 7.3 to 8.3 | RC | | | | | | | | | | | | | | | | | | | | | | 29 | NIL | 3.1 | 0.4 | 2.63 | 2.63 | 2620 | 5.5 | | | | | |

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Kozhikode, Kerala, 673028.

# Grain Size Distribution of Soil Test Report

Report No: ML22/N-020006/1
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

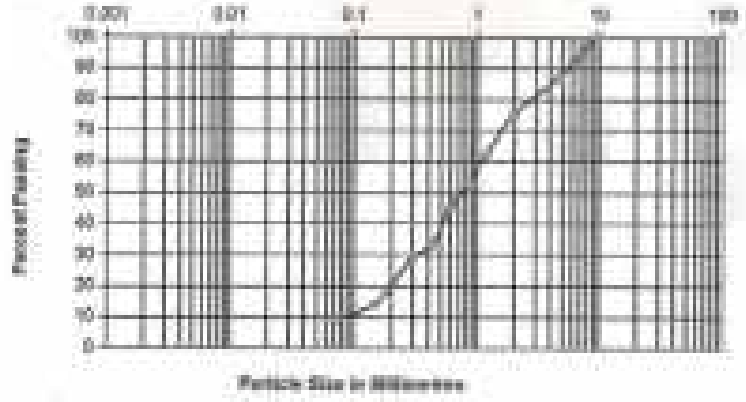
UA-TC107(2)2308004633F

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*): | Soil, BH 01, Depth 4.50m |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/S4 | Source*): | BH 01, Depth 4.50m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx. |
| Sample Location*): | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 20/06/2023 - 22/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 4.50m |
| Tested By: | GK | Client Sample Desc.*): | Soil, BH 01, Depth 4.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution - Wet & Dry Sieving

Method: IS: 2720 (Part 4)-1985




| Sieve Size (mm) | % Passing | Project Limit |
|---|---|---|
| 9.500 | 100 | - |
| 4.750 | 87 | - |
| 2.000 | 75 | - |
| 1.180 | 62 | - |
| 0.850 | 53 | - |
| 0.600 | 45 | - |
| 0.425 | 33 | - |
| 0.300 | 29 | - |
| 0.150 | 14 | - |
| 0.075 | 9 | - |

For and on behalf of MatterLab

Comments
*Information provided by client

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Kozhikode, Kerala, 673020.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-02006/2
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

ULR:TC789423000046534F

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 3.00m |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/S1 | Source*: | BH 01, Depth 3.00m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 21/06/2023 - 23/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 3.00m |
| Tested By: | VV | Client Sample Desc*.: | Soil, BH 01, Depth 3.00m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3 Mechanical Method | Liquid Limit,% | 40 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 21 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 19 | - |

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Kozhikode, Kerala, 673035

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-02008/3
Issue No: 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

UA-TC10745 2 3 0 8 0 0 0 4 6 3 5 F

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 4.50m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/S4 | Source*: | BH 01, Depth 4.50m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 21/06/2023 - 23/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 4.50m |
| Tested By: | MV | Client Sample Desc*.: | Soil, BH 01, Depth 4.50m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3 Mechanical Method | Liquid Limit,% | 46 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 22 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 24 | - |

SUBILESH T.V
Head-QM Laboratory

For and on behalf of MatterLab

## Comments

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TC-6040

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/R-02000/04
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 629330 |
| Contact: | Mr. Ranatar Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

ULR-TC187023000046 3F

## Sample Details

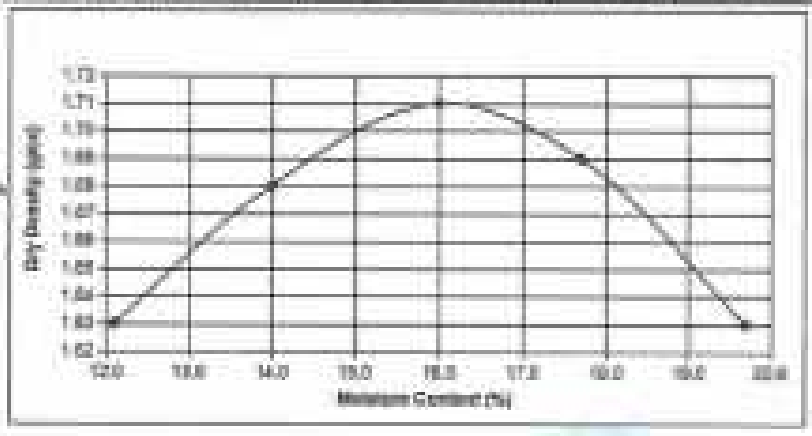
| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-2), BH 01, Depth 4.00m |
| Work Order ID: | ML23/W-02000 | Sample Submitted By:*: | Geotechnical Division |
| Sample ID: | ML23/W-02000/03 | Source*: | BH 01, Depth 4.00m |
| Date Sampled: | 09/06/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 21/06/2023 - 22/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 4.00m |
| Tested By: | DK/GK | Client Sample Desc.: | Soil (UDS-2), BH 01, Depth 4.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ (cm³) | 998 | | | | |
| Test No | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4063 | | | | |
| Mass of mould + compacted sample | | W (g) | 5889 | 5979 | 6039 | 6049 | 6033 |
| Mass of sample | | | 1826 | 1916 | 1976 | 1986 | 1946 |
| Wet density | $(W-W_m)/V_m$ | $\rho_w$ (Mg/m³) | 1.83 | 1.92 | 1.98 | 1.99 | 1.95 |
| Mass of wet sample | | W (g) | 474.8 | 474.1 | 460.3 | 446.3 | 445.0 |
| Mass of dry sample | | W (g) | 423.8 | 415.9 | 396.8 | 380.9 | 371.8 |
| Moisture content | $(W_2-W_3)/W_3 \times 100$ | m (%) | 12.1 | 14.0 | 16.0 | 17.7 | 19.7 |
| Dry density | $\rho_w/(1+m/100)$ | $\rho_d$ (Mg/m³) | 1.65 | 1.68 | 1.71 | 1.68 | 1.63 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc: | 1.71 |
| Optimum moisture content, %: | 16 |
| Material retained on 20mm,%: | 0 |
| Sample used: | Single |
| Size of mould: | 1000cm³ |
| Weight of rammer: | 2.6 kg |




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Comments:
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Thiruvannur, Kozhikode, Kerala, 673029

# Hydrometer Analysis Test Report

Report No: ML23/N-02006/01
Issue No: 1
Report Date: 27/06/2023

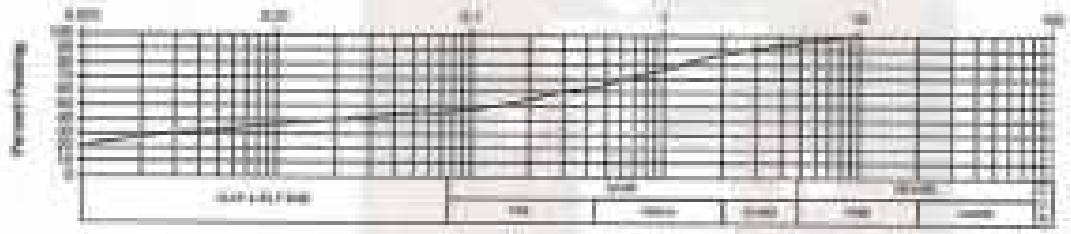
| | | | |
|---|---|---|---|
| Client: | SPE Water | Consultant: | - |
| Address: | Kavanad Building, Kannadanmr Village, Kakkanad, Ernakulam, Kerala - 626030 | Owner: | KMWP |
| Contact: | Mr. Ranabir Dey | Contractor: | - |
| Project No: | - | Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam | Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 12/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 3.00m |
| Work Order ID: | ML23/N-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/N-02006/S1 | Source*: | BH 01, Depth 3.00m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2720 - 1981 | Sample Shape: | 5 Approx |
| Sample Location*: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 21/06/2023 - 22/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 3.00m |
| Tested By: | BH | Client Sample Desc.*: | Soil, BH 01, Depth 3.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution

Method: IS: 2720 (Part 4)-1985, Cl.24




| Sieve Size (mm) | % Passing |
|---|---|
| 0.075 | 100 |
| 4.750 | 95 |
| 2.000 | 87 |
| 0.850 | 74 |
| 0.600 | 69 |
| 0.425 | 63 |
| 0.300 | 60 |
| 0.150 | 51 |
| 0.075 | 43 |
| 0.053 | 40 |
| 0.037 | 42 |
| 0.026 | 41 |
| 0.019 | 39 |
| 0.013 | 38 |
| 0.010 | 36 |
| 0.007 | 34 |
| 0.005 | 32 |
| 0.003 | 30 |
| 0.002 | 27 |
| 0.001 | 21 |

| | |
|---|---|
| Gravel % | 5 |
| Sand % | 53 |
| Silt % | 16 |
| Clay % | 27 |

SREELESH T.V
Technical Manager

For and on behalf of MatterLab

Comments:
*Information provided by client

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Thiruvanmur, Kozhikode, Kerala, 673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-020004/
Issue No: / 1
Report Date: 07/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanad Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 629030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/05/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/02 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 09/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 20/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.50m |
| Tested By: | GK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 2.11 | - |

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Nabl Civil Laboratory

For and on behalf of MatterLab

**Comments**

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Thiruvannur, Kozhikode, Kerala, 673029

# UNCONFINED COMPRESSIVE STRENGTH(UCS) OF SOIL TEST REPORT

Report No: ML23/R-020007
Issue No.: 1
Report Date: 27/06/2023

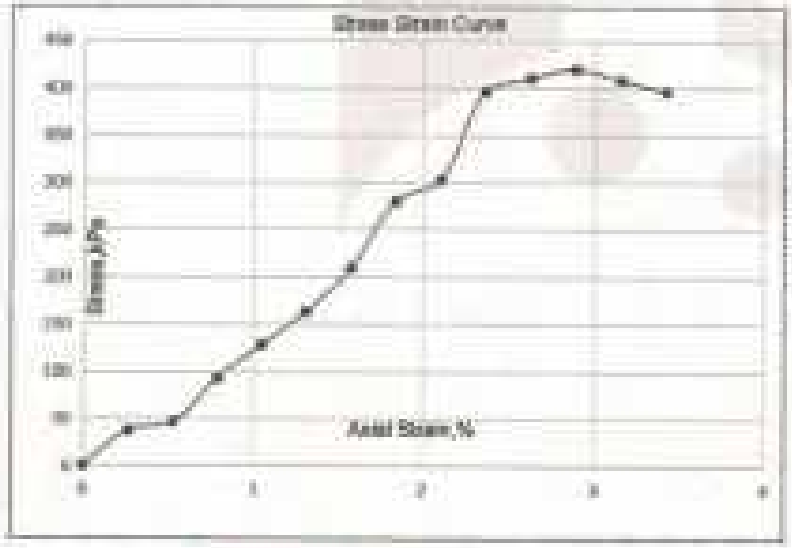
| | |
|---|---|
| **Client:** | IRE Global |
| **Address:** | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 6030030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 15/06/2023 | **Client Sample Ref.*:** | Soil (UCS-2), BH 01, Depth 4.00m |
| **Work Order ID:** | ML23/W-020006 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-020006/03 | **Source:** | BH 01, Depth 4.00m |
| **Date Sampled:** | 09/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method:** | IS: 2132 - 1986 | **Sample Size(kg):** | Approx |
| **Sample Location:** | Kumbhalathumuri, Kothamangalam, Ernakulam District | **Date Tested :** | 21/06/2023 - 22/06/2023 |
| **Sample Cont. No:** | - | **Test Method Variation:** | None |
| **Test Location:** | MatterLab, Kozhikode | **Lab Sample Desc.:** | Soil (UCS-2), BH 01, Depth 4.00m |
| **Tested By:** | CH.LI | **Client Sample Desc.:** | Soil (UCS-2), BH 01, Depth 4.00m |

**Test Results**

Method: IS: 2720 (Part 10) 1991 (R2019)




| | |
|---|---|
| Unconfined Compressive Strength(kPa) | 420 |
| Specimen Height (mm) | 76 |
| Specimen Dia(mm) | 38 |
| Specimen Density(g/cc) | 2.03 |
| Moisture Content(%) | 16 |
| Type of specimen | Undisturbed |
| Specimen Condition | - |

For and on behalf of Matter Lab

**Comments**

Information provided by client

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Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

# POINT LOAD INDEX OF ROCK TEST REPORT

Report No: ML-23/R-03008/B
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPC Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ravatar Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client sample Ref.:* | BH 01, Depth 6.3m - 7.3m |
| Work Order ID: | ML23/W-03008 | Source*: | BH 01, Depth 6.3m - 7.3m |
| Sample ID: | ML23/W-03008/S8 | Sampled By*: | Geotechnical Division |
| Sampling Location: | Kumbalathumuri, Kothamangalam, Ernakulam District | Sampling Method: | IS: 2131 - 1981 |
| Sample Cont. No: | - | Date Tested: | 23/06/2023 - 24/06/2023 |
| Tested By: | GK/JJ | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Sample Description: | Rock Core sample |

**Test Results** — Test Method: ISRM Suggested Method

| | | | | |
|---|---|---|---|---|
| Specimen No | | 1 | 2 | 3 |
| Sampling Date | | 09/06/2023 | | |
| Moisture Condition @ Test | | As received | | |
| Moisture Content | (%) | 1.30 | 1.25 | 1.40 |
| Test type | | Axial | | |
| Direction of Loading to Plane of Weakness | | Perpendicular | | |
| Specimen Diameter | (mm) | 43.3 | 49.5 | 52.7 |
| Specimen Thickness | (mm) | 29.6 | 34.7 | 37.4 |
| Failure Load | (kN) | 1.577 | 1.134 | 1.093 |
| Equivalent Core Dia | (mm) | 1371 | 1934 | 1942 |
| Point Load Index, $I_s$ | (MPa) | 1.00 | 0.72 | 0.59 |
| Corrected Point Load Index, $I_{s(50)}$ | (MPa) | 0.90 | 0.65 | 0.53 |
| Mean Point Load Index, $I_{s(50)}$ | (MPa) | | 0.7 | |

Head-Civil Laboratory

For and on behalf of MatterLab

**Comments**

*Information provided by client
Test conducted on available bore hole sample.

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Thiruvannur, Kozhikode, Kerala, 673029

# POINT LOAD INDEX OF ROCK TEST REPORT

Report No: ML23/R-02008/B
Issue No : 0
Report Date:27/06/2023

| | |
|---|---|
| Client: | IRE Global |
| Address: | Kavanati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 626030 |
| Contact: | Mr. Renabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client sample Ref.:* | BH 01, Depth 7.3m - 8.3m |
| Work Order ID: | ML23/W-02008 | Source*: | BH 01, Depth 7.3m - 8.3m |
| Sample ID: | ML23/W-02008/S8 | Sampled By*: | Geotechnical Division |
| Sampling Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Sampling Method: | IS 2131 : 1981 |
| Sample Cert. No: | - | Date Tested : | 23/06/2023 - 24/06/2023 |
| Tested By: | GK | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Sample Description: | Rock Core sample |

| Test Results | | | | Test Method: ISRM Suggested Method |
|---|---|---|---|---|
| Specimen No | | 1 | 2 | 3 |
| Sampling Date | | 09/06/2023 | | |
| Moisture Condition @ Test | | As received | | |
| Moisture Content | (%) | 0.54 | 0.21 | 0.20 |
| Test type | | Axial | | |
| Direction of Loading to Plane of Weakness | | Perpendicular | | |
| Specimen Diameter | (mm) | 49.1 | 50.0 | 50.0 |
| Specimen Thickness | (mm) | 28.1 | 28.2 | 24.8 |
| Failure Load | (kN) | 5.569 | 7.191 | 4.652 |
| Equivalent Core Dia | (mm) | 1703 | 1768 | 1579 |
| Point Load Index , $I_s$ | (MPa) | 3.18 | 4.01 | 2.83 |
| Corrected Point Load Index, $I_{s(50)}$ | (MPa) | 2.94 | 3.72 | 2.64 |
| Mean Point Load Index, $I_{s(50)}$ | (MPa) | | 3.1 | |

ENGLISH TV
Authorised Signatory

For and on behalf of MatterLab

| Comments |
|---|
| *Information provided by client |
| Test conducted on available bore hole sample |

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Thiruvannur, Kozhikode, Kerala, 673025

# Permeability of Soil Test Report

Report No: ML23/R-02006/10
Issue No: 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveratt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/02 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kumbalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 21/06/2023 - 23/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.50m |
| Tested By: | DK/GK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 3.00 E-05 | - |

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## Comments

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# SHEAR STRENGTH TEST REPORT

Report No: ML23/R-0200/1
Issue No.: 1
Report Date: 27/06/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kaveneli Building, Kanayaloor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| **Tel / Email:** | - |

## Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 13/06/2023 | **Client Sample Ref.*):** | Soil (UDS-1), BH 01, Depth 3.60m |
| **Work Order ID:** | ML23/W-0209/R | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-0209/S2 | **Source:*** | BH 01, Depth 3.60m |
| **Date Sampled:** | 09/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method:** | IS: 2132 : 1986 | **Sample Size(kg):** | 5 Approx |
| **Sample Location:*** | Kumbhalathumuri, Kothamangalam, Ernakulam District | **Date Tested :** | 22/06/2023 - 23/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Test Location:** | MatterLab - Kozhikode | **Lab Sample Desc.:** | Soil (UDS-1), BH 01, Depth 3.60m |
| **Tested By:** | SR | **Client Sample Desc.:** | Soil (UDS-1), BH 01, Depth 3.60m |

## Test Results

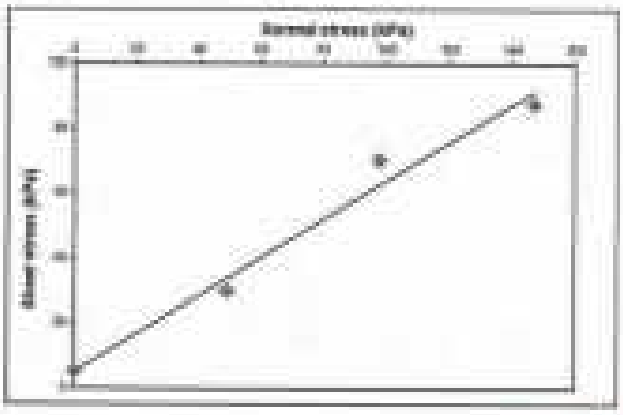
Method: IS 2720 (Part 13): 1986

| | | |
|---|---|---|
| Area of specimen ($cm^2$) | : | 36 |
| Height of specimen (mm) | : | 25 |
| Rate of strain (mm/min) | : | 1.25 |
| Test Condition | : | Unconsolidated Drained |
| Bulk Density ($Mg/m^3$) | : | 2.11 |
| Moisture content (%) | : | 13 |
| Dry Density ($Mg/m^3$) | : | 1.87 |

| Load Increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Stress (mm) |
|---|---|---|---|
| 1 | 49 | 38.9 | 2.0 |
| 2 | 98 | 70.2 | 2.4 |
| 3 | 147 | 97.5 | 3.6 |

**Cohesion Intercept (C'), kPa** : 9

**Angle of Internal friction (Φ')** : 30°




SREELESH T.V
Head-Civil Laboratory

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## Comments

*Information provided by client

Material tested was passing 4.75 mm test sieve, reconstituted at maximum achievable density and moisture content

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# Water Absorption - Test Report

Report No: ML23/R-020000/1/2
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveriatt Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 628000 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref*): | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Work Order ID: | ML23/W-03000 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-03000/03 | Source*: | BH 01, Depth 6.3m - 7.3m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 25/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Tested By: | GK | Client Sample Desc.*): | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Water Absorption,% | 1.3 | - |

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Head-Civil Laboratory

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# Water Absorption - Test Report

Report No: ML23/W-02006/13
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kirvanet Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Renabir Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref*): | Rock Core, BH 01, Depth 7.3m - 8.3m |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/06 | Source*): | BH 01, Depth 7.3m - 8.3m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*): | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 25/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Rock Core, BH 01, Depth 7.3m - 8.3m |
| Tested By: | GK | Client Sample Desc.*): | Rock Core, BH 01, Depth 7.3m - 8.3m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Water Absorption,% | 0.4 | - |

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# Density - Test Report

Report No: ML23/R-03008/1/F
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavenad Building, Kanayancoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Renabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref*: | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Work Order ID: | ML23/W-03008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-03008/58 | Source*: | BH 01, Depth 6.3m - 7.3m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 26/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Tested By: | GK | Client Sample Desc.*: | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Rock Density kg/m³ | 2560 | - |

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# Density - Test Report

Report No: ML23/R-02006/19
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveratt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref*: | Rock Core, BH 01, Depth 7.3m - 8.3m |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/09 | Source*: | BH 01, Depth 7.3m - 8.3m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 26/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Rock Core, BH 01, Depth 7.3m - 8.3m |
| Tested By: | GK | Client Sample Desc.*: | Rock Core, BH 01, Depth 7.3m - 8.3m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Rock Density kg/m³ | 2620 | - |

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# Specific Gravity - Test Report

Report No: ML23/R-02006/15
Issue No: 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref*: | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/55 | Source*: | BH 01, Depth 6.3m - 7.3m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Kumbalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 20/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Tested By: | GK | Client Sample Desc.*: | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | SSD Specific Gravity,g/cc | 2.60 | - |
| | Dry Specific Gravity,g/cc | 2.57 | |

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Head, Civil Laboratory

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Thiruvannur, Kozhikode, Kerala, 673029

# Specific Gravity - Test Report

Report No: ML23/W-03008/01
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavanatt Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| **Tel / Email:** | - |

## Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 13/06/2023 | **Client Sample Ref*:** | Rock Core, BH 01, Depth 7.3m - 8.3m |
| **Work Order ID:** | ML23/W-03008 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-03008/08 | **Source*:** | BH 01, Depth 7.3m - 8.3m |
| **Date Sampled:** | 09/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method:** | IS: 2131 - 1981 | **Sample Size(kg):** | - |
| **Sample Location*:** | Kumbhalathumuri, Kothamangalam, Ernakulam District | **Date Tested :** | 25/06/2023 - 27/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Rock Core, BH 01, Depth 7.3m - 8.3m |
| **Tested By:** | GK | **Client Sample Desc.*:** | Rock Core, BH 01, Depth 7.3m - 8.3m |
| **Test Location:** | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | SSD Specific Gravity,g/cc | 2.63 | - |
| | Dry Specific Gravity,g/cc | 2.63 | |

For and on behalf of MatterLab

## Comments

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Thiruvannur, Kozhikode, Kerala, 673029

# SCRATCH HARDNESS OF SURFACE ACCORDING TO MOHS'SCALE OF ROCK TEST REPORT

Report No: ML23/0-00006/1B
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IRE Global |
| Address: | Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Work Order ID: | ML23/W-03006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-03006/55 | Source*: | BH 01, Depth 6.3m - 7.3m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 25/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Tested By: | GK | Client Sample Desc.*: | Rock Core, BH 01, Depth 6.3m - 7.3m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| Using Mohs' Scale | Mohs' Hardness | 4.5 | - |

IREELESH T.V
Head, Civil Laboratory

For and on behalf of Matter Lab

**Comments**

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Thiruvannur, Kozhikode, Kerala, 673029

# SCRATCH HARDNESS OF SURFACE ACCORDING TO MOHS'SCALE OF ROCK TEST REPORT

Report No: ML23R-02006/1R
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ramesh Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Rock Core, BH 01, Depth 7.3m - 8.3m |
| Work Order ID: | ML23W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02006/58 | Source*: | BH 01, Depth 7.3m - 8.3m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 25/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Rock Core, BH 01, Depth 7.3m - 8.3m |
| Tested By: | GK | Client Sample Desc.*: | Rock Core, BH 01, Depth 7.3m - 8.3m |
| Test Location | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| Using Mohs' Scale | Mohs' Hardness | 6.8 | - |

SREELESH TV
Technical Manager

For and on behalf of Matter Lab

**Comments**

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Thiruvenmur, Kozhikode, Kerala, 673029

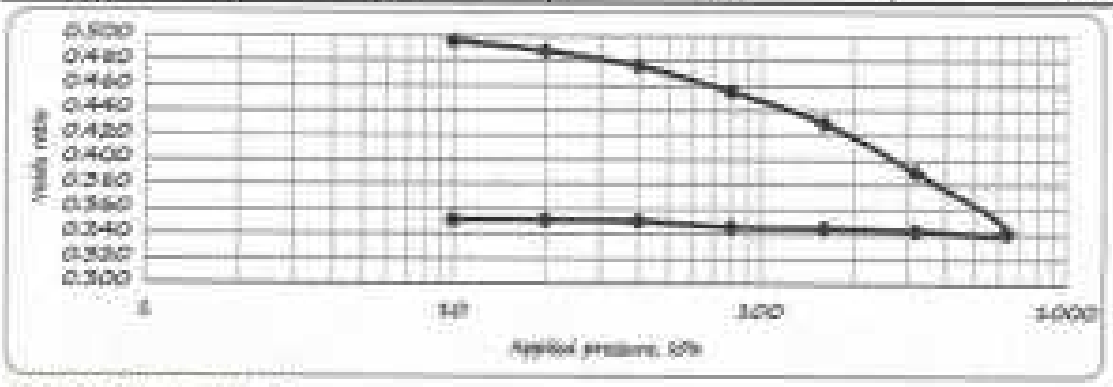
# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | | | |
|---|---|---|---|
| Date Received | 13/06/2023 | Report No. | ML23/R-02006/23 |
| Date Reported | 21/07/2023 | Client Ref. | Soil (UDS-1), BH 01, Depth 3.50m |

| | | | |
|---|---|---|---|
| Client | IPE Global | | |
| Adress | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 626030 | | |
| Contact | Mr. Rasakh Dey | | |
| Project Number | - | | |
| Project Name | Geotechnical Investigation at Dumpsite in Kumbalathumuri, Kothamangalam | | |
| Consultant | - | | |
| Owner | KSWMP | | |
| Source* | BH 01, Depth 3.50m | Client Sample Ref*. | Soil (UDS-1), BH 01, Depth 3.50m |
| Sampled by | Geotechnical Division | Date Tested | 04/07/2023 |
| Test Method | IS : 2720 ( Part 15 ) - 1986 | Test Location | MatterLab - Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | ML23/M-02006/S3 | Initial diameter (mm) | 60 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Kumbalathumuri, Kothamangalam, Ernakulam District |
| Initial voids ratio | 0.502 | Dry Density (Mg/m$^3$) | 1.751 |
| Moisture content (%) | 21.3 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 10 | 0.496 | 69.80 | 0.400 |
| 20 | 0.487 | 39.79 | 0.392 |
| 40 | 0.476 | 38.06 | 0.404 |
| 80 | 0.455 | 27.94 | 0.344 |
| 160 | 0.430 | 28.45 | 0.219 |
| 320 | 0.399 | 24.42 | 0.174 |
| 640 | 0.341 | 21.64 | 0.110 |




Preconsolidation Pressure: 105 kPa
Compression Index, $C_c$: 0.14
Recompression Index, $C_r$: 0.005

Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 2 of 3 & 3 of 3)
*Information provided by client

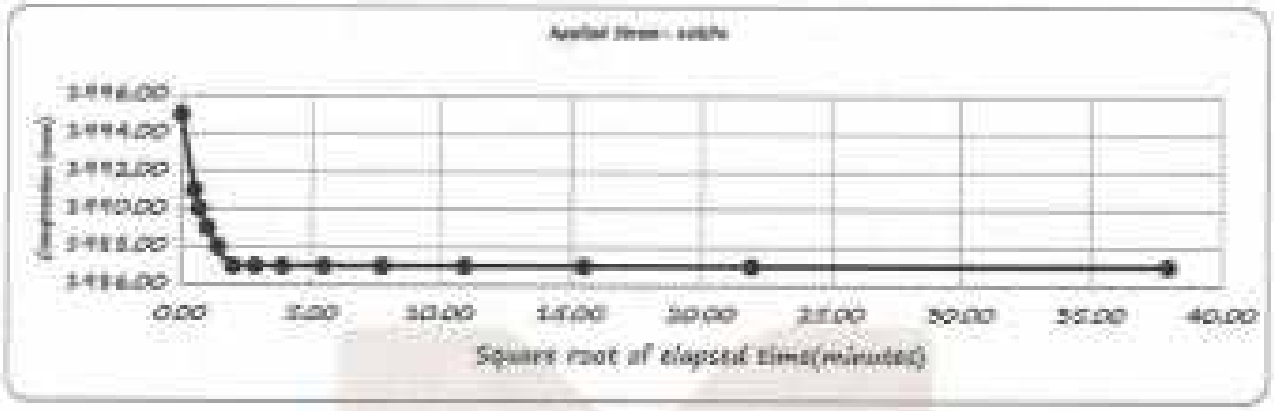


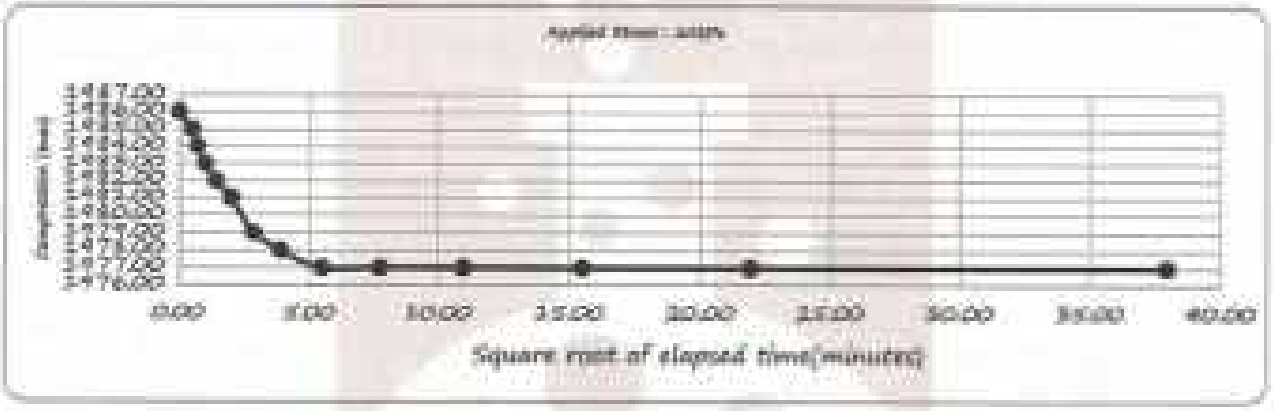
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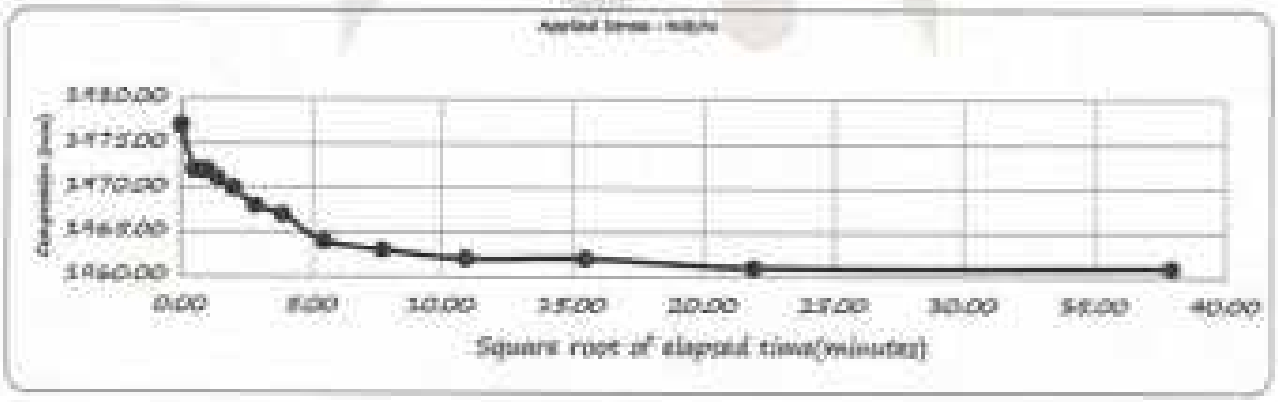
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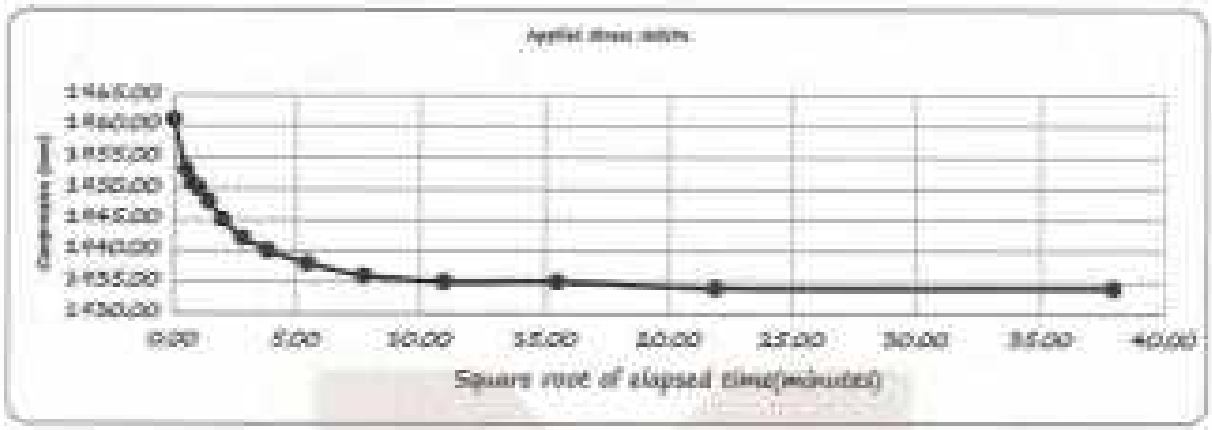
Compression Vs square root of time curves

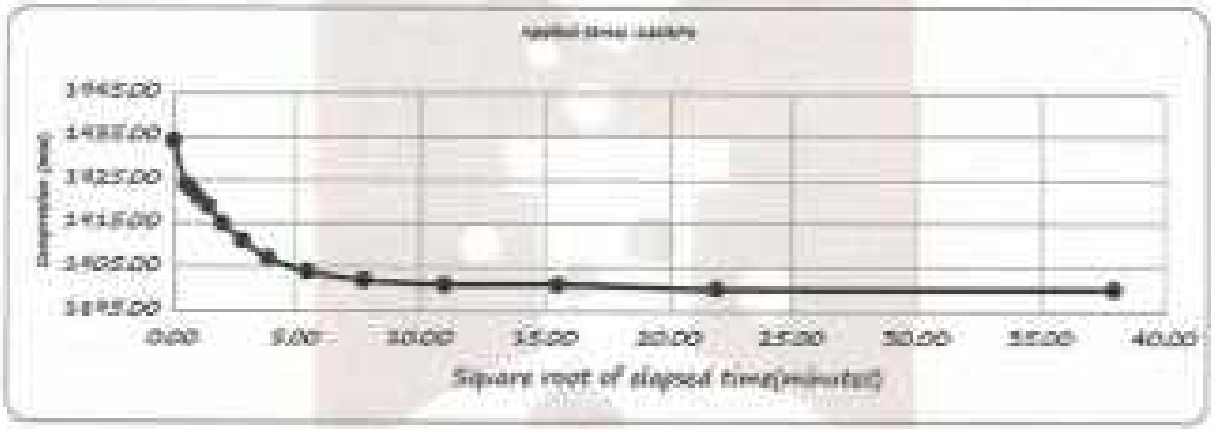


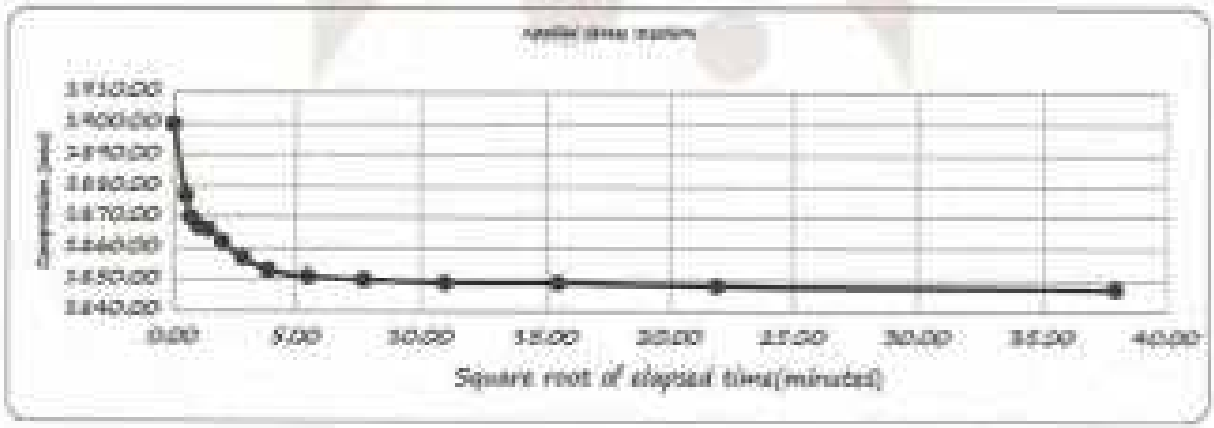



**Compression Vs square root of time curves**



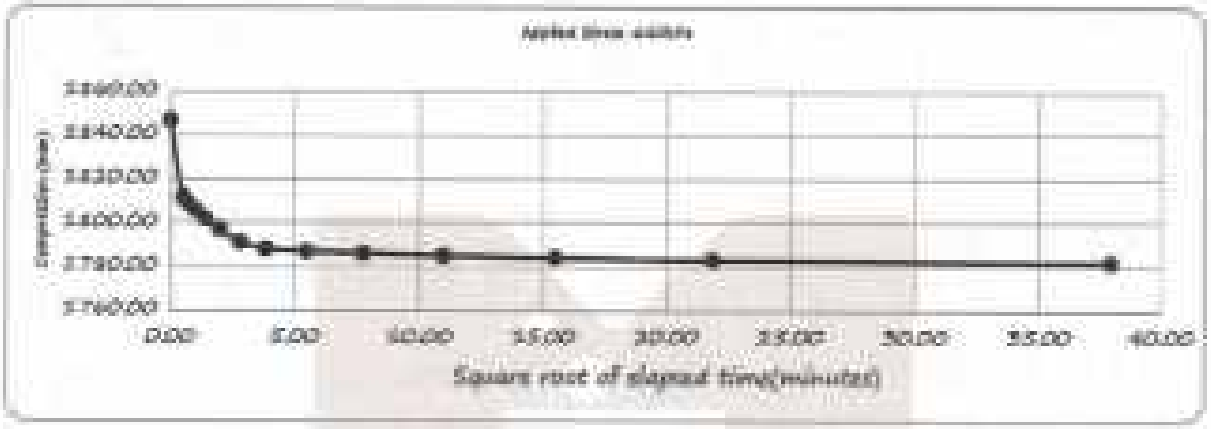



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**Compression Vs square root of time curves**




SREELESH T.V
Head-Civil Laboratory

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UIN-TC107423988005472F

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-02006/21
Issue No: 1
Report Date:03/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveriatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/S2 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 26/07/2023 - 28/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.50m |
| Tested By: | MV | Client Sample Desc*.: | Soil (UDS-1), BH 01, Depth 3.50m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3: Mechanical Method | Liquid Limit,% | 36 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 20 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 16 | - |

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Head, Civil Laboratory

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Kozhikode, Kerala, 673328.

## Water Content of Soil Test Report

Report No: ML23/R-02000/02
Issue No : 0
Report Date: 03/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 629020 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

IR-WC20230803000002F

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Work Order ID: | ML23/W-02000 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02000/S2 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx. |
| Sample Location*: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.50m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 13 | - |

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Head-Civil Laboratory

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# Water Content of Soil Test Report

Report No: ML23/R-02006/23
Issue No : 1
Report Date: 03/08/2023

| | |
|---|---|
| Client: | PE Global |
| Address: | Kavenat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranalin Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 26/07/2023 | Client Sample Ref.*: | Soil (UDS-2), BH 01, Depth 4.00m |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/S3 | Source*: | BH 01, Depth 4.00m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kumbalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 4.00m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-2), BH 01, Depth 4.00m |
| Test Location: | MatterLab - Kozhikode | | |

Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 18 | - |

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Head-Civil Laboratory

For and on behalf of Matter Lab

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Thiruvannur, Kozhikode, Kerala, 673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-02006/24
Issue No.: 1
Report Date: 03/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 29/07/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Work Order ID: | ML23/WI-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/WI-02006/S2 | Source*: | BH 01, Depth 3.50m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.50m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 3.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 2.11 | - |
| | Dry Density,g/cc | 1.87 | - |

SREELESH T.V
Head -Civil Laboratory

For and on behalf of MatterLab

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Thiruvannur, Kozhikode, Kerala, 673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-02006/23
Issue No : 1
Report Date: 03/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kunnthalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kunnthalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-2), BH 01, Depth 4.00m |
| Work Order ID: | ML23W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02006/S3 | Source*: | BH 01, Depth 4.00m |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 3132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Kunnthalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 25/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 4.00m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-2), BH 01, Depth 4.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 2.03 | - |
| | Dry Density g/cc | 1.77 | - |

SREELESH T.V
Lab In-Charge
For and on behalf of MatterLab

**Comments**

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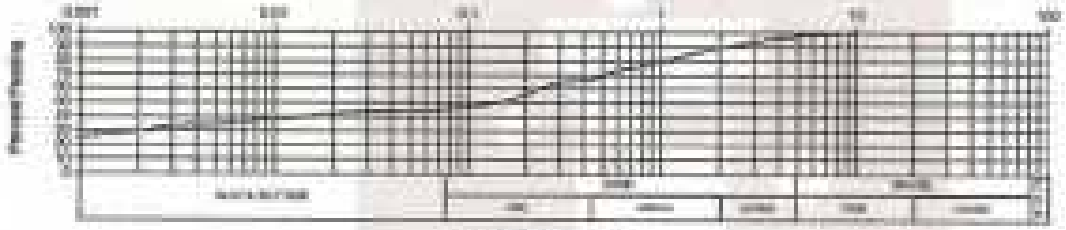
## Hydrometer Analysis Test Report

| | | | |
|---|---|---|---|
| Client: | IPE Global | Consultant: | - |
| Address: | Nisarath Building, Narayanoor Village, Kakkanad, Ernakulam, Kerala - 682032 | Owner: | KSWMP |
| Contact: | Mr. Ranabir Dey | Contractor: | - |
| Project No: | - | Project Location: | Kumbalaathumuri, Kothamangalam, Ernakulam District |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbalaathumuri, Kothamangalam | Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 29/07/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 3.00m |
| Work Order ID: | MLDSW-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | MLDSW-02008/03 | Source*: | BH 01, Depth 3.00m |
| Date Sampled: | 08/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 – 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kumbalaathumuri, Kothamangalam, Ernakulam District | Date Tested : | 27/07/2023 – 29/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 3.00m |
| Tested By: | SH | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 3.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4): 1985, Cl. 6.4.2




| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 97 |
| 2.000 | 90 |
| 0.850 | 77 |
| 0.425 | 73 |
| 0.300 | 66 |
| 0.150 | 54 |
| 0.075 | 50 |
| 0.053 | 46 |
| 0.038 | 44 |
| 0.028 | 43 |
| 0.019 | 41 |
| 0.013 | 38 |
| 0.010 | 34 |
| 0.007 | 30 |
| 0.005 | 24 |
| 0.003 | 22 |
| 0.002 | 20 |
| 0.001 | 20 |

| | |
|---|---|
| Gravel,% | 3 |
| Sand,% | 52 |
| Silt,% | 18 |
| Clay,% | 28 |

SREELESH T.V
Lab Manager

For and on behalf of MatterLab

**Comments**

*Information provided by client

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Where Quality Matters

Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

## Chemical Test Report of Soil

Report No: ML23/S-02571/1
Issue No : 1
Report Date: 27/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building,Kanayanoor Village,Kakkanad,Ernakulam,Kerala – 628030 |
| Contact: | Mr.Ranabir Dev |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri,Kothamangalam |
| Owner: | KSWMP |
| Project Location: | Kumbhalathumuri,Kothamangalam,Ernakulam District |
| Tel No: | - |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 12/07/2023 | Client Sample ID:* | Soil and Rock |
| Work Order ID: | ML23/W-02571 | Source:* | Borehole - 1 (Depth 1.5m from orginal soil) |
| Sample ID: | ML23/W-02571/S1 | Sample Submitted By: | Geotechnical Division |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sample Location: | Kumbhalathumuri,Kothamangalam | Date Tested: | 13/07/23 - 20/07/23 |
| Tested By: | MLA | Test Method Variation: | None |

### CHEMICAL ANALYSIS

| Test/Parameter | Test Method | Unit | Result |
|---|---|---|---|
| Cation Exchange Capacity | USDA No.19 | (meq/100gm) | 11.03 |

ANWAR. P
Lab Manager-Chemistry

For and on behalf of Matter Lab

Mini Bypass Road Thiruvannur Nada (PO) Thiruvannur, Kozhikode Pin 673 029

### Comments

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Mini Bypass Road, Thiruvambur Nada (PO)
Thiruvambur, Kozhikode, Kerala, 673029

# Chemical Test Report of Soil

Report No: ML23/R-02571/2
Issue No: 1
Report Date: 06/10/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building,Kanayannoor Village,Kakkanad,Ernakulam,Kerala - 628030 |
| Contact: | Mr.Ranabir Dey |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri,Kothamangalam |
| Owner: | KSWMP |
| Project Location: | Kumbhalathumuri,Kothamangalam,Ernakulam District |
| Tel No: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 12/07/2023 | Client Sample ID:* | Soil and Rock |
| Work Order ID: | ML23/W-02571 | Source* | Borehole - 1 (1.5 m from orginal ground level) |
| Sample ID: | ML23/W-02571/S1 | | |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Tested By: | Matterlab,Kozhikode | Date Tested: | 13/06/23 - 20/06/23 |
| Sample Location: | Kumbhalathumuri,Kothamangalam | Test Method Variation: | None |

**CHEMICAL ANALYSIS - Test Method: IS 9334:2021 & CPHEEO Manual**

| Test/Parameters | Units | Results |
|---|---|---|
| pH Value | - | 6.69 |
| Electrical Conductivity | mS/cm | 0.555 |
| Nitrogen (N) | % | 0.34 |
| Phosphorus (P) | % | 0.02 |
| Potassium (K) | % | 0.24 |
| Carbon | % | 2.72 |
| Carbon / Nitrogen Ratio | % | 8.0 |
| Biodegradable Factor | % | < 0.1 |

**HEAVY METALS - Test Method: EPA 3050 (ICP OES)**

| | | |
|---|---|---|
| Arsenic (As) | mg/Kg | 3.0 |
| Cadmium (Cd) | mg/Kg | < 5.0 |
| Chromium (Cr) | mg/Kg | 166.7 |
| Copper (Cu) | mg/Kg | 83.8 |
| Lead (Pb) | mg/Kg | 39.9 |
| Nickel (Ni) | mg/Kg | 92.8 |
| Zinc (Zn) | mg/Kg | 573.6 |
| Mercury (Hg) | mg/Kg | < 0.1 |

ANWAR. P
Lab Manager-Chemistry
For and on behalf of Matter Lab

**Comments**

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**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

Phone : 0484-2544030, 8281982322, 9747400085.www.poluchem.com, poluchem@gmail.com

ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5048/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 19/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received: | 09/06/2023 |
| | Date of analysis | 09/06/2023 |
| | Sample Description | Waste Analysis -Kothamangalam - Kumbalathumuri |
| | Sample Location | Gps Reading : : N- 10 °04'43.303"<br>E -76°38'52.058" |

**CHEMICAL PARAMETERS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 7.26 |
| 02 | Biodegradable Factor | USEPA | % | 2.3 |
| 03 | Total carbon | USEPA 9060A | % | 4.7 |
| 04 | Phosphorus(P) | USEPA | % | 0.017 |
| 05 | Nitrogen(N) | USEPA | % | 0.24 |
| 07 | Potassium(K) | USEPA | % | 0.023 |
| 08 | C/N Ratio | USEPA | .. | 19.5:1 |
| 09 | Calorific Value | ASTM D 5865 | K.cal/kg | Nil |

Conti.....

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5048/2023 |
|---|---|---|
| M/s. IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 19/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received: | 09/06/2023 |
| | Date of analysis | 09/06/2023 |
| | Sample Description | Waste Analysis -Kothamangalam - Kumbalathumuri |
| | Sample Location | Gps Reading : : N- 10°04'43.303"<br>E -76°38'52.058" |

**TOXICITY ANALYSIS- HEAVY METALS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 10 | Iron (Fe) | USEPA 3050 | % | 1.98 |
| 11 | Arsenic(As) | USEPA 3050 | mg/kg | <0.1 |
| 12 | Selenium(Se) | USEPA 3050 | mg/kg | <0.1 |
| 13 | Nickel(Ni) | USEPA 3050 | mg/kg | 12.29 |
| 14 | Zinc (Zn) | USEPA 3050 | mg/kg | 39.5 |
| 15 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 |
| 16 | Copper (Cu) | USEPA 3050 | mg/kg | 26.7 |
| 17 | Chromium(Cr) | USEPA 3050 | mg/kg | 9.65 |
| 18 | Lead(Pb) | USEPA 3050 | mg/kg | 33.4 |
| 19 | Mercury(Hg) | USEPA 3050 | mg/kg | <0.1 |
| 20 | Manganese(Mn) | USEPA 3050 | mg/kg | 72.7 |

* End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD.

AUTHORIZED SIGNATORY

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## TEST REPORT



**Ref.No: PL/RT/5045/2023** **Date of Issue: 19/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Leachate Kothamangalam -Kumbalathumuri
Sample Location : Gps Reading : N-10 °04'.062"
E -76°41'17.339"

Sample code : F/5045/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Results |
|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 7.09 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 1885 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 180 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 788.41 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 320 mg/l |
| B O D (3 days at $27^0$ C) | IS 3025 (P) 44 – 1993 RA 2014 | 110 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 72.4 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 45.5 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992 RA2014 | 6.3 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 4.5 mg/l |
| Cyanide as $CN^-$ | IS 3025(P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 1.6 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 6.8 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER

*End of the report*

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5047/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 19/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received: | 09/06/2023 |
| | Date of analysis | 09/06/2023 |
| | Sample Description | Waste Analysis - Kothamangalam - Kumbalathumuri |
| | Sample Location | GPS Reading : N- 10 °04'43.303"<br>E -76°38'52.058" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 15.98 |
| 02 | Bulk Density | | | USEPA | $kg/m^3$ | 1089 |
| 03 | Density | | | USEPA | $g/cm^3$ | 1.0466 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | Nil |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 4.75 | 4 + | | | 28.63 |
| | | 2.36 | 8 | | | 6.41 |
| | | 1.18 | 16 | | | 16.47 |
| | | 0.6 | 30 | | | 31.22 |
| | | 0.3 | 50 | | | 12.71 |
| | | 0.15 | 100 | | | 4.50 |
| | | 0.09 | 170 | | | 0.06 |
| | | 0.075 | 200 | | | 0 |
| | | 0.045 | 325 | | | 0 |

* End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD.

SREEJA RAMESH
AUTHORIZED SIGNATORY
QUALITY MANAGER

MatterLab
Where Quality Matters

Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

# Size Distribution of Solid Waste - Test Report

Report No: ML23/R-02009/07
Issue No : 1
Report Date:19/08/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavanatt Building, Kandyanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 09/08/2023 | **Client Sample Ref.*:** | MSW |
| **Work Order ID:** | ML23/W-02008 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02009/07 | **Source*:** | - |
| **Date Sampled:** | 09/08/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | - | **Sample Size(kg):** | 15 Approx |
| **Sample Location*:** | Kumbhalathumuri, Kothamangalam, Ernakulam District | **Date Tested :** | 14/08/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | MSW |
| **Tested By:** | GK | **Client Sample Desc.*:** | MSW |
| **Test Location:** | MatterLab - Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4) 1985

| Sieve Size (mm) | % Retained |
|---|---|
| 80.0 | 10.0 |
| 37.5 | 6.9 |
| 10.0 | 27.4 |
| 4.0 | 19.1 |
| Passing | 36.6 |

For and on behalf of MatterLab

**Comments**

*Information provided by client

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Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673028

# Field Density (Core-Cutter Method) of Solid Waste - Test Report

Report No: ML23/R-02006/23
Issue No: 1
Report Date: 15/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Test Results**

| | | | |
|---|---|---|---|
| Date Recieved: | 09/06/2023 | Client Ref:* | - |
| Work Order ID: | ML23/W-02006 | Layer | - |
| Sample ID: | ML23/W-02006/S6 (1-2) | Depth of test (mm): | - |
| Sample Description: | MSW | Date Tested | 09/06/2023 - 10/06/2023 |
| Source* | - | Tested By | GK |
| Location* | Kumbhalathumuri, Kothamangalam, Ernakulam District | Method Variation | None |
| Test Methods : | IS 2720 : Part 28 : 1974 -(DRY DENSITY OF SOILS IN PLACE BY THE CORE-CUTTER METHOD)<br>IS 2720 : Part 2 : 1973 -(DETERMINATION OF WATER CONTENT) | | |

| Test No. | 1 | 2 |
|---|---|---|
| Sample ID | S6-1 | S6-2 |
| Test Location | Kumbhalathumuri, Kothamangalam, Ernakulam District | |
| Weight of wet Material (g) | 1426 | 1548 |
| Volume of core-cutter ($cm^3$) | 992 | 1008 |
| In-situ Bulk Density ($g/cm^3$) | 1.44 | 1.53 |
| In-situ Water Content (%) | 13 | 16 |
| In-situ Dry Density ($g/cm^3$) | 1.27 | 1.32 |

SREELESH T.V
Soil Lab Incharge

For and on behalf of MatterLab

**Comments**

*Informations provided by client

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Thiruvannur, Kozhikode, Kerala, 673029

## Solid Waste - Test Report

Report No: ML23/K-03008/23
Issue No: 1
Report Date: 19/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveraki Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-03008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-03008/S7 | Source*: | - |
| Date Sampled: | 09/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Quantity: | 15 Approx |
| Sample Location*: | Kumbalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 14/09/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GK | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Waste Materials retained on | | | |
|---|---|---|---|---|---|
| | | 80 mm | 37.5 mm | 10 mm | 4 mm |
| CPHEEO (2000) | Percentage of Plastic Waste, % | 77.5 | 10.3 | 4.0 | Nil |
| | Percentage of Cloth Waste, % | 1.2 | 0.1 | 0.5 | Nil |
| | Percentage of Glass Waste, % | Nil | 4.4 | 4.1 | Nil |
| | Percentage of Wood Waste, % | 0.5 | Nil | 13.8 | Nil |
| | Percentage of Construction Debris, % | Nil | Nil | Nil | Nil |
| | Percentage of Bio Fraction, % | Nil | Nil | Nil | Nil |
| | Percentage of Gravel, % | Nil | 85.2 | 76.5 | 100 |
| | Rubber, % | 21.0 | Nil | Nil | Nil |
| | Metals, % | Nil | Nil | 1.0 | Nil |

SREELESH T.V
Civil Engineering

For and on behalf of Matter Lab

**Comments**

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Thiruvannur, Kozhikode, Kerala, 673029

## Solid Waste - Test Report

Report No: ML23/S/03306/00
Issue No: 1
Report Date: 19/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*: | MSW (4mm Sieve Passing Fraction) |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/S7 | Source*: | - |
| Date Sampled: | 09/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 15 Approx |
| Sample Location*: | Kumbalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 14/08/2023 - 19/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW (4mm Sieve Passing Fraction) |
| Tested By: | GK | Client Sample Desc.*: | MSW (4mm Sieve Passing Fraction) |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Tests/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Silt & Clay, % | 20 | - |

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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Where Quality Matters

Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

# Solid Waste Size Analysis - Test Report

Report No: ML23IR-0300031
Issue No : 1
Report Date: 19/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveratti Building, Karayancoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Renatar Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbhalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbhalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23AW-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23AW-02008/S7 | Source*: | - |
| Date Sampled: | 09/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(Kg): | 15 Approx |
| Sample Location*: | Kumbhalathumuri, Kothamangalam | Date Tested : | 14/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | MV | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results** — Test Method:CPHEEO -2000

| Type of Waste Material | 80 mm | | 37.5 mm | | 10 mm | |
|---|---|---|---|---|---|---|
| | Minimum Size of a Single Waste Material, m³ | Maximum Size of a Single Waste Material, m³ | Minimum Size of a Single Waste Material, m³ | Maximum Size of a Single Waste Material, m³ | Minimum Size of a Single Waste Material, m³ | Maximum Size of a Single Waste Material, m³ |
| Plastic Waste | 0.8536 | 1.1500 | 0.1560 | 0.3120 | 0.0144 | 0.0720 |
| Cloth Waste | 0.8041** | | 0.1584** | | 0.0036 | 0.0150 |
| Glass Waste | - | - | 0.0452 | 0.2835 | 0.0143 | 0.0193 |
| Wood Waste | 0.410** | | - | - | 0.0195 | 0.0291 |
| Rubber | 0.1040 | 0.4876 | - | - | - | - |
| Metals | - | - | - | - | 0.0255 | 0.0090 |

For and on behalf of Matter Lab

**Comments:**
*Information provided by client
** Only one piece of cloth waste & wood waste included in the waste composite

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Mini Bypass Road, Thiruvanmur Nada (PO)
Thiruvanmur, Kozhikode, Kerala, 673035

# Moisture Content of Solid Waste - Test Report

Report No: ML23/W-02006/22
Issue No: 1
Report Date: 10/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kumbalathumuri, Kothamangalam |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kumbalathumuri, Kothamangalam, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*): | MSW |
| Work Order ID: | ML23/W-02006 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02006/ST | Source*): | - |
| Date Sampled: | 09/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | - | Sample Size/kg: | 15 Approx |
| Sample Location*): | Kumbalathumuri, Kothamangalam, Ernakulam District | Date Tested : | 09/08/2023 - 10/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GR | Client Sample Desc.*): | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Moisture Content, % | 12 | - |

SREELESH TV
Civil Engineer

For and on behalf of Matter Lab

**Comments**
*Information provided by client

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TC-6589

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/139/2023 (ULR NO:TC658923000000013 9F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 19/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received | 09/06/2023 |
| | Date of analysis Started | 10/06/2023 |
| | Sample description | Ambient air -Kothamangalam - Kumbalathumuri |
| | Sample Code | G/F/139/2023 |
| | Sample Location | GPS Reading : N- 10 °04'44.67" E -76°38'51.097" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 85.3µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 32.4µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 18.4 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 21.4 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 1.3 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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For and on behalf of
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AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES P. LTD

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5041/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 19/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received | 09/06/2023 |
| | Date of analysis Started | 10/06/2023 |
| | Sample description | Ambient air -Kothamangalam - Kumbalathumuri |
| | Sample Code | G/F/5041/2023 |
| | Sample Location | GPS Reading : N- 10 °04'44.67"<br>E -76°38'51.097" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | 8.9 µg/m$^3$ | 400 µg/m$^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m$^3$ | 1 µg/m$^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 6 ng/m$^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 20 ng/m$^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m$^3$ | 180 µg/m$^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m$^3$ | 5 µg/m$^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m$^3$ | 1 ng/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/140/2023 (ULR NO:TC658923000000001405F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 19/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received | 09/06/2023 |
| | Date of analysis Started | 10/06/2023 |
| | Sample description | Ambient air -Kothamangalam - Kumbalathumuri |
| | Sample Code | G/F/140/2023 |
| | Sample Location | GPS Reading : N- 10 °04'48.384" E -76°38'51.173" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 96.5µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 41.3µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 16.3 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 18.2 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 1.1 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5042/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 19/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Date of sample received | 09/06/2023 |
| | Date of analysis Started | 10/06/2023 |
| | Sample description | Ambient air -Kothamangalam - Kumbalathumuri |
| | Sample Code | G/F/5042/2023 |
| | Sample Location | Gps Reading : N- 10 °04'48.384" E -76°38'51.173" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | 5.6 µg/m$^3$ | 400 µg/m$^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m$^3$ | 1 µg/m$^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 6 ng/m$^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 20 ng/m$^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m$^3$ | 180 µg/m$^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m$^3$ | 5 µg/m$^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m$^3$ | 1 ng/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
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SREEJA RAMACHANDRAN
QUALITY MANAGER

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**TEST REPORT** 

| **Client Name & Address** | **Certificate No:** | **PL/RT/SD/5042/2023**(ULR NO:TC658923000000005042F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 19/06/2023 |
| | Date of monitoring | 08/06/2023 |
| | Monitoring Location | Kothamangalam -Kumbalathumuri<br>GPS Reading : N- 10 °04'43.139"<br>E -76°38'52.160" |
| | Sample Description | Ambient Sound Level |

| **HOURLY INTERVAL** | | **RESULT** | **HOURLY INTERVAL** | **RESULT** |
|---|---|---|---|---|
| 08.06.2023 | 12.00 Hrs | 58.3 dB (A) | 05.00 Hrs | 56.4 dB (A) |
| 13.00 Hrs | | 55.7 dB (A) | 06.00 Hrs | 54.7dB (A) |
| 14.00 Hrs | | 54.7 dB (A) | 07.00 Hrs | 54.1 dB (A) |
| 15.00 Hrs | | 59.1 dB (A) | 08.00 Hrs | 55.6 dB (A) |
| 16.00 Hrs | | 54.2 dB (A) | 09.00 Hrs | 54.8 dB (A) |
| 17.00 Hrs | | 48.4 dB (A) | 10.00 Hrs | 55.9 dB (A) |
| 18.00 Hrs | | 55.7dB (A) | 11.00 Hrs | 51.9 dB (A) |
| 19.00 Hrs | | 61.0dB (A) | | |
| 20.00 Hrs | | 59.9 dB (A) | | |
| 21.00 Hrs | | 56.4 dB (A) | | |
| 22.00 Hrs | | 54.6 dB (A) | | |
| 23.00 Hrs | | 53.5 dB (A) | | |
| 09.06.2023 | 00.00 Hrs | 51.0 dB (A) | | |
| 01.00 Hrs | | 48.7 dB (A) | | |
| 02.00 Hrs | | 47.5dB (A) | | |
| 03.00 Hrs | | 48.4 dB (A) | LeqDay | 55.6 dB (A) |
| 04.00 Hrs | | 49.0 dB (A) | LeqNight | 50.6 dB (A) |

Limits: Industrial Area Day Time-75dB(A),Night Time- 70dB(A),Commercial area Day Time -65 dB(A),Night Time55dB(A),
Residential area Day Time -55 dB(A),Night Time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am

*End of the Report *

For Poluchem Laboratories (P) Ltd.

Authorised Signatory
SREEJA RANJITH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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## TEST REPORT



**Ref.No: PL/RT/GW/1412/2023**
(ULR NO:TC658923000000001412F)

**Date of Issue: 19/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Kothamangalam -Kumbalathumuri
Gps Reading : N- 10 °04'35.649"
E -76°38'57.976"

Sample code : F/1412/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.61 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | BDL(MDL-0.1 NTU) | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 80 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 52 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1 mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 34.34 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 6 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 16.33 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 4.53 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL-0.05 mg/l) | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 11.32 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

Conti...

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 1412/2021

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 130 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



**RefNo: PL/RT/GW/5043/2023**

**Date of Issue: 19/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Kothanangalam -Kumbalathumuri
Gps Reading : N- 10 °04'35.649"
E -76°38'57.976"

Sample code : F/5043/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 8 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34–1988 RA2014 | BDL(MDL- 1mg/l) | ---- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Conti..

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Continuation of Test Certificate No: 5043/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAJEEV
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Phone : 0484-2544030, 8281982322, 9747400085.www.poluchem.com, poluchem@gmail.com


ACCREDITED BY KERALA STATE "A" GRADE LABORATORY

## TEST REPORT



**Ref.No: PL/RT/5045/2023** **Date of Issue: 19/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Leachate Kothamangalam -Kumbalathumuri
Sample Location : Gps Reading : N-10 °04'.062"
E -76°41'17.339"

Sample code : F/5045/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Results |
|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 7.09 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 1885 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 180 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 788.41 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 320 mg/l |
| B O D (3 days at $27^0$ C) | IS 3025 (P) 44 – 1993 RA 2014 | 110 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 72.4 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 45.5 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992 RA2014 | 6.3 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 4.5 mg/l |
| Cyanide as $CN^-$ | IS 3025(P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 1.6 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 6.8 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER

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TC-6565

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## TEST REPORT



**Date of Issue: 19/06/2023**

**Ref.No: PL/RT/SW/1413/2023**
(ULR NO:TC658923000000001413F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector

Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014

Sample Description : Surface Water- Kothamangalam - Kumbalathumuri

Sample Location : Gps Reading : N- 11 °04'44.267" E -76°38'52.902"

Sample code : F/1413/2023

Date of Sample Collected : 08/06/2023

Date of receipt of sample : 09/06/2023

Date of analysis started : 09/06/2023

Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 –1983RA2017 | 6.76 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 –1983RA2017 | 8 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 2.3 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 240 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 156 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 5 mg/l | --- | -- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 56 mg/l | 200 mg/l | -- |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 60 mg/l | -- | -- |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 33.69 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 10.35 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 –1989RA2014 | 2.1 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.26 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 1.82 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.5 mg/l | 1.5 mg/l |

Conti...

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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Continuation of Test Certificate No: 1413/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 280 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | --- | --- |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory

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## TEST REPORT



**Ref.No: PL/RT/SW/5044/2023** **Date of Issue: 19/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- Kothamangalam - Kumbalathumuri

Sample Location : Gps Reading : N- 11 °35'29.729"
E -75°36'24.791"

Sample code : F/5044/2023
Date of Sample Collected : 08/06/2023
Date of receipt of sample : 09/06/2023
Date of analysis started : 09/06/2023
Date of completion of analysis : 17/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | --- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | --- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27$^{O}$ C ) | IS 3025 (P) 44 -1993RA2014 | 4.6 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 8 mg/l | --- | -- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 –1988 RA2014 | 3.6 mg/l | --- | -- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

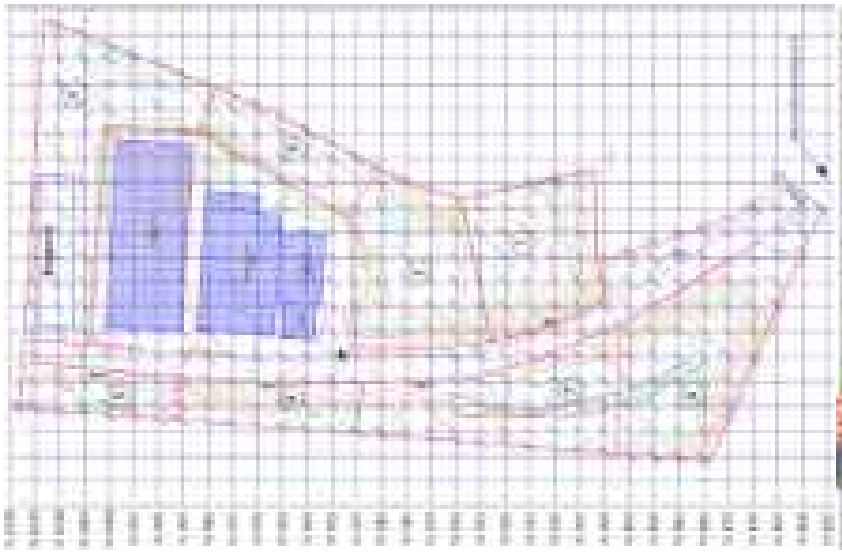
For Poluchem Laboratories (P) Ltd

Authorised Signatory
SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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N 1020
N 1015
N 1010
N 1005
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N 995
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N 965
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**Contour Map – Kothamangalam Dumpsite**



**Proposed Operation Plan**

Land shall be reclaimed i.e. all the legacy waste will be removed till it reaches the surface of the earth/ soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the contractor to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to bi-weekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site.

# Part B

## Social Impact Assessment



## KOTHAMANGALAM DUMPSITE

DISTRICT - ERNAKULAM ULB - KOTHAMANGALAM

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## 1. Introduction

The goal of the sustainable approach for dump site remediation is to carry out the process in a way that reduces adverse impact on human and environment. So, it is very important to consider social safeguard aspects during dump site remediation with a key focus on meaningful engagement with stakeholders, comprehension of stakeholders' risk perceptions, and the restoration of sites to a safe and environmentally sustainable condition. This report provides an update about the remediation of the dump site in Kothamangalam Municipality based on the findings from the social screening and transect walk. The report addresses the current situation at the dumpsite, potential social impacts due to the implementation of the project, recent fire incidents, remediation efforts, the quantity of legacy waste, the dumpsite's location within the solid waste management facility, and the complaints received from nearby communities.

## 2. Kothamangalam Municipality- Brief Profile

Kothamangalam is a Municipality in the eastern part of Ernakulum district in the Indian state of Kerala. It is around 14 km northeast of the town of Muvattupuzha and 55 km northeast of Kochi city. The town is in the foothills of the Western Ghats Mountain ranges. The highway NH-49 Ernakulum – Madurai – Rameswaram passes through Kothamangalam. The town serves as the headquarters of a taluk and a municipality of the same name.

**Table 1 Socio Economic Profile**

| SOCIO ECONOMIC PROFILE DATA | |
|---|---|
| District Name | Ernakulum |
| Sub District Name | Kothamangalam |
| Town Name | Kothamangalam |
| Total Households | 10389 |
| Total Population of Town | 42012 |
| Total Male Population of Town | 20812 |
| Total Female Population of Town | 21200 |
| Total Scheduled Castes Population of Town | 2283 |
| Total Scheduled Castes Male Population of Town | 1118 |
| Total Scheduled Castes Female Population of Town | 1165 |
| Total Scheduled Tribes Population of Town | 34 |
| Total Scheduled Tribes Male Population of Town | 18 |
| Total Scheduled Tribes Female Population of Town | 16 |

## 3. Profile of Kothamangalam Dumpsite

Kothamangalam dumpsite is located at 6.0 km from the center of Kothamangalam town in western side and encompasses a total area of approximately 2.6 acres of land, out of this 2.13 acres of land is covered with solid waste. The geographical coordinates of the dumpsite are 10.078930° N & 76.647811° E. It is in ward no. 6 of the municipality. Kothamangalam municipality holds the ownership of the dumpsite.

Dumping was started approximately 30 years back and stopped in 2019. Currently, the quantity of waste dumped at this site is about 21,295 Cu.m above the surface level as per the topographic survey, and 8620 cu.m below the surface as per geotechnical survey. The legacy waste is presented about 3.0 m below and 2.5 m above the ground level respectively. Hence bioremediation of the dumpsite is essential to mitigate the environmental and social impacts. Dumpsite reclamation involves excavation, screening, and separation of material from dumpsites into various components such as soil, recyclable materials, and residues

## 4. Socio economic baseline of Host community

It is identified that there is only one family residing within 200m distance from this dump site. Shops or any institutions are also not there near to the site. 6 migrant labours are working in the MCF and RRF employed by the agency ASM Enterprises. 12 sanitation workers (10 women and 2 men) are employed in the windrow compost unit at site.

### 4.1 Vulnerability mapping of Host community

The site is far from habitation. So, it will not affect any vulnerable communities. There is no risk with respect to the social and economic conditions of the host communities.

## 5. Data Collection Tools

### 5.1 Social Screening

The social screening has been conducted with social screening checklist as per the requirement of ESMF. And it is observed that there is only the risk associated with labour are envisaged. There are no other adverse social impacts on dwellings, land, labour, livelihood, community resources of host and other vulnerable communities. The assessment of social screening indicates that the dumpsite remediation can create a positive impact in the living conditions of the host community.

As per the social screening, it is identified that there is no need of land acquisition/transfer or purchase for the project implementation. The dumpsite has enough road access thus there will not be any disruption to the public for any type of transportation. There are no scheduled tribes, rag pickers and other vulnerable communities living near the dumpsite. Since there is not much risk with respect to the social and economic conditions of the host communities, the dumpsite can be categorized into “Moderate Risk”.

### 5.2 Transect walk

A transect walk was conducted around the dumpsite on 06/06/2023. The aim of the transect walk was to assess the site and gather information about its location, potential social risks, existing infrastructure, and the impact on surrounding communities. The group exercise that entails walking between two points to intentionally cross or transect a community. The group explores environmental and social resources, conditions, and systems by observing, asking, listening, looking, and producing a transect diagram. Information collected can be used to reveal land use practices, hazards, and vulnerabilities to inform disaster mitigation and water management.

### 5.3 Site specific Observations from Transect walk and social screening

- Dumpsite is located more than 200 meters from the habitation/settlements as there is only one family residing within 200m aerial distance.
- 6 migrant labourers of ASM Enterprises are working there in the MCF and 12 sanitation workers of Municipality are engaged in Windrow composting unit. The dumpsite remediation works may not affect their livelihood during the remediation period as there is no need to shift these facilities during the implementation period.
- During the transect walk, it was observed that there are no rag pickers associated with the dumpsite. Therefore, there are no livelihood risks for rag pickers in this context.
- The total scheduled tribal population in the ULB is 34, but there are no scheduled tribes staying near the dumpsite,
- There are no households affected by the proposed project activity, including non-titleholders or squatters.

### 5.4 Focus Group Discussion

One Preliminary FGD was conducted dated on 1-11-2023 in the Municipal Hall with the residents living near to the dumpsite. Concerned social and Communication experts from TSC, DPMC, and DPMU along with dumpsite remediation expert participated. Communication expert from TSC presented the detailed activities that are going to be done as part of remediation. In the discussion that followed, people shared their concerns. Concerned expert cleared the doubts and all the anticipatory risks and precautionary measures we are planning explained.

## 6. Stakeholder Analysis

The remediation process requires collaboration of the following stakeholders.

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| **Service Providers** | | |
| 1 | ULB Council | Providing ground support for the process |
| 2 | Govt institutions like PCB, KSEB, KWA, Fire station, Police station, Thaluk Hospital etc | To deliver necessary approvals and provide necessary services for remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | DPMU | Monitoring and Evaluation |
| 5 | TSC/PMC | Technical support and consultation |
| 6 | Contractor | Execution of the Remediation process |
| 7 | 48 HKS workers and 22 sanitation workers of the Municipality | Proper collection and waste segregation to prevent further dumping after remediation |
| **Affected Community** | | |
| 1 | 12 sanitation workers employed in windrow composting unit. | Attending in orientation programs about the remediation process, comply with health and safety measures and deliver support and cooperation to the remediation process |
| 2 | 6 migrant labours engaged in MCF and RRF deputed by the agency ASM Enterprises. | Attending in orientation programs about the remediation process, comply with health and safety measures and deliver support and cooperation to the remediation process |
| 3 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |

Table 2 Stakeholder Details

## 7. Positive social impacts after remediation

### a) Enhanced quality of life

The remediation can restore the aesthetics of the area, reducing visual blights, foul odour and improving air and water quality. According to the opinion of people residing in the ward, the

project can contribute to an improved sense of well-being. Also, it results to a clean and hygienic work environment for the workers engaged in MCF and RRF.

**b) Livelihood and employment of vulnerable community**

It is identified that no rag pickers are currently engaged in collecting waste from the dumpsite or making a living from it. Therefore, the proposed dumpsite rehabilitation project will have no impact on housing or livelihood of any rag pickers.

**c) Economic opportunities**

After remediating the site, the Municipality is planning to enhance the capacity of the MCF and RRF to process more non-biodegradable waste and to set up some more centralized waste management units here to process the bio-degradable waste. These projects will create more job opportunities to the people who are looking for employment in waste management sector.

**d) Access to service**

It is observed that the project will not affect access to any facilities, services, or natural resources as there is enough space/land available in the exiting site.

**e) Land availability**

2.6 acres of land is available in the in the existing dumpsite, which is owned by the Municipality, so there is no need of land acquisition/transfer or purchase. Dumpsite remediation will create acres of vacant land which can be effectively useful for other purposes of ULB especially for the waste management. Recovered land can be converted to Transfer Station for the temporary storage of the inert waste. The cleaned-up land can potentially be used for new construction, commercial development, or recreational activities. The property value after the remediation will be very high.

## 8. Expected site-specific social impacts/risks

6 migrant labourers of ASM Enterprises are working there in MCF. 12 sanitation workers of the ULB are also employed in windrow composting unit. Proper safety measures need to be adopted to make them safe during the remediation work.

## 9. Suggestions/recommendations

- A project-level grievance redressal mechanism will be established at ULB level to receive and facilitate resolution of the stakeholder's concerns and grievances. Necessary information boards shall be installed at site about the GRM.
- Awareness shall be given to the HKS, Sanitation workers and ULB council members about the remediation process.
- Protective gears shall be provided to all the employees engaged in MCF and Windrow compost unit.
- The public access towards the dumpsite should be restricted during the execution of the project.

- Prior information shall be given to the nearby Police station, Fire station and Thaluk hospital about the process for the immediate

## 10. Scoping of Social Impact Assessment and required Action plans

All the social risks were identified through the social screening and Transect walk conducted at site. Considering the social impact assessment, certain action plans have been formulated to be followed at site

- **Labour Management Plan**

Maximum of 15 labours are expected to be engaged in remediation process at a time. A detailed labour Management plan has been prepared and attached as Annexure.

- **Labour Influx Management Plan**

Only one family is residing near the site. So, there will not be much impact to the community due to the labour influx. But considering the service providers employed at site, a Labour Influx Management plan has been prepared and attached as Annexure.

- **Preventive GBV Action plan**

Considering the labours at site, a detailed GBV action plan has been prepared and attached as Annexure.

- **Citizen Engagement Plan**

A detailed citizen engagement plan has been prepared considering the service providers employed at site and attached as Annexure.

As per the detailed assessment of potential social risk during the remediation process, the identification from social screening with screening checklist, transect walk and focus group discussion indicates that there will not be any impacts on the livelihood of the community and service providers including rag pickers and land acquisition is not required as sufficient land is available.

## 11. Conclusion

The Social Screening and Transect Walk helped to analyze and identify the potential social impacts on host community related to the remediation of the dump site. There will not be any adverse social impacts on any valuable community, tribes, dwellings, land and community resources of host communities. The availability of land and the moderate social risk associated with the implementation of dumpsite remediation activities are positive factors for the success of the project.

# CITIZEN ENGAGEMENT PLAN

## 1. Brief introduction about the project

Dumpsite is an open piece of land where all kinds of waste are being dumped for long- long years back. Dumpsites mainly emit gas and contaminated water as well as wind-blown litter and dust. Through dumpsite remediation these negative impacts on health would be addressed finally; this may be defined as a process by which disposed wastes in an existing dumpsite are excavated and either reused or disposed of in a scientific manner. However, during the execution there are some potential health hazards for the people who would be directly engaged in the remediation work. The site used to receive untreated unorganized mixed waste stream, there is a possibility of biomedical and hazardous items within the accumulated waste in the dumping ground.

Along with the health hazards some social impacts are there. There is no land issue; within 200 meters from the site there is only 1house. As no rag picker's livelihood depends upon this dumpsite so their livelihood would not be at stake due to the remediation work and there is no tribal population resident in the nearby location of the dumpsite.

## 2. Stakeholder identification

***2.1 Waste Generators:*** The nearby community, viz., resident, commercial establishments, different institutions are the waste generators.

**2.2 Service Providers:** The service provider may be considered a primary and secondary. Primary service providers are the HKS workers, where the secondary service providers are the all concerned staff including the ward councilors, office bearers of the concerned municipality.

**2.3 Agency Workers for Remediation Work:** For this particular project the agency workers will play the most crucial role so basic orientation of the project along with some other awareness programs like GBV, OHS etc. are very pertinent here.

## 3. Socio-economic profile of the community

Kothamangalam is a Municipality in the eastern part of Ernakulum district in the Indian state of Kerala. It is around 14 km northeast of the town of Muvattupuzha and 55 km northeast of Kochi city. The town is in the foothills of the Western Ghats Mountain ranges. The highway NH-49 Ernakulum – Madurai – Rameswaram passes through Kothamangalam

It is identified that there is only one family residing within 200m distance from this dump site. Shops or any institutions are also not there near to the site. 6 migrant labours are working in the MCF and RRF employed by the agency ASM Enterprises. 12 sanitation workers (10 women and 2 men) are employed in the windrow compost unit at site.

## 4. Vulnerability data of host community:

The site is far from habitation. So, it will not affect any vulnerable communities. There is no risk with respect to the social and economic conditions of the host communities

## 5. Need of the plan

The management of municipal solid waste is one of the main functions of all Urban Local Bodies (ULBs) in the country. All ULBs are required to meticulously plan, implement and monitor all systems of urban service delivery especially that of municipal solid waste. As per the 74th Constitution Amendment Act, the SWM Rules, 2016 and the State Municipal Laws, ULBs are primarily responsible for the provision of municipal solid waste management services which includes the following initiatives regarding dumpsite:

Ø stop land filling or dumping of mixed waste soon after the timeline as specified in rule 23 for setting up and operationalization of sanitary landfill is over.

Ø investigate and analyze all old open dumpsites and existing operational dumpsites for their potential of bio- mining and bioremediation and where so ever feasible take necessary actions to bio-mine or bio-remediate the sites.

## 6. Objective of the plan

- To reduce pollution effects
- To protect groundwater sources
- To reduce the health hazards of the workers engaged in the existing MCF
- To improve the aesthetic ambience of the locality
- To improve workers friendly environment for those engaged in the MCF& RRF located in the same site

## 7. Stakeholder concerns

**7.1 Waste Generators**: The waste generators will comply with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future; not only that their cooperation during the remediation work is highly expected.

**7.2 Service Providers**: Officers and the council members are responsible for tendering, finalization and deputing contractor/agency for remediation & arranging alternative livelihood of the HKS workers engaged in the MCF, RRF functional in the same compound and monitoring the day to day project activities. HKS workers, and the other staff engaged directly to collect the waste from the doorstep of the waste generator expected to collect and segregate the waste properly to prevent further dumping after remediation

### 7.3 Agency Workers for Remediation Work

All the labors, drivers, supervisors, security staff of the contractor/ agency engaged in the remediation work directly are the main player of the to make it successful. They will play the most

crucial role in remediation work and not only that during the execution they may be primary contact person of the neighborhood community.

## 8. Public disclosure

Project-related information shall be disclosed through a public consultation and making relevant documents available in public locations. The project agencies and associated line departments shall provide relevant safeguards information promptly, in an accessible place, and the manner and language understandable to affected persons and other stakeholders. For illiterate people, other suitable communication methods will be used.

The following documents shall be made available at the offices of municipality, Bus stand, Local Police Station, Project site and other public places for public reference and shall also be uploaded on respective websites.

(i) Summary of project (in English and local language - Malayalam)

(ii) Draft ESMF Report (in English; translated summary in Malayalam)

(iii) Environmental monitoring reports

(iv) Grievance addressing measures

## 9. Activities proposed

### 9.1 Community/citizen Awareness

Before remediation work community / citizen awareness regarding the whole process of remediation work is the precondition for smooth execution of the project. Informed community is always the power bank of the proper and time bound execution of any community based development work. During the execution of the process regular interaction with the host community is also required.

### 9.2 Awareness to Service providers

All primary and secondary service providers should come under awareness activity under the remediation work; the mode of communication may vary depending upon their status of primary or secondary, but the total process of the remediation work should be imparted. They should be intimated regarding the benefit of the activity and their important role in this concern.

### 9.3 Awareness to the Workers

All the labors, drivers, supervisors, security workers of the agency who would be awarded for the work should be aware about the project and their responsibility, the community, issues concerned with GBV, OHS, basic labor laws. They should also be aware about the important services like fire, police and health facilities for emergency situations.

## 10. Citizen Engagement Plan Matrix

| S. No | Engagement Challenge | Impacts on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| 1 | Awareness on project activities - bio mining | Proper awareness will be created. | Exposure visit | Contractor |
| 2 | Awareness boards. | Proper awareness will be created. | Installation of boards and signage's. | Contractor |
| 3 | Health and safety education. | Do's and Don'ts will be cleared. | Orientation session. | Contractor |
| 4 | Traffic management | Schedules are to be finalized. | Planning meeting. | Contractor |

## 11. Budget

| S. No | | Specification | Quantity | Cost |
|---|---|---|---|---|
| 1 | Awareness on project activities - bio mining | 1. Training to SWM workers at site, and family residing nearby | 1 No's | [redacted] |
| 3 | Health and safety education. | SWM Workers at site, Sub contract labors | 1 No's | [redacted] |
| | **Total** | | | [redacted] |

# LABOUR MANAGEMENT PLAN

## 1. INTRODUCTION

### 1.1 PROJECT TITLE:

Project for the remediation of dumpsite at ward 6 owned by Kothamangalam Municipality

### 1.2 PROJECT AREA

The Dumpsite of Kothamangalam Municipality is situated in ward 6 of the municipality, covering an area of 2.6 acres.

## 2. SCOPE AND STRUCTURE OF THE LABOUR MANAGEMENT PLAN

The scope of the LMP shall be as outlined in the World Bank's ESMF. The engagement will be planned as an integral part of the project's social assessment and project design and implementation. This document has 10 chapters. This chapter viz., chapter 1 served as introduction. Scope and structure of LMP is provided in chapter 2. An overview of labour use in the project is presented in chapter 3. Key potential labour risks are listed in chapter 4. Legislative framework governing labour employment in India/Kerala is discussed in chapter 5. Implementation Arrangements, policies and procedures follow in the subsequent chapter. Grievance redressal mechanism, contractor management are presented in the last chapters.

## 3. OVERVIEW OF LABOUR USE ON THE PROJECT

### 3.1 Details of Labors

The proposed remediation process requires following category and number labors

| Sl.No | Equipment | Category of labors | Required No.of labors |
|---|---|---|---|
| 1 | trammel | Labors for waste segregated purpose | 5 |
| 2 | One excavator | Operator | 1 |
| 3 | One JCB | Operator | 1 |
| 4 | Two small tippers | drivers | 2 |
| | | Helpers | 2 |
| 5 | | Supervisor | 1 |
| **Total Labours** | | | **12** |

# 4. ASSESSMENT OF KEY POTENTIAL LABOUR RISKS

## 4.1 Project Activities:

The bioremediation of the dumpsite includes the following activities;

- Mobilization of plant and machinery for bio-mining
- waste excavation and forming of windrow
- Spraying with inoculum and waste stabilization
- Waste segregation and refinement
- sorting materials into recyclable, RDF, compost and inert
- Transport to the authorized recyclers and end users

## 4.2 Key Labour Risks

It is assessed that key labour risks would be associated with health and safety risks related to the construction activities such as exposure to physical hazards during construction activities such as: use of heavy equipment, exposure to noise and dust, falling objects, exposure to hazardous materials and exposure to electrical hazards from the use of tools and machinery, lack of proper sanitation facilities, availability of separate toilet for women workers. As the construction activities will involve hazardous work, persons under the age of 18 will not be employed by the Project. Many workers will be exposed to occupational health and safety hazards, primarily including but not limited to:

- Injuries/accidents/ fatalities leading to even death, while at work.
- Inadequate accommodation facilities at work force camps, including inadequate sanitation and health facilities.
- Non-payment of wages by Employer.
- Non-payment of benefits (compensation, bonus, maternity benefits etc.) by Employer
- Discrimination in Employment (e.g., abrupt termination from employment, working conditions, wages or benefits etc.)
- Engagement of child labour.
- Sexual harassment at work sites.
- Forced labour or trafficking.
- Security of women workforce.
- Inadequate facilities for pregnant women and lactating mothers.
- Inadequate facilities for the children of the workforce at workforce camp sites
- Possibility of Gender based violence as the work is mostly carried out within the premises of the existing facilities like MCFs/ RRFs etc where female

SWM workers are engaged.

- Absence or inadequate or in accessible emergency response system for rescue of labor/workforce.
- Health risks of labor relating to HIV/AIDS and other sexually transmitted diseases.
- Unclear terms and conditions of employment.
- Discrimination and denial of equal opportunity in hiring and promotions/incentives/training opportunities.
- Denial for workers' rights to form workers organizations, etc.
- Absence of a grievance redressal mechanism for labor to seek redressal of their grievances/issues.

## 5. BRIEF OVERVIEW OF LABOUR LEGISLATION: TERMS AND CONDITIONS

| Sl No | Applicable Acts | Details |
|---|---|---|
| 1. | Employees Compensation Act 1923: | The Act provides for compensation in case of injury, disease or death arising out of and during employment |
| 2. | Contract Labour (Regulation & Abolition) Act 1970 | The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. |
| 3. | Minimum Wages Act 1948: | The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. |
| 4. | Payment of Wages Act 1936: | It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the workers. |

| | | |
|---|---|---|
| 5. | Equal Remuneration Act 1976: | The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training, and promotions etc. |
| 6. | Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: | The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc. |
| 7. | Child Labour (Prohibition & Regulation) Act 1986: | The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in the Building and Construction Industry. |
| 8. | Employees State Insurance Act 1948: | The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the Central Government. The Act also provides for benefits to dependents of insured persons in case of death because of an employment injury. |
| 9. | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: | This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee |

| | | |
|---|---|---|
| 10. | Industrial Disputes Act 1947: | The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing the establishment. |
| 11. | Trade Unions Act 1926: | The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. |

## 6. RESPONSIBILITY MAPPING

The ULB (Urban Local Body) will award the proposed work to the contractor through competitive bids. The contractor will be responsible for hiring laborers for both civil and skilled work. In the recruitment process, the contractor is obligated to provide opportunities to members of the host community who possess the necessary skills and willingness to engage in the activities available at the dumpsite for remediation.

The contractor is required to adhere to existing labor laws in the state of Kerala while employing laborers, ensuring compliance with all applicable welfare measures mandated by the relevant labor legislation and rules. Additionally, the contractor is responsible for implementing measures to protect and assist vulnerable groups of workers, including individuals with disabilities, migrant workers, and women workers. These protective measures should be explicitly outlined in the work agreement.

Furthermore, the contractor must prioritize occupational health and safety measures for the laborers. The ULB will actively monitor the contractor's compliance with legal and welfare requirements. The ULB will also organize training sessions for the workers and establish a forum at the ULB level to address any grievances raised by the workers.

It is a prerequisite for the contractor to possess a valid Labor License, and all laborers working on the site must be registered with the appropriate authorities. This comprehensive approach ensures the well-being and fair treatment of workers throughout the remediation project.

## 8. CODE OF CONDUCT

A code of conduct needs to be incorporated with the contract under the project. The contractor should conduct continuous awareness generation and training activities to ensure that the workers abide by the code of conduct. While preparing the code of conduct, following aspects should be ensured;

- Compliance with applicable laws, rules, and regulations of the jurisdiction
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment (PPE), preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment)
- The use of illegal substances
- Non-Discrimination (for example based on family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction)
- Interactions with community members (for example to convey an attitude of respect and non-discrimination)
- Sexual harassment (for example to prohibit use of language or behavior, towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate)
- Violence or exploitation (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favors or other forms of humiliating, degrading or exploitative behavior)
- Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behavior with children, limiting interactions with children, and ensuring their safety in project areas)
- Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by their employer and not open areas)
- Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favors, are not provided to any person with whom there is a financial, family, or personal connection)
- Respecting reasonable work instructions (including regarding environmental and social norms)
- Protection and proper use of property (for example, to prohibit theft, carelessness, or waste)
- Duty to report violations of this Code
- No retaliation against workers who report violations of the Code, if that report is made in good faith.

## 9. SYSTEMATIZING THE CODE OF CONDUCT

Awareness raising: The Contractor is required to conduct ongoing awareness-raising and training activities to ensure that workers consistently adhere to the Code of Conduct. Additionally, the Contractor must take measures to ensure that local communities are well-informed about the Code of Conduct, enabling them to report any concerns or instances of non-compliance. This proactive approach aims to foster a shared understanding of ethical standards and accountability within both the workforce and the surrounding communities.

## 10. TRANSPARENCY IN CONTRACT SPECIFIC TERMS AND CONDITIONS

All contracts must contain

- Wages: Specific wages and payment modality, timeline
- Working Hours: hours of work, maximum number of hours that can be worked on the project, overtime, compensation
- Leaves: rest per week, annual leave, maternity leave, sick leave
- Benefits: medical treatments in case of accidents or otherwise
- Notice of termination of employment and details of severance payments in a timely manner
- Collective agreements that apply to the project, other specific terms, and conditions
- Details of the grievance redressal mechanism

**LABOUR MANAGEMENT PLAN MATRIX**

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To complete the registration by the Principal Employer, the ULB, as per the provisions of the Contract Labour (Regulation & Abolition) Act 1970 (CL Act), Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979 (ISML Act) and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 (BOCW Act) and procure certificate to that effect. | 3 Registration Certificates to be procured by the ULB under CL Act, ISML Act and BOCW Act respectively. | Before Awarding works | Registration Certificate issued by District Labour Officer under CL Act, ISML Act and BOCW Act | PIU |

| | | | | |
|---|---|---|---|---|
| To Procure license under CL Act, ISML Act and registration under BOCW Act by the contractor | 2 Licenses and One registration under CL Act, ISML Act and BOCW Act respectively. | Before commencing the work at site | License and registration certificate issued by the competent Authority. | Contractor |
| To procure Workmen Compensation insurance policy proportionate to the number of labour force deployed. (By the Contractor) | One insurance policy. | Before commencing work at site | Copy of insurance policy | Contractor |
| To display a copy of the certificate of registration at the conspicuous place at the premises where the building and other construction work is being carried on.<br><br>To establish a labour information signboard at camp site by including following details like, date of payment of wages, working hours, holidays, wages rates for different categories of labours and name and contact details of local | One notice board<br><br>One notice board | As soon as the work is started.<br><br>Do | Photographs of the notice board where the license is displayed.<br><br>do | Contractor |

| | | | | |
|---|---|---|---|---|
| labour inspector and his/ her office and emergency contact numbers. | | | | |
| To conduct pre-employment medical examination (as per the provisions of BOCW Act)- to ensure medical fitness of the employee. | All workers must be examined | No of workers employed by the contractor | Pre-Medical Examination certificate issues as per Rule 223(C) of BOCW Act (Form No. IX) by the Registered Medical Practitioner. | Contractor |
| To conduct Periodical Medical Check-ups (once in every six months) | All workers must be examined. | No of workers employed by the contractor | Medical Examination certificate issued by a registered medical practitioner. | Contractor |
| To provide safe drinking water- the contractor must provide safe drinking water at worksite as well as camp site* (Guideline is provided along with this document) | As per requirement | During the entire contact period | Photographs of supply of potable water, Bill of water purchase. | Contractor |
| To arrange first Aid facility at work site as well as camp site (Specifications and items to be maintained | As per requirement | During the entire contract period | First Aid Register, Bill of purchase, photographs of First Aid kit | Contractor |

| | | | | |
|---|---|---|---|---|
| in the box is mentioned in this document) | | | | |
| To arrange separate First Aid room at work site | Allot one specified room | To be made available during the construction period | Photographs of the facility | Contractor |
| To provide first Aid training to selected labourers or staff members through an authorized agency. | One training with authorized agency | Within one month of commencement of the work | Training records & Photographs | Contractor |
| To establish linkage with local hospitals/ health care institutions for emergency medical assistance | Tie up with at least one hospital | Within one month of the commencement of the work | Letters issued by the hospital or correspondence and agreement with the hospital. | Contractor |
| To establish rest room at work site or camp site | | Before the commencement of the work | Photographs of the rest room | Contractor |
| To establish Canteen facility for labours if the contractor engages more than 250 labours | | Before the commencement of the work | Photographs of the facility, canteen register etc | Contractor |
| To maintain essential registers and records like Form A (Registration of employees), Attendance | | As and when the work starts | Copy of registers. | Contractor |

| | | | | |
|---|---|---|---|---|
| Register, Wages Register, and other registers like incidents registers including Accident register, Harassment complaints, recovery register, Maternity leave, Termination etc | | | | |
| Constitute GRC for labours (maximum members to be six. Number of members from employer and employee to be equal. Female members should be minimum 50%. ) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| Constitution of ICC (minimum members to be four. The presiding member should be a senior female employee) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| To publish the abstract of labour laws within the premises of the labour camp.<br>1. The Payment of Wages Act | Abstract of Six acts | As and when the camp is established | Photos of the notices published. | Contractor |

| | | | | |
|---|---|---|---|---|
| 2. The Employee compensation Act<br>3. The Building and Other Construction Workers (RECS) Act<br>4. The Contract Labour (A&R) Act<br>5. The Child and Adolescent Labour (P&R) Act<br>6. The Maternity Benefit Act<br>☑ | | | | |
| To establish code of conduct and provide induction trainings | | As and when new employees are joined | Training reports and other documents | Contractor |
| Conduct HIV/AIDS awareness programs | As per requirement | Once in six months | Reports, photographs etc | Contractor |

| | | | | |
|---|---|---|---|---|
| All the Drivers should possess effective and valid Driving License | Drivers should be selected after verification of DL | As and when drivers are appointed | Photocopy of licence ids to be collected | PIU |
| All the vehicles involved in the project shall be insured to cover the third-party risk | Vehicle must be allowed to be plied in the project only after procurement of third-party insurance to the vehicle | As and when vehicles are plied in the project | Photocopy of insurance is to be collected | PIU |

**Budget for LMP**

| S.No | Item | Cost |
|---|---|---|
| 1 | Labour compliance as per LMP | [redacted] |

# PREVENTIVE GBV ACTION PLAN

## 1. Sub project information

Bio Remediation of existing dumpsite in ward 6 of Kothamangalam Municipality

### 1.1 Details of labors

The project is under pre planning stage. ULB has to finalize contactor/Agency for Remediation. So the exact number of Labors are not available. But approximately we can expect maximum of 12 labors

| | |
|---|---|
| Total number of labors | : 12 (Approx.) |
| Category of labors (Age/sex/gender) | : Not available |
| Data of migrant labors, if any | : Not available |

## 2. GBV Issues likely to be identified at site

1. Issues against female workers at site
2. Lack of safe and Gender friendly toilets at work sites
3. Disparity in work and wages based on gender

## 3. Activities under GBV Action plan

1. **Formation of Internal Complaints Committee**

   The committee should be Presided by a senior women and more than half of the total Committee members should be women. There should be an external member who has experience in dealing with issues related to women. Preferably a Social Worker /Advocate/NGO Representative.

2. **Placing of ICC informatory boards at Work site**

| Insert Logos of KSWMP,WB,AIIB | | | |
|---|---|---|---|
| **Project Name (KERALA SOLID WASTE MANAGEMENT PROJECT)** | | | |
| **Sub Project Name:** | | | |
| **Internal Complaints Committee** | | | |
| Sl.No | Name | Designation | Contact Number |
| | | | |
| | | | |
| | | | |
| **EMERGENCY CONTACT NUMBER** | | | |

3. **Gender Sensitization trainings for Labors**

Based on an earlier bio remediation process conducted at this site, Project expect around 12 labours will be employed in a day and women participation in the labor force is limited, even the project is taking precaution to protect and prevent any GBV incidence at the site. Taking into consideration all these aspects, the project plan to conduct a half day sensitization program in the following subjects, viz. the type of GBV, the action to be taken by the victim, the laws and the support organizations which extend support to the victim of GVB and the role of ICC and their contact details etc.

4. **Allocation of Gender friendly and safe toilet facilities for women**

Project has taken special care to arrange a separate toilet, wash and rest facility for female workers to protect their privacy and safety, and the same must be arranged by the contractor.

5. **Keeping of wage register at site to restrict wage disparity based on gender**

The project actively opposes gender-based wage disparity at any site funded under the KSWMP-supported SWM project. To ensure gender parity in various aspects such as wages, division of labor, and facilities, an appropriate monitoring mechanism, such as a wage register, should be maintained for the scrutiny of the project implementers.

6. **Details of GBV Service Providers identified**
The government of Kerala has constituted a help desk under Kudumbashree to support or to prevent and extend support to the GBV victims, and their details are given below.

Kudumbashree Snehitha Gender Help Desk

Contact Number – 0484-2428745

Toll free number - 180042555678

## Preventive GBV Implementation plan Matrix

| Sl No | Activity | Timeline | Primary Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 1 | Formation of Internal complaint committee | Pre-Construction Phase. | ULB/Contractor | TSC |
| 2 | Placing of ICC informatory Board at worksite | Pre-Construction Phase. | Contractor | TSC |
| 3 | Gender sensitization Training to labors | During Construction | Contractor | TSC |
| 4 | Ensuring Gender friendly and safe toilet facilities | Construction stage | Contractor | TSC |
| 5 | Keeping Wage Register at site | Construction stage | Contractor | TSC |

## Budget

| Sl No | Particulars | Cost |
|---|---|---|
| 1 | Placing of ICC Informatory board at site | [redacted] |
| 2 | Gender sensitization trainings to labor | [redacted] |
| | **Total Cost** | [redacted] |

## Monitoring plan

| Activity | Monitoring Indicators | Means of Monitoring | Reporting Period | Responsibility |
|---|---|---|---|---|
| Formation of Internal complaint committee | Minutes of Meeting/Bye Law of Committee/Reports | Verification of Minutes of Meeting and Reports | 15 days after commencement of work | TSC |
| Placing of ICC informatory Board at worksite | Photos of Board placed | Physical verification | 15 days after the commencement of work | TSC |
| Gender sensitization Training to labors | Attendance and Photographs | Verification of Documents | 5 days after the commencement of work | TSC |
| Ensuring Gender Friendly and safe toilet Facilities | Gender friendly signage's, Condition of latches, Floor Condition, Status of Flush | Physical verification | Before Commencement of work | TSC |
| Keeping Wage Register at site | Photographs | Verification of Register | 5 days after the commencement of work | TSC |

## LABOUR INFLUX MANAGEMENT PLAN

| RISK | MITIGATION MEASURES | IMPLEMENTATION RESPONSIBILITY | MONITORING INDICATORS | MONITORING RESPONSIBILITY |
|---|---|---|---|---|
| Social and Community wellbeing | Joint Meeting with the community by ULB officials and Elected members | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Economic and Livelihood Issues | Skilled /Unskilled jobs for the Community members in the sub-project | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC |
| Accommodation /labour camp | Ensure basic amenities are provided to the labourers (Toilets, Water, Kitchen facilities etc.)<br><br>Daily briefing to the labourers | Contractor | • Risk identification report<br>• Proposed action/mitigation plan<br>• List of facilities in labour camp<br>• Details of labours | TSC |

| | | | | |
|---|---|---|---|---|
| Communicable Diseases | Access to Medical Check-up<br>Awareness to the labours | Contractor | • SOP for prevention of communicable disease and health wellbeing on worksite and labour camp<br>• Report on medical check-up | TSC |
| Crimes | Intimation to the Local police about the camp | Contractor | Work site complaint register<br>Number of cases reported, and action taken | TSC |
| Child Labour | Ensure Adhar card of all labourers at the site | Contractor & TSC | • Number of child labour issues reported<br>• Data of labours | ULB/TSC |
| Gender-based violence, including sexual harassment child abuse and exploitation | Gender sensitisation briefing to the labourers | Contractor/TSC | • Number of cases reported<br>• Action taken report<br>• Number of cases resolved<br>• Time taken for resolving complaints | ULB/TSC |
| Labour licences | To be ensured by the contractor | Contractor/PIU | Number of labours having licence | TSC |

**Summary of SMP budget**

| S.No | SMP Activity | Cost |
|---|---|---|
| 1 | Labour Management Plan | [redacted] |
| 2 | Labour Influx Management Plan | [redacted] |
| 3 | Preventive GBV action plan | [redacted] |
| 4 | Citizen Engagement Plan | [redacted] |
| **Total** | | [redacted] |

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESMENT REPORT FOR UGRANKUNNU DUMPSITE - BIOMINING AND BIOREMEDIATION, KOTTARAKARA MUNCIPALITY, KOLLAM DISTRICT KERALA



**Kerala Solid Waste Management Project**

# Part A

# Environmental Impact Assessment

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# List of Abbreviation

| | | |
|---|---|---|
| APHA | : | American Public Health Association |
| BDL | : | Below Detectable Level. |
| BGL | : | Below Ground Level |
| CGWB | : | Central Groundwater Board |
| COD | : | Chemical Oxygen Demand |
| CPCB | : | Central Pollution Control Board |
| CPHEEO | : | Central Public Health and Environmental Engineering Organisation |
| ESIA | : | Environmental & Social Impact Assessment |
| ESMC | : | Environmental & Social Monitoring Cell |
| ESMP | : | Environmental & Social Management Plan |
| FR | : | Feasibility Report |
| GHG | : | Greenhouse Gas |
| GoI | : | Government of India |
| GoI | : | Government of India |
| GoK | : | Government of Kerala |
| IS | : | Indian Standard |
| KSDMA | : | Kerala State Disaster Management Authority |
| KSPCB | : | Kerala State Pollution Control Board |
| KSWMP | : | Kerala State Solid Waste Management Project |
| KSWMP | : | Kerala Solid Waste Management Project |
| LSGD | : | Local Self Government Department |
| MCF | : | Material Collection Facility |
| MoEF&CC | : | Ministry of Environment, Forests and Climate Change |
| MoHUA | : | Ministry of Housing and Urban Affairs |
| NAAQ | : | National Ambient Air Quality |
| NABL | : | National Accreditation Board for Testing and Calibration Laboratories |
| NBDW | : | Nonbiodegradable waste |
| NGT | : | National Green Tribunal |
| NH | : | National Highway |
| NOC | : | No Objection Certificate |
| NTU | : | Nephelometric Turbidity Unit |
| O&M | : | Operation and Maintenance |
| O.P. | : | Operational Policy |
| PCM | : | Public Consultation Meeting |
| PM | : | Particulate Matter |
| RRF | : | Matetrial Recovery Facility |
| SWM | : | Solid Waste Management |
| TOC | : | Total Organic Carbon |
| ToR | : | Terms of Reference |
| TPD | : | Tonnes per day |
| TSC | : | Technical Support Consultant |
| ULB | : | Urban Local Body |

# Summary

Kottarakkara, a Semi Urban Local Body (ULB) in Kollam District, with a total area of 17.67 Sq.kms divided into 29 administrative wards, has a total population of 30055 as per 2011 census. Ugrankunnu dumpsite operation was started in the year 1994. The dumpsite, at Ward no.26 is located at a distance of 3Km from Muncipal Office, Kottarakkara. Dumping of waste at Ugrankunnu was continued till 2018 and due to public protest, it was stopped. Originally the site had an area of 0.24 hectares (60 cents), an additional land of 0.4046 hectares (1 acre) adjacent to it was acquired and now the area is about 0.15 hectares (37.66 cents).

"Legacy Waste" refers to aged municipal solid waste in landfills or dumpsites. It is a mix of partially or completely decomposed biodegradable waste, plastics, cloths, metals, glass and other such discarded items. Legacy waste of Ugrankunnu is almost 30 years old. Bio Mining is proposed for the remediation of the site. Land area proposed to be remediated is 0.15 ha (37.66 cents). Total quantity of legacy waste calculated on the basis of Total Station Survey was 8591 tonnes. Bio mining process will begin by excavating the legacy waste, followed by Windrow formation and stabilization of it. Once the waste gets stabilized it will go through trommel and then will be sieved to various fractions such as bio-earth, inerts, rejects, recyclables and RDF. The project envisages the reuse of recovered products. RDF will be transported to cement factories for co processing. Inert/ soil will be disposed at approved locations and recyclables will be sent to authorized recyclers.

Project duration estimated as five months. Sieving & sorting plant, machinery and other infrastructure are required to be set up. It is expected that the time for mobilisation, and installation of machinery would be concurrent. Transportation of materials are concurrent. The design considers three months of sieving/baling operations with mobilisation and setting up of plant within 30 days of commencement of contract. Based on this, an average of 100 to 120 tonnes per day to be excavated.

Plant and machineries to be set up at site are: Back hoe loader (2 nos.), excavators (with 8-10 cu m/hr,2 nos.), trucks of 10 cu m for internal transport (1nos.), trucks of 16 cu m capacity for carrying earth/RDF etc (4 nos), trucks of 10 cu m capacity for RDF (1), trucks of 10 cu m capacity (1), sieving machine of 60 to 80 TPD for inert/recyclable/glass (1) with dual trommel and baling machine of 50 T (1).The plant and machinery details are explained in detail in FR of dumpsite

Total manpower required for the project is 20 persons (staff and labourers). Out of 8591 tonnes of legacy waste, approximately 7803 tonnes of soil/bio-earth, 518 tonnes of RDF/ plastics, 109

tonnes of recyclables/glass along with an expected 2% inert/rejects which is approximately 160 tonnes may be available. Soil /bio earth and stones can be used for filling of land for playground, formation of medians in the ongoing highway, ring road projects, Vizhinjam port, or similar construction sites and also in low lying areas within the state. A part of earthen material approximately 20% can be used for filling the low-lying areas within the site. Another feasible option is to use as daily cover in sanitary landfill facilities. Stabilised organic manure recovered from the dumpsite after processing in Windrows Sieving.Value Addition and Packing is a viable option for utilisation in the nearby areas for agricultural purposes. Recyclables like glass and iron can be sent to recyclers within or outside the state.

Various available methods were studied to select the best remediation process. Based on baseline environmental assessment, stage of degradation of organic waste, absence of toxic contamination in the dumpsite as well as in the surrounding environment, biomining is found to be the viable method

In accordance with the SWM Rules of 2016, the selection of an appropriate method or technique for remediating a dumpsite should be determined through a feasibility study that consider technical, financial and Environmental aspects complying with regulatory requirements (KSPCB/NGT).The formulation of the subproject adhered to the State/National and World Bank safeguards policies, both in its planning phase and will continue to do so during the implementation and monitoring stages. This commitment to compliance will be upheld for a period of two years following the completion of the remediation activities.

As Ugrankunnu biomining project comes under KSWMP and its projects are funded by the World Bank, the present project should adhere to the safeguard policies like Environmental Assessment (OP/BP 4.01), Natural Habitats (OP/BP 4.04) and Pest Management (OP 4.09) of the Bank.

Preliminary environmental screening for the evaluation of the present condition of the dumpsite and it's surrounding, and also to assess the impact on the nearby sensitive receptors due to the project was conducted. Based on it, the present project falls under E2 category due to the very small extent of the dumpsite, absence of any sensitive environmental feature in or around the site, short biomining period, and the overall positive impacts of the proposed development post mitigation measures. A transect walk was also carried out to assess the socio-environmental characteristics in the surroundings of the site.

As part of the ESIA, a detailed environmental baseline study was carried out for analyzing quality of air, groundwater, surface water, noise levels and, leachate characteristics. Apart from

the primary data, secondary data such as rainfall, temperature, hydrology and land use pattern of the project area were analysed.Secendory data showed that the climate of the project area is mostly warm ,with temperatures ranging from 22°C - 32°C.Project area experiances heavy rainfall during the months of May to July and then from September to November in calendar year.The planning of major project activities should be in a timeline avoiding these heavy rainfall months.

Primary baseline studies have been conducted on major environmental parameters such as air, noise, water, soil and ambient air quality of the project area by collecting samples from two locations, one being the sensitive location. None of the analysed parameters exceeded the NAAQS at time of sampling. This shows that the dumpsite in the present condition does not create any type of air pollution in and around the vicinity. Ground water environment was studied by collecting ground water samples from one bore well within the RRF/MCF/dumpsite compound and three dug well samples from nearby houses. The results revealed that most of the ground water parameters were confirming with the drinking water standards, IS 10500: 2012. There are some minor variations in pH of GW1 sample. Turbidity exceeds in GW3 and GW4 samples. The biological analysis of GW1 and GW2 showed presence of coliform bacteria. These variations are not influenced by the dumpsite.

The ambient noise levels at project area were analysed by a noise survey at the front gate of the dumpsite. The results, while comparing with noise standards, show that at daytime the noise levels were within the prescribed limit. During night there is a slight increase of 5 dB. There is a mobile tower near the sampling station and there are chances of DG sets attached to the tower may affect the noise level while in operation.

Soil beneath and above the legacy waste was assessed and the results were compared with the standards specified in the SWM Rule 2016 for organic compost. It is found that the level of heavy metals was within the prescribed limits and hence the recovered soil can be used for the manufacture of organic compost.

Social risk factors of the project were assessed with a social screening checklist, personal interviews with key stake holders and site reconnaissance survey. The social exclusion criteria shows that socio economically weaker groups in the project area have to be invoved in the project. During the transect walk in and around the dumpsite area, it has been observed that the proposed project does not affect any community resources and will not cause any displacement, or loss of assets or resources

Environment impact/risk of the project has been assessed in a step-by-step process. Impacts associated to selected resources of concern, such as ground water, air and noise quality and biodiversity are identified and the significance of each impact was calculated based on its's extent, duration and intensity. The major impacts during, pre and post bio mining phase are identified and management measures are formulated for each of them.

Social impact on host communities/ vulnerable/ livelihood/labour laws/gender/health and safety risk/improper grievance redress mechanism/disruption of utilities was assessed. SIA was conducted in a seven-step process. Concerns of livelihood, gender equality, labour welfare etc. were individually assessed and management measures for each concern is detailed in the SIA section of the report.

Project specific environmental and social management plan is formulated, to ensure that the project is implemented as a sustainable and socially responsible one. A bio mining set up plan, as part of the environmental management plan, is given in Chapter 5. Major process in bio mining and management measures are illustrated in the plan.

The indicative, critical environmental and social attributes of environmental and social performance of the project should be periodically monitored and analyzed during the biomining and post bio mining phase of the project.The major Environmental parameters in concern such as Air,Water,noise and Ground Water will be monitored during the bio mining phase and site specific Environmental Monitoring Programme is forumated .The total budget proposed for Environmental monitoring, social monitoring and Environment Management is [redacted] which will be covered in the allocated ESMP budget. Through the dumpsite remediation the present environmental and social setting of the project area will be improved.

***Note: All the references to Social Impact Assessment and Social Management Plan may be referred to Part B- Social Impact Assessment which is a separate document attached along with this document.***

# രത്നച്ചുരുക്കം

[redacted]

[redacted]

[redacted]

[redacted]

# 1

# INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-financing Framework agreement and as agreed Project Co-lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65% of the urban population (approximately 10 million people) spread across the 14 Districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and BMW management facilities.

## 1.2 Rationale of the proposed Sub project:

Ugrankunnu dumpsite has an area of 0.15 ha. the waste which is present at site is back from 1994. Untill 2018 the unscientific dumping continued and thereafter halted due to public protest. "Legacy waste" typically refers to aged municipal solid waste in landfills or dumpsites. Legacy waste is a mix of partially or completely decomposed biodegradable waste, plastic waste, textiles, metals, glass and other components. Total quantity of legacy waste calculated based on total Staion survey was 8591 t. The site is located between Lat: 9°05.18"N and Long: 76°45'33.09"E. The elevation of the Ugrankunnu dumpsite is 105 (m), gentle slope towards the South Eastern side and South Western section from the dumpsite.

The wastes are covered with a soil caping in Ugrankunnu dumpsite. This soil covering is not scientific and the legacy waste still exists there. Legacy waste may contaminate the soil and GW, cause air pollution, Habitat destruction etc. and also may affect the Aesthetic properties of the area.



***Figure 1.1: Legacy waste conditions on March 2023 and June 2023***

Above **Figure 1.1** shows the condition of the legacy waste in Ugrankunnu which are mixed with soil and vegetation. The vegetation cover acts as breeding gorund for many rodents, reptiles, dogs etc which can cause significant health effects to nearby inhabitants.

Kottarakkara ULB proposes biomining and bioremediation of the Ugrankunnu legacy waste dumpsite site under KSWMP supported by the World Bank and Feasibility Report has been prepared for this subproject. Considering the environmental and social impacts associated with legacy dumpsite biomining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

## 1.3 Objective and Scope of ESIA

### 1.3.1 Environmental Categorisation and Assessment

As per indicative categorization for dumpsite biomining and bioremediation, this subproject is categorized as E1. In case of Ugrankunnu the overall extent of the dumpsite area is limited (0.15 ha).At present the dumpsite area is covered with unwanted vegetation above legacy waste and this vegetation cover acts breeding gorund for many rodents, reptiles, dogs etc.Thus the dumpsite area may cause serious health effects to nearby residents.Post bio mining the land area can be utilised by the ULB for any public benifiting project.Although there are sensitive receptors such as houses and one temple within 200m,through suggested management measures these receptors will be least affected by the project .Thus Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (0.15 ha) and absence of environmentally sensitive features around, this subproject is individually considered as E2, and EIA is prepared accordingly.

Process of Bioremediation commences after the site preparation. This cycle commences with the excavation of materials and ends with the disposal of recovered outputs.

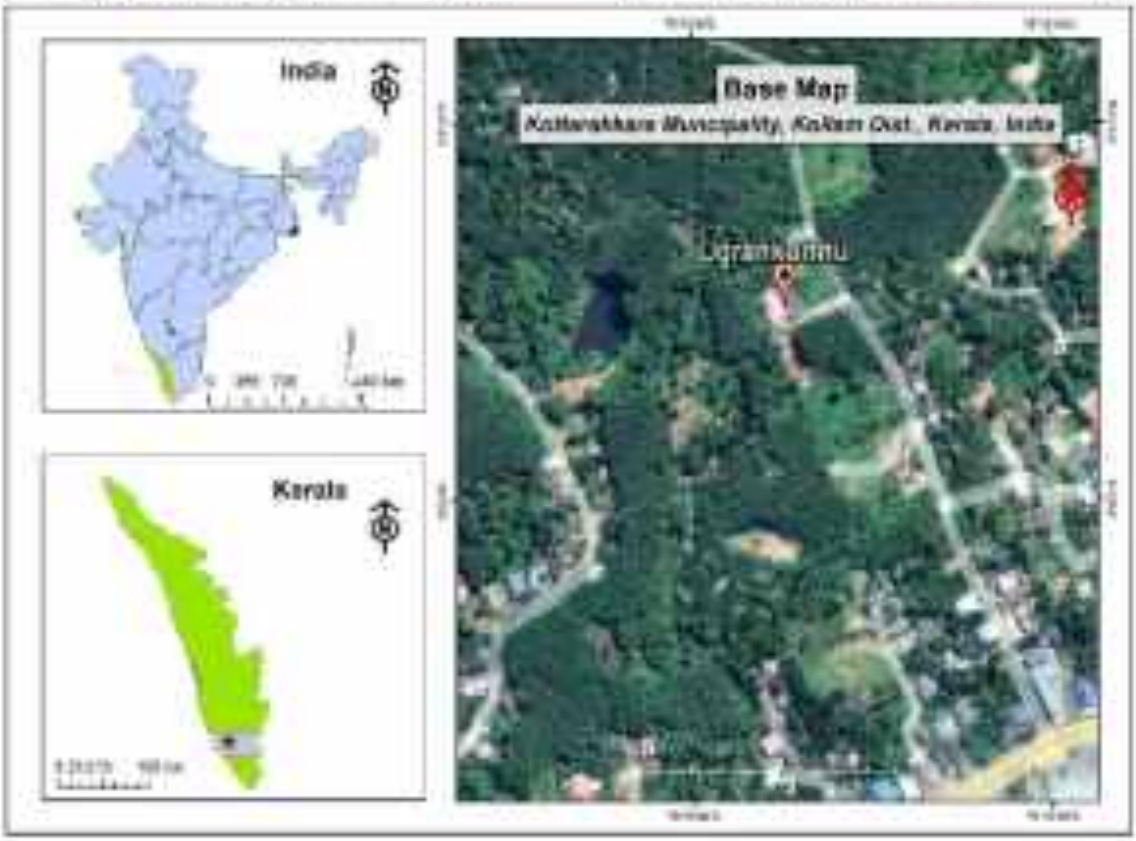
### 1.3.2 Social Impact Assesment

Under this category social impact assessment is also a key factor to be considered. Accordingly, detailed assessment of the environmental and social impacts was carried out

## 1.4 Proposed Sub Project details

**Table 1.1 Sub-Project Details summarized**

| Sl No | Project description | Details | Units | Remarks |
|---|---|---|---|---|
| 1. | Name of the ULB | Kottarakkara | | |
| 2. | District | Kollam | | |
| 3. | Ward No. | 26.Railway Station Ward | | |
| 4. | GPS Co-ordinate of the Site | Latitude: 9°05.18"N, Longitude: 76°45'31.09"E | | |
| 5. | Total Land Area | 6070 | sq. m | Dump site is only 37.66 Cents out of 1 acre 50 cents total land |
| 6. | Disposal Site Used till | 2018 | Year | |
| 7. | Legacy Waste Disposed over | 1524 | sq. m. | |
| 8. | Legacy Waste Volume | 8249 | cum | |
| 9. | Quantity of Legacy waste | 8991 | Tonne | Density @1.042 T/m m |




*Source: TSC Package 4*

*Figure 1.2: Dumpsite location in Ugrankunnu, Kottarakara Municipality*

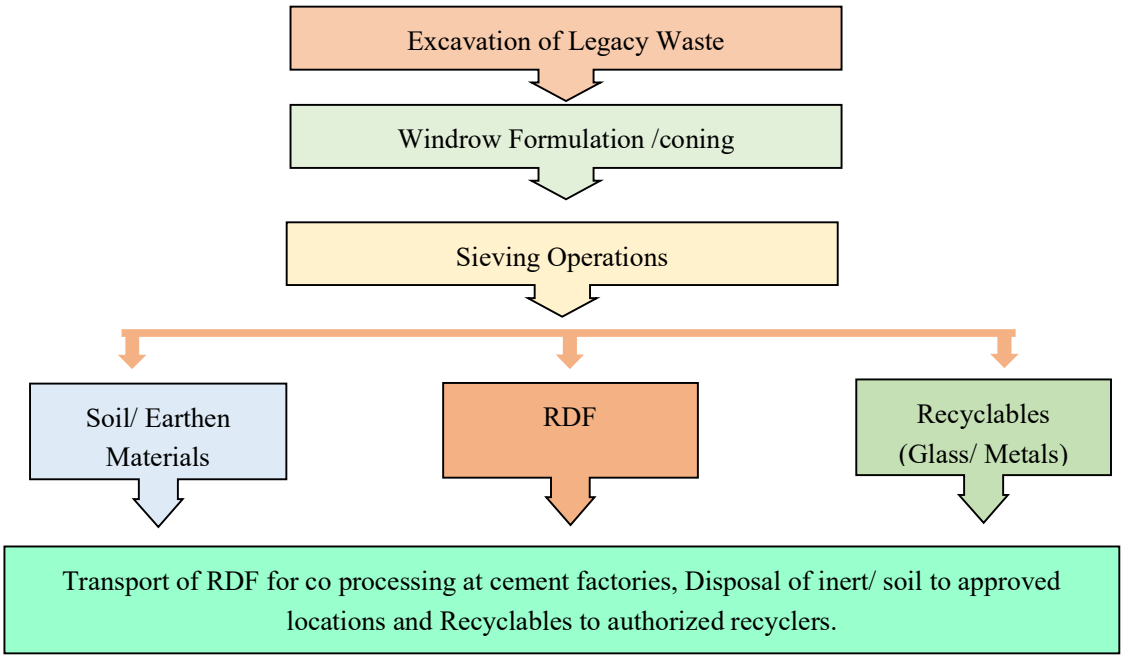



**Source TSC Package A*

***Figure 1.3: Dumpsite boundary along with existing facilities in Ugrankunnu***

### 1.4.1 Stages in Biomining

The proposed steps for executing biomining process,




**Source TSC Package A*

***Figure 1.4: Dumpsite location in Ugrankunnu, Kottarakara Muncipality***

## 1.5 Site Management Plan

Site Managemnt plan is developed as a proposed site setting of machineries which will be deployed during bio mining phase. The efficient and sustainable bio mining can be made possible with suggested management measures. The plan will be able to minimise the impacts to nearby receptors.

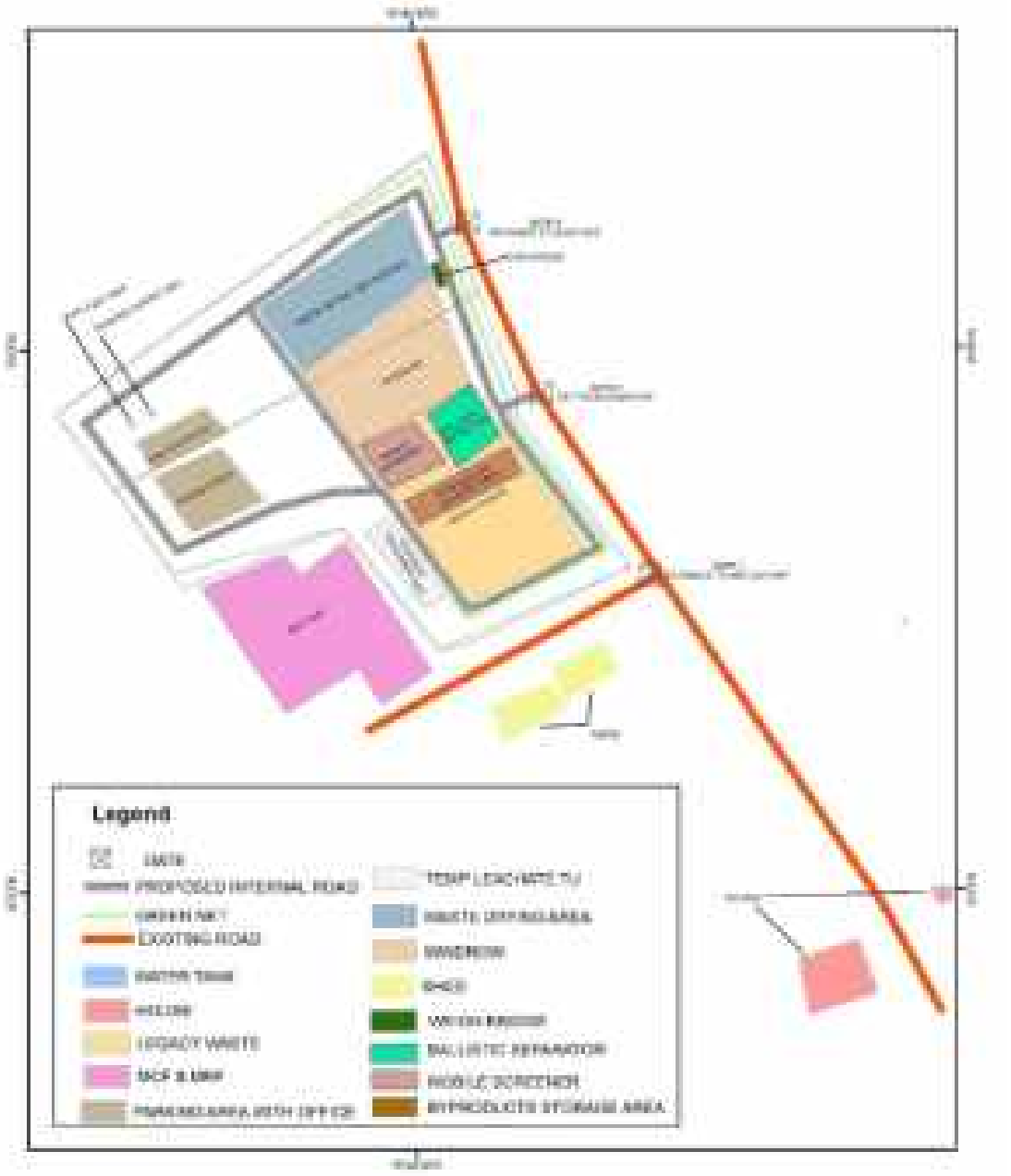



***Figure 1.5: Dumpsite location in Ugrankunnu, Kottarakara Muncipality***

**Source TSC Package A*

## 1.6 Structure of the Report

The ESIA report contains project features, baseline environmental conditions, assessment of environmental impacts, and formulation of mitigation measures along with environmental management and monitoring plan.

The ESIA report for the Ugrankunu Dumspite will be comprising of 9 chapters. The chapters are as discussed below,

**Chapter 1: Introduction**

This chapter provides background information of the project proponent, need for the rapid ESIA study as per prevailing legislation, Location and brief description of the project, methodology adopted for ESIA study and structure of the report.

**Chapter 2: Policy and Regulatory Framework**

This chapter deals with the details of the potential legal, administrative, planning and policy framework which have been referred in the preparation of the ESIA Report.

**Chapter 3: Environmental and Social baseline**

This Chapter describes the baseline environmental conditions around the project site for various environmental attributes, viz. physical, biological and socio-economic, within the 200 m radial zone, which is termed as the study area. Topography, soil, water, meteorology, air, noise, and land constitute the physical environment, whereas flora and fauna constitute the biological environment. Demographic details and occupational pattern in the study area constitute socio-economic environment. Baseline environmental conditions are based on the information collected from the various agencies and the secondary data collected from published sources.

**Chapter 4: Analysis of Alternatives**

This chapter deals with systematic comparison of the proposed methodology used for remediation with other existing one's. There process and operational alternatives are compared in terms of their potential environmental impact.

**Chapter 5: Assessment of Environmental Impacts**

This chapter details the inferences drawn from the environmental & social impact assessment of the proposed project. It describes the overall impacts of the project activities and underscores the areas of concern, which need mitigation measures.

**Chapter 6: Environmental Management Plan**

This Chapter provides mitigation and control measures to attenuate and/or eliminate environmental impacts, which are likely to be caused by the proposed project. An Environmental Management Plan (EMP) has been developed to mitigate the potential adverse impacts and to strengthen the beneficial impacts. This chapter also provides the environmental monitoring plan proposed for the project.

**Chapter 7: Institutional Arrangements**

This chapter provides the information regarding Proposed Institutional Arrangement for Implementation of ESMP.The responsibility of the monitoring of ESMP, capacity building and grievence redressal mechanism will be discussed in this chapter

## Chapter 8: Public Consultation and Disclosure

This Chapter provides an insight into the process & methodology followed for carrying out the public consultation meetings in study area and proceedings of pubic consultations.

# 2

# POLICY AND REGULATORY FRAMEWORK CONSIDERATION

## 2.1 Introduction

A review of the existing legislations and institutions relevant to this project at the national and state levels are presented in this section. Since the project is funded under the IPF instrument of the World Bank, its Operational Policies (OPs) and Bank Procedures (BPs) are applicable for the project Regulations concerning procedures and requirements that may directly concern the project, the capacity of the concerned institutions and their ability to successfully implement the environmental management measures have been addressed.

## 2.2 Environmental Regulations of Government of India

The Indian constitution makes environmental protection an explicit duty for every citizen by the statement, "It shall be duty of every citizen of India to protect and improve the environment including forests, lakes, rivers, wild life, and to have compassion for living creatures." In addition, GoI has laid out various policy guidelines, acts and regulations pertaining to sustenance of environment and these have been presented in the following sections.

### 2.2.1 Applicable Environmental Legislation

As per the nature of the project, screening has been done as per intital Environmental Screening form of ESMF guidance manual.Additonal Screening form from Guidance document for assessment and remediation of contaminated sites in India by MoEF was also utilised for the current project .This helped in the identifications of the legislations applicable to the project. Legislations applicable to the project are given in **Table 2.1**

*Table 2.1: Summary of Environmental and Other Legislation with Applicability Screening*

| Name | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|
| **Environmental Protection Legislations** | | | | | |
| G.O.(Rt)No.2629/2022/LSGD dated , 29-10-2022- Guidelines for implementation of projects for reclamation of legacy waste dumpsites through bio remediation (bio mining and management of recoverables and rejects) by State Government of Kerala | Comprehensive guidelines incorporating the various steps to be followed during the bio mining implementation | Applicable | Technical sanction for the project shall be issued by the concerned Engineer in LSGD (LID & EW) as per the existing financial powers and necessary reporting to the Chief Technical Examiner (Finance Wing) may be ensured for compliance as per norms | LSGD/SPCB | ULB /Contractor |
| NOC from Department of Kerala Fire and rescue Services | To follow SOP published by Department of Kerala Fire and rescue Services | Applicable.<br>Applicable due to windrow formation and waste segregation activities and operation of machineries | NOC | Kerala Fire and Rescue Services | ULB |
| Air (Prevention and Control of Pollution) Act, 1981, 1987 | An act to prevent and control Air pollution | Applicable.<br>The applicability is due to Emission from Operation of construction equipment like Trommels/Conveyors, DG sets, and similarly, during operation stage backup power generation, material handling related aspects | Consent to Establish & Consent to Operate | SPCB | ULB /Contractor |
| Water Prevention and Control of Pollution) Act, 1974, 1988 | An act to prevent and control water pollution. | Applicable. It is applicable for the projects having potential to generate effluent during any stage of the project. Effluents are | Consent to Establish & Consent to Operate | SPCB | ULB /Contractor |

| Name | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|
| | | expected to be generated during biomining phase of the project as leachate | | | |
| Noise Pollution (Regulation and Control Act) 2000 and amendment till date | Ambient Noise Standards for different areas and zones | Applicable due to generation of noise during construction and operation stage | No permits issued under this act | SPCB | ULB /Contractor |
| Hazardous Wastes (Management Handling and Trans- boundary) Rules, 2008 | Protection to general public against improper handling storage and disposal of hazardous waste. The rules prescribe the management requirement of hazardous wastes from its generation to final disposal. | Applicable. Project has potential to generate hazardous waste (Waste Oil) during bio mining phase | Authorization for storage and handling hazardous waste | SPCB | Contractor shall obtain authorization for handling, storage and disposal of hazardous waste (Waste Oil) along with CTE/CTO under air and water act. |
| MSIHC Rules, 1989 | Usage and storage of hazardous material | Applicable only for storage of highly inflammable liquids like HSD/LPG | No specific permit is required. however precautions defined under the material safety datasheets shall be followed. Safety audit and other requirements shall have to be complied if storage quantity exceeds the threshold limit | Chief Controller of Explosives, MoEF&CC & DC | Contractor and ULB |
| The Batteries (Management and Handling) Rules 2001 | To regulate the disposal and recycling of lead acid batteries | Applicable for disposal of used led acid battery if likely to be used in any equipment during bio mining stage. | No specific registration required. Compulsion to buy and sale through | MoEF&CC | Contractor and ULB |

| Name | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|
| | | | registered vendor only. | | |
| Building and Other Construction Workers (Regulation of Employment and conditions of Service) (Central Act) 1996, Kerala Building and Other Construction Workers Act, 1998 and Welfare Cess Rules | Health and Safety and environmental aspects associated with construction and allied works | Applicable | No specific permit is required. | Central and Kerala State Govt. | Contractor |
| Construction and Demolition Waste Management Rules 2016 | Proper management including segregation, collection, processing, and reuse of C&D waste | Applicable | strictly adhere to the Standard Operating Procedures of CPCB and KSPCB in handling and storage of C&D waste<br>Bulk generators shall enter into an agreement with authorized C&D waste management facility operators for the removal of the waste and shall strictly abide by the protocol for storage, collection, transportation and processing of C&D waste as per the directions and guidelines of PCB | Central and Kerala State Govt. | Contractor |

| Name | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|
| E-Waste (Management) Rules, 2022 | To regulate the proper reuse of E waste | Applicable for disposal of any type of e waste observed from mined out legacy waste | To provide to registered E waste recyclers | SPCB | Contractor / ULB |
| The Kerala Municipality (amendment) Bill, 2023 | Waste management duties of ULB amended | Applicable | No specific permit is required | ULB | |
| The Bio Medical Waste (Management and Handling rules), 1998 | To control storage, transportation and disposal of Bio Medical Waste | Applicable for the disposal of bio-medical waste generated at site ,if any | No specific permit is required. Just comply with the handling and disposal requirements of the rule | Contractor/ULB | |
| **Safety and Other Related Legislations** | | | | | |
| Fire Prevention | To avoid accidental fires and explosion during bio mining phase | Applicable, as per fire and Safety protection rules | Permission from local Fire and rescue Dept. | Chief of Fire and Rescue Dept. | ULB |
| Petroleum Rules, 2002 | Use and Storage of Petroleum products | Applicable as storage of HSD/LPG or any other petroleum product may be required for the project purpose | License to store petroleum beyond prescribed quantity. | Chief Controller of Explosives/DC | Contractor / ULB |
| Central Motor Vehicle Act 1988 and amendment Central Motor Vehicle Rules, 1989 and amendments till date | To minimize the road accidents, penalizing the guilty, provision of compensation to victim and family and check vehicular air and noise pollution. | Applicable, for all the vehicles at site during construction & operation phase | No permit issued under this Act | Motor Vehicle Department (Licensing authority, registration authority & State Transport Authorities) | Contractor to follow Rules for all the construction vehicles being used at site during construction purpose. Contractor shall follow the rules for all its vehicles at site during operation phase and should also |

| Name | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|
| | | | | | monitor that loading & unloading vehicles also comply with these rules |
| Kerala State Traffic Police | Traffic regulations | During traffic re routing | To take permission if rerouting of road traffic is suggested | Local Traffic Police Station | Contractor/ULB |

**Source: TSC Package A*

## 2.3 International Best Practices& Guidelines

### 2.3.1 Operational Policies of World Bank

The project is being developed with the financial aid from World Bank. World Bank operational policies triggered for this project are listed in **Table 2.2.**

*Table 2.2: World Banks Operational Policies – Environmental & Social Safeguard*

| Name | Key Requirement | Applicability | Remarks |
|---|---|---|---|
| OP 4.01 Environmental Assessment | Ensures sustainability and environmental feasibility ofthe project. Projects are classified into A, B & C category depending on the nature and extent of the impact. | Triggers | Project classified asCategory E2 consideringnature of activities and impacts |
| OP 4.04 Natural habitats | Ensures conservation ofnatural habitats anddiscourages disturbance to any natural habitat due toproject development byrecommending adoption ofalternative method/route/approach oradopting managementmeasures | Not Triggers | Applicable for projectslocated in close vicinity to eco-sensitive zones likewildlife sanctuary, wetlandsunder Ramsar convention, national parks bird sanctuary, turtle breeding grounds etc. |
| OP 4.36 Forests | Ensures that project activities does not disturbs/interfere with theforest, forest dwelleractivities, fauna and flora ofthe forest. Prevents and discourages deforestationand impacts on rights of forest dependent people | Not Triggers | Neither diversion of forest land is involved nor any tree cutting is anticipated.However, tree cutting may be involved for access road. Permission will be required for felling any tree from forest department. |
| OP 4.12 Involuntary Resettlement | Ensures minimal involuntary resettlement by considering feasible alternatives project design, assisting displaced people to improve their former living standard | Not Triggers | Pvt. Land proposed to be acquired for facilitating biomining activity is unhabitated |
| OP 4.09 Pest Management | Objective of the Policy is to minimize and manage the environmental and health risks associated with pesticide use and promote and support safe, effective, and environmentally sound pest management | Not Triggers | The project does not involve any usage of Pesticides |
| OP 4.11 Physical Cultural Resources | Ensures preservation of property of cultural and religious importance, heritage and property of natural importance and enhancement of cultural properties | Triggers | Nearby Ugrankunnu Bagavathi temple exists. |

# 3

# ENVIRONMENTAL BASELINE

## 3.1 Project location & Area of influence

The dumpsite is located at Ugranikunnu (9°0'4.68"N 76°45'33.73"E), a hillock in Kottarakkara Municipal area, and about 3 km away from the Municipal Head Quarters. It was a burial ground, with an area of 0.24 hectares and before converting it to a waste processing area, an additional land of 0.4046 hectares adjacent to it was acquired.

For the present study ,200m area around the dumpsite was considered as area of influence and baseline studies was conducted covering this 200 m radius from centere of the dumpsite. **Figure 3.1** shows the boundary of the facility and 200 m area of influence. The air, water, noise and soil samples within 200m radii showed that there is no significant contamination at present and hence further samplings are not carried out above 200 m radii. The sensitive receptors were also covered in the sampling area. **Table 3.1** shows the immediate sensitive receptors near to dumpsite.

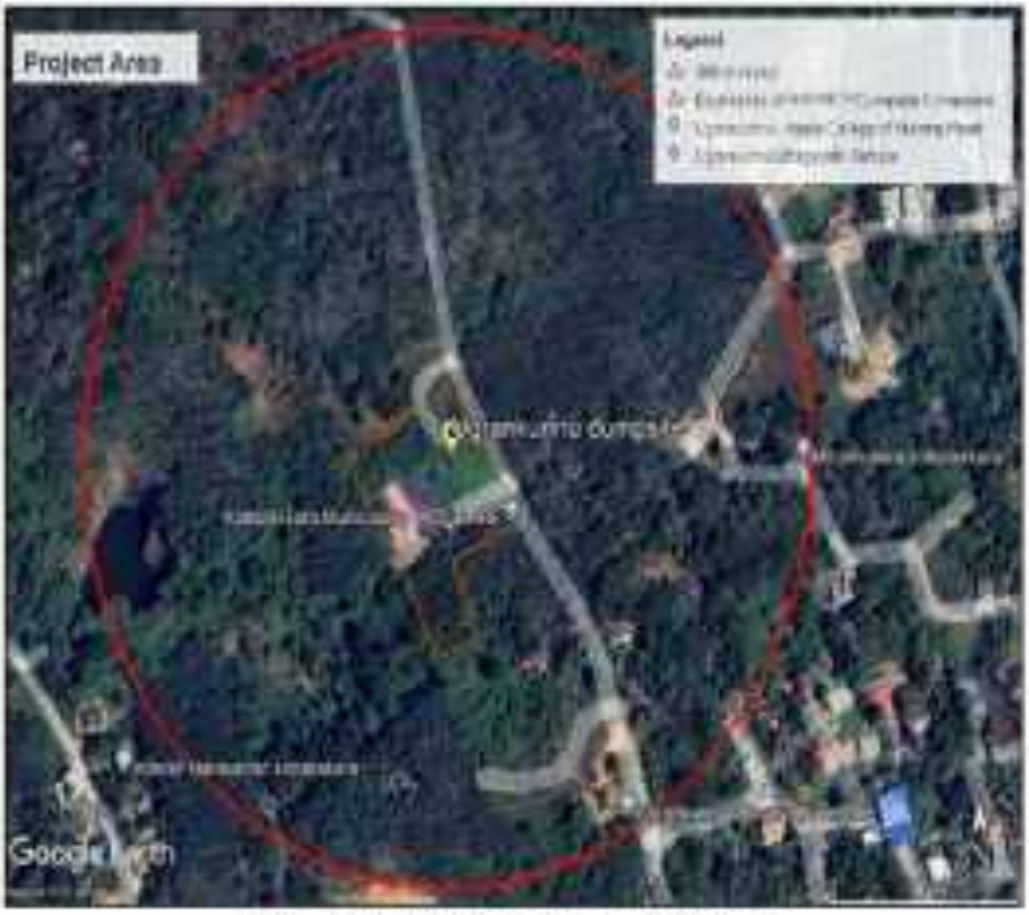



*Figure 3.1: Project area and area of influence*

*Source: TSC Package A

*Table 3.1: Details of sensitive receptors near to dumpsite*

| S. No | Sensitive Receptors | Distance |
|---|---|---|
| 1 | Residential buildings | Nearest house located at a distance of 90m from the entrance of dumpsite area in Eastern direction. |
| 2 | Educational institutions | Vijaya college of Nursing, located at Northern side with a distance of 435 m |
| 3 | Religious Places | Ugranikunnu Devi temple located at Southern Side with a distance of 150 m |
| 4 | Nearest waterbodies | One unused quarry, with a pond exists around 165m aerial distance from site in Western direction. But the water is not used for any purpose by nearby residents as no access to enter to waterbody. |

*Source: TSC Package A

## 3.2 Methodology for Environmental Baseline studies

A Baseline Study in EIA process refers to a comprehensive assessment of an area's existing environmental conditions and characteristics that may be potentially affected by a proposed project. The relevance of the Baseline Study in EIA process cannot be overstated. It provides essential information that guides decision-making on the proposed project, ensures compliance with regulatory requirements, and helps minimise the project's adverse impacts on the environment and communities.

For the current project 200m radii area from centre of the dumpsite has been considered for baseline studies. The study involved collection of both primary and secondary baseline data. Baseline of the area was established by the combination of both primary and secondary data. Primary data collection was carried out for the environmental parameters such as air, water, noise and soil. NABL approved laboratory Poluchem Laboratories conducted the sample collection and analysis of air,water and noise parameters.Geo technical studies of soil and waste analysis was conducted by Matter Material Testing and Research Laboratory Pvt. Ltd., Kozhikode. The below table indicates the environmental attributes and frequency of monitoring.

*Table 3.2: Environmental Attributes*

| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| 1 | Meteorology | Temperature humidity and rainfall | - | Study area | Data collected from IMD |
| 2 | Ambient air quality | $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$, VOCs | AAQ1 – N- 9° 0'4.70", E -76°45'33.60"<br><br>AAQ2 – N- 9° 0'16.10", E -76°45'24.00" | 2 | 24 hourly samples |
| 3 | Noise levels | Noise levels in dB(A) Leq | N1 – N- 11°35'39.983", E -75°36'20.205 | 1 | Once |
| 4 | Groundwater quality | Physical, chemical and biological parameters including pH, temperature, turbidity, magnesium hardness, total alkalinity, chlorides, | GW1- N- 9° 0'4.20" E - 76°45'32.90" GW2- N-9° 0'4.10" E-76°45'36.40" GW3- | 4 | Once |

| | | | | | |
|---|---|---|---|---|---|
| | | sulphates, fluoride, Copper, DO, BOD, COD, salinity, Zinc, Lead, Arsenic. | N-9° 0'1.70" E-76°45'36.30" GW4- N-9° 0'10.80" E-76°45'30.00" | | |
| 5 | Biological environment | Existing flora and fauna | - | Study Area | Through field visits and substantiated through secondary data sources. |
| 6 | Soil characteristics | Physical, chemical and biological parameters including pH, Total Hardness, Nitrites, Phosphates, Organic matter, Fluorides, Total Iron, Nickel, Copper and Lead, TOC, Permeability.,Heavy metals | Soil Samples collected from dumpsite | Dumpsite area | Once |
| 7 | Land use/land cover | Land use for different land use Classifications. | - | Study Area | Land use / Land Cover Analysis using satellite imaging and GIS Technique |

*Source: TSC Package A

## 3.3 Existing Facilities on site and its Environmental Audit

RRF and MCF facility exists in same compound and there are 42 female HKS members working for entire Municipality for collection, transportation and segregation of waste. Dumpsite consists of toilet, rest sheds and one borewell

The MCF/RRF is not considered under this subproject. However, an environmental audit of the facility is important as this is an associated facility to which some recyclables may be channelized to and is situated at the same site and might be impacted by the booming activities.

*Table 3.3: Environmental Audit of existing facilities*

| Sl No | Aspects | Remarks |
|---|---|---|
| 1 | Structural Characteristics | MCF and RRF facility exists in 767 sq m<br>Buffer/setback around the MCF-5m<br>Distance from waste pile of dumpsite-5m<br>Roof: (Material, condition)-GI sheet and in good condition<br>Floor (Material, Condition)-Concreted floor in good condition<br>Walls: buildings are enclosed with masonry wall of 1.5 m and the above portion is enclosed with metal nets.<br>Doors & windows: Metal Doors<br>Bio mining will not impact the structural characteristics of the building. The MCF/RRF exists at an offset of 5m and in different topographical level. Damages to roof can anticipate if there are accidents /tip over occurs |
| 2 | Functional Characteristics | Activities in the MCF/RRF: Waste segregation, baling activities<br>Materials and condition of stacking: Improper stacking of material inside and outside<br>Activities spilling out into the dumpsite: No since both exists in different elevation, there is no spilling onto dumpsite<br>Access to the MCF (through dumpsite or other): There are separate gates for dumpsite and MCF/RRF compound<br>No: of workers: 42, HKS members |
| 3 | Facilities | Parking area: There is limited area available infront of MCF and RRF for parking.<br>Loading/unloading area: The area infront of the MCF/RRF is utilised as loading /unloading area<br>Storage room & area: One office room of area 45m$^2$<br>Worker snack/rest areas: 2 rest room<br>Worker / other washrooms & sewerage: One toilet facility<br>Water supply for Cleaning, Washroom: One borewell is available within facility<br>Greenbelt: Facility itself does not have any green belt, but the entire facility is surrounded by rubber plantations which acts as a green belt |
| 4 | Expected Impacts | Since common road is available for MCF/RRF and dumpsite there will be access issues during bio mining stage<br>Additional toilet facilities required<br>The compound wall is partially covering the existing MCF/RRF, this increases the trespassing of animals/personnels into facility premises So the compound wall to be completed<br>Chances of damages to existing compound wall to the eastern side of MCF, if buffer is not given during bio mining stage. |

## 3.4 Analysis of Environmental baseline

*Table 3.4: Environmental baseline*

| Sl No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| 1 | Topography | The elevation of the Ugranikunnu dumpsite is 105(m), gentle slope towards the South Eastern side and South Western section from the dumpsite. The land area in dumpsite is midland. Soil is predominantly lateritic in nature. Ugranikunnu site falls within the tropical to sub-tropical climatic region. | No leachate was observed in downward sides |
| 2 | Climate | The climate of Ugranikunnu is mostly moderate The place experiences warm temperatures of 22°C - 32°C. | Rains are heavy, and the site is at an elevated draining out of stored waste and leachate during dumpsite biomining & bioremediation works |
| 3 | Hydrology/Hydrogeology & Soil | The decadal average water level of the Ugranikunnu dumpsite area ranges from 10-15m.The high elevation of the area is the reason behind higher depth of water levels.<br><br>Soil is predominantly hard lateritic/laterite soil Ground below waste was observed as sandy clay | The clay content below waste can act as a barrier in holding up of leachate and prevents spreading to nearby GW sources.<br><br>But during bio mining the excavations will bring up the wet waste and if rain occurs the leachate can immediately slow to nearby GW sources |
| 4 | Forests and Ecology | The Kottarakkara ULB does not have any forest area. As per protected areas in Kerala, Kollam district consists of one notified protected area Shendurney Wildlife Sanctuary.Place is located at a distance of 41 Km from the dumpsite area Some of the common flora and fauna found near the site. | None of the flora fauna found near to dumpsite falls in IUCN red list<br><br>The flora will be affected during the bio mining phase .But trees are not disturbed.These all fauna will be mainly creepers and plants that are grown on top soil of dumpsite<br><br>Fauna that are found are basically birds and squirell .they will shift to nearby undisturbed areas by themselves and the current project will not be a concern to them. |

| | Scientific name | Common Name | Type |
|---|---|---|---|
| | Corvus macrorhynchos | Large-billed crow | Fauna [Bird] |
| | Acridotheristristis | Commmon Myna | Fauna [Bird] |
| | Centropes sinensis | Greater Coucal | Fauna [Bird] |
| | Funambulustristriatus | Jungle palm squirrel | Fauna [Mammals] |
| | Corvus macrorhynchos | Large-billed crow | Fauna [Bird] |
| | **Species** | **Family** | **Type** |
| | Macaranga peltata | Vatta | Flora [Tree] |

| Sl No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | | Xenostegia tridentata \| Prasarani \| Flora [Creeper]<br>Cissampelos pareira \| \| Flora [Creeper]<br>Clerodendrum odoratum \| Connaraist pacha \| Flora [Shrubs]<br>Macaranga peltata \| Vatta \| Flora [Tree] | |
| 5 | Socio Economic Aspects | The dump site is in the middle of Rubber estate. On the southern side, 130 metres from the site, there is a temple called Ugrankunnu Sree Bhadra Bhagavathi Temple and on the Northern side there is a Nursing (Vijaya Nursing College) college which is 435 m away. On the eastern side a rubber plantation area 7 families with 62 inhabitants residing within 200 meters of it and 7 residential houses are there and on the western side is MCF and RRF.<br><br>The proposed dumpsite rehabilitation project will not have any adverse impact on livelihood of rag pickers. Similarly, there is no influx of migration of workers to the site or to the nearby areas. The proposed project does not affect any community resources and will not cause any economic displacement, or loss of assets or resources | Transect Walk map and discussions are briefly explained in Section 7.3.1 |
| 6 | Land use, Development Pattern and Key Projects | As per the LULC map, Ugrankunnu dumpsite area comes under dry agriculture/residential area. The dumpsite is surrounded by Rubber plantations and some houses in south -eastern side of the dumpsite-.<br><br>Nearby cultural resources- Ugrankunnu Devi temple is located at a distance of 135m in Southern Side<br><br>MCF/RRF exists in same compound and occupies an area of 767 sq.m | Measures have to be taken not to affect the functioning of existing MCF/RRF |
| 7 | Infrastructure and Services | For the efficient bio mining activity, the present available land is not sufficient Hence an additional adjacent land of area about 1500 – 2000 sq m to be leased out.<br><br>Also there is need to enhance the fire safety equipment and arrangements in place. | NA |
| 8 | Traffic and Transportation | Traffic arrangement is discussed seperatly along with Traffic map in section 3.5 | The implementing agency shall ensure staggering of the traffic movements from site considering peak hours/college timings. Also, night time vehicular movements can be implemented.<br>More accurate information shall be available once Contractor is being |

| Sl No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | | | onbourded. EIA to be updated by the contractor based on his work plan |
| 9 | Water Supply<br>Surface water<br>Ground Water | Ground Water collected from 3 different location and results found – all parameters are well within limits except for pH.<br><br>The analysis results revelaved that most of the parameters in Ground water were confirming with the drinking water standards, IS 10500: 2012.There are some minor variations in pH of GW1 sample. Turbudity exceeds in GW3 and GW4 parameter. In case of biological analysis GW1 and GW2 showed presence of Coliform bacteria. The variations in these results are not influenced by the dumpsite | Site Drainage & leachate Impacts due to of biomining activity (esp during any seasonal rain) is important with respect to nearby soil & water environment |
| 10 | Drainage, Sewerage and Sanitation | Ugranikunnu dumpsite does not have any drainage network. The water flows naturally along the slope of the area.<br>Ugranikunnu is mainly served with septic tanks for individual premises and in dumpsite one toilet and septic tank exists within the MCF/RRF compound | |
| 11 | Soil quality of dumpsite | Soil and Waste in dumpsite were analysed for the presence of heavy metals. Heavy metals were under the prescribed limits as per SWM Rule 2016 for organic compost | Compost manufacturing from the soil fractions can be considered |
| 12 | Solid Waste Management | Kottarakkara Municipality is collecting only dry waste from households and institutions and the dry waste is stored in MCF facilities and at RRF the materials are recovered and sorted. The MCF/RRF exists in same compound of the dumpsite. The recovered materials are transferred to CKCL. The dumpsite area/project area is non functional since 2018 | |
| 13 | Air quality | 2 locations -One in sensitive receptor on Northern side of the dumpsite and another location is in the front gate of the dumpsite in Southern direction to dumpsite. All parameters were within permissible limits | In bio mining stage due to continious truck/equipment movement and during the travel thorugh katcha road inside the dumpsite there will be increase in particulate matter |
| 14 | Noise level | 1 location -In the entrance of bio mining Parameters were within the permissible limits at day and at night there is a slight increase in noise level (+5dB) from permissible limits | Dumpsite is surrounded by rubber plantations and there are no other commercial institutions in immediate vicinity<br><br>There is a mobile tower situated nearby sampling station and during certain occasions there are chances for operation of DG sets attached to mobile tower and the operation of DG set during |

| Sl No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | | | night time can affect the noise level |

*Source: TSC Package A

## 3.5 Traffic arrangement

Ugrankunnu dumpsite is situated at a distance of 0.4 km from the major road Kollam Punalur Thenkashi road. The road infront of dumpsite leads to Vijaya College of nursing, which is at a distance of 0.4 km from dumpsite entrance. Along the road another sensitive receptor Ugrankunnu Bagavathi temple also exists.The road is not a wide road it is having a width of 3 m.

As per the college officials, the college buses will do services in shift basis, i. e from 7.30 am to 9.30 am in the morning and 3.30 pm TO 5.30 pm in the afternoon. This will be the peak time of traffic through the road infront.

So during the project phase ,the tipper/other meachinery operations should be done in time frame outside of the college trip timing .Also there should be coordination with the drivers of college bus ,so that the mining contractor can free up the road during there trip.Also there should be traffic control points with representative at major junctions/points to avoid any traffic congestion.One should be at exit to Kollam Punalur Thenkashi road and one should be before Vijaya College of Nursing.Also the temple during festive occasion there will be higher traffic ,during this time traffic arrangments to be modified based on that.

The dumpsite is situated in RRF/MCF facility ,the facility will be active during the bio mining phase ,there will a total of three/four trips per day/month to the facility for the processing of waste.At present there is no specific time schedule followed by ULB to dispose these wastes.But during the bio mining phase ,the timing should be arranged in discussion with the mining contractor and ULB ,to avoid traffic congestion in roads.

Below **Figure 3.2** shows the road map of the dumpsite area, road connection with major sensitive factors has been showed in the figure.




***Figure 3.2 Traffic map of Ugrankunnu Dumpsite***

*Source: TSC Package A

## 3.6 Description of Environmental Parameters

The primary baseline characteristics of Dumspite area and the immediate vicinity has been evaluated by conducting Environmental Monitoring of Air, water, noise and soil characteristics. The Environmental monitoring stations established for the present project is presented in below **Figure 3.3** The analysis was carried out on month of April 2023. (Summer Season).




***Figure 3.3 Environmental Monitroing Station locations***

*Source: TSC Package A

*Table 3.5: Distance of sampling points*

| S.No. | Description | Direction and distance from dumpsite | Inference |
|---|---|---|---|
| *Air quality monitoring stations* | | | |
| | Main Gate of MCF/RRF compound (AAQ-1) | 34 m- adjacent to existing dumpsite | Air quality stations are slected based on predominant wind direction and covering one sensitive receptor.<br><br>Northern and Southern Sides are covered |
| | Vijaya College of Nursing (AAQ-1) | 427.10 m- in North Western direction from dumpsite | |
| *Groundwater quality stations* | | | |
| | Borewell Sample inside dumpsite - GW1 | 51m-Within the MCF/RRF compound | Samples are selected such that one point as control point not interfered by the dumpsite .One within the dumpsite boundary and all other samples are collected from downward side of the dumpsite, according to natural slope of terrain |
| | Mr.Shanavas.S, Alnvilaveeduhouse -GW2 | 106m-in South Eastern direction from dumpsite | |
| | Mr.Thulaseedharan ,Aswathy Bhavan-GW3 | 153m-in Southern direction from dumpsite | |
| | Mrs.Lekha, Pazhankanjivilla-GW4 | 186m-in northern direction from dumpsite | |
| *Noise quality* | | | |
| | Near Main Gate of Dumpsite Ugranizamm-N1 | 34 m- adjacent to existing dumpsite | The entrance gate where oncoming vehicles are coming |
| **Note:** Surface water body existing within 200m radii is an abanded quarry pond. There was no acess to collect water from the pond.and the water was not used for any purposes by the residents | | | |

*Source: TSC Package A

### 3.6.1 Sampling Methodology

*Table 3.6: Sampling Methodology*

| S.No | Description | Method |
|---|---|---|
| 1 | Air sampling | Calibrated High Volume Sampler, Calibrated rotameter & calibrated Dry gas meters and sampling locations selected based on wind rose and impacts on surrounding landuses |
| 2 | Noise | Calibrated sound level meter and sampling locations selected based on highest noise level on site and impacts on surroundings |
| 3 | Ground water | Water collected in polyethylene bottles in presence of TSC/IPE global persons and sampling locations selected based on leachate and run off flow and impacts on surroundings |

***Note: Sampling result and photographs of sampling is attached as Annexure in FR report***

# 4

# ANALYSIS OF ALTERNATIVES

During the entire stage of the project preparation, comprising of screening and detail design preparation, various alternatives were identified and analyzed to help in decision making.

## 4.1 Zero or No Project Alternatives

The "With" project scenario with positive/beneficial impacts results in overall improvement of the area and also the land area can be utilised for any other development projects by ULB.The availability of vacant land is deficient in Kerala.The legacy waste inside the soil ,is an environmental concern as it may pollute the soil and if leachate contamination occurs it can contaminate nearby ground water.Also at present the dumpsite acts a breeding ground for reptiles,insects,dogs,mosquitoes and this can cause health related issues to nearby residents."With" project these environmental and health effects can be effectively addressed.

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevent further contamination of the site.

If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows.

- 1. Foul Oder Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.
- 2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.
- 3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.
- 4. Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the surrounding environment, disrupting natural habitats and causing long-term ecological imbalances.
- 5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

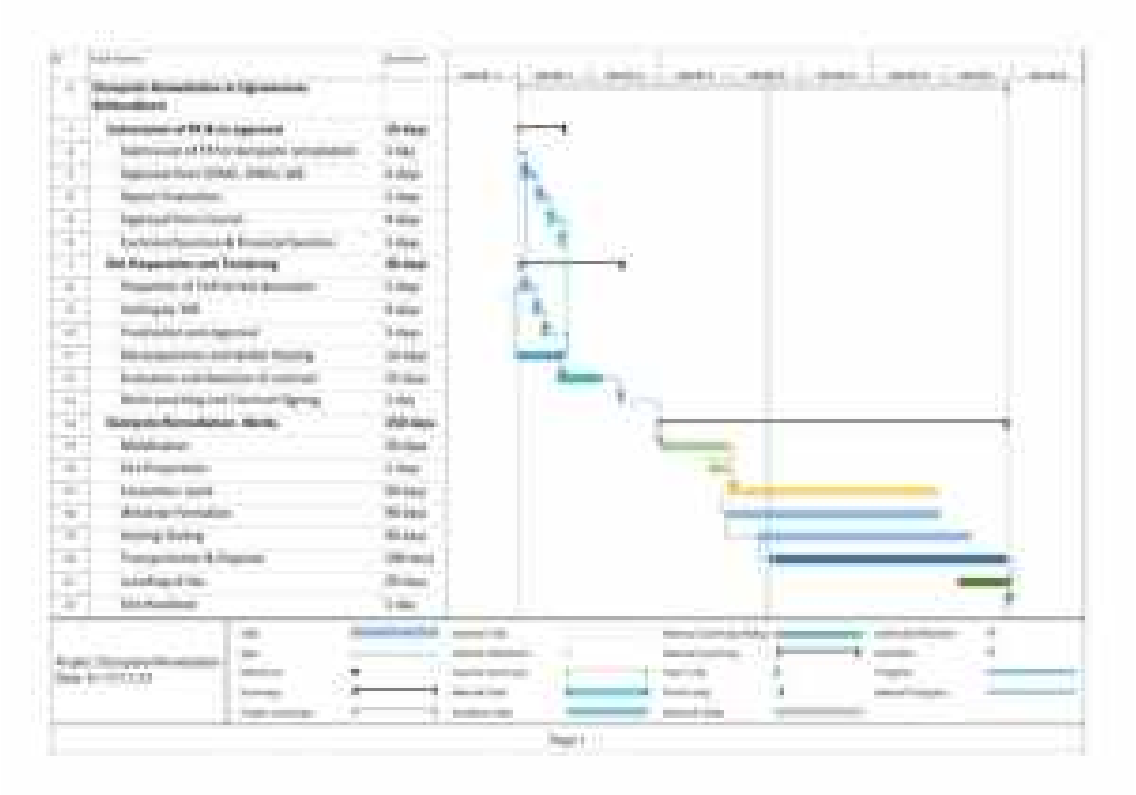
On July 17, 2019, the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested biomining and bioremediation as environmentally safe and the most preferable approaches to dumpsite remediation. *(Source: Toolkit Legacy Waste Management and dumpsite remediation in India).* Bioremediation is one of the key focus areas of Swachh Bharat Mission 2.0. The guidelines released in October 2021 expects that all the legacy historic waste dumpsites across the country are remediated and converted to green zones or as state-of-the-art Solid Waste Management facility.

## 4.2 Mode of execution /Management alternatives

Regarding the execution strategy, the storage of recovered by products obtained from bio mining will be an issue. The existing compound does not have the infrastructure facility to hold on these wastes for long period of time.

The present dumpsite has very limited land availablity for the efficient execution of the process. The nearby vacant land is available to lease for the project activities. These are some of the hindrances that can have issue during the site-based approach of biomining in Ugrankunnu.

The total duration anticipated for the completion of the project is five months.Proposed timeline for the activity is given below in Figure 4.1



***. Figure 4.1 Proposed timeline for Ugrankunnu dumpsite biomining***

## 4.3 Technology Alternatives

There are various techniques/technologies for remediation of waste landfills. Based on the type /nature of the waste, geographical conditions, and required outcomes of the project suitable project specific technique need to be selected.

A few known technologies for bioremediation are discussed below

- Biomining
- Capping of landfill
- Capping with partial land recovery

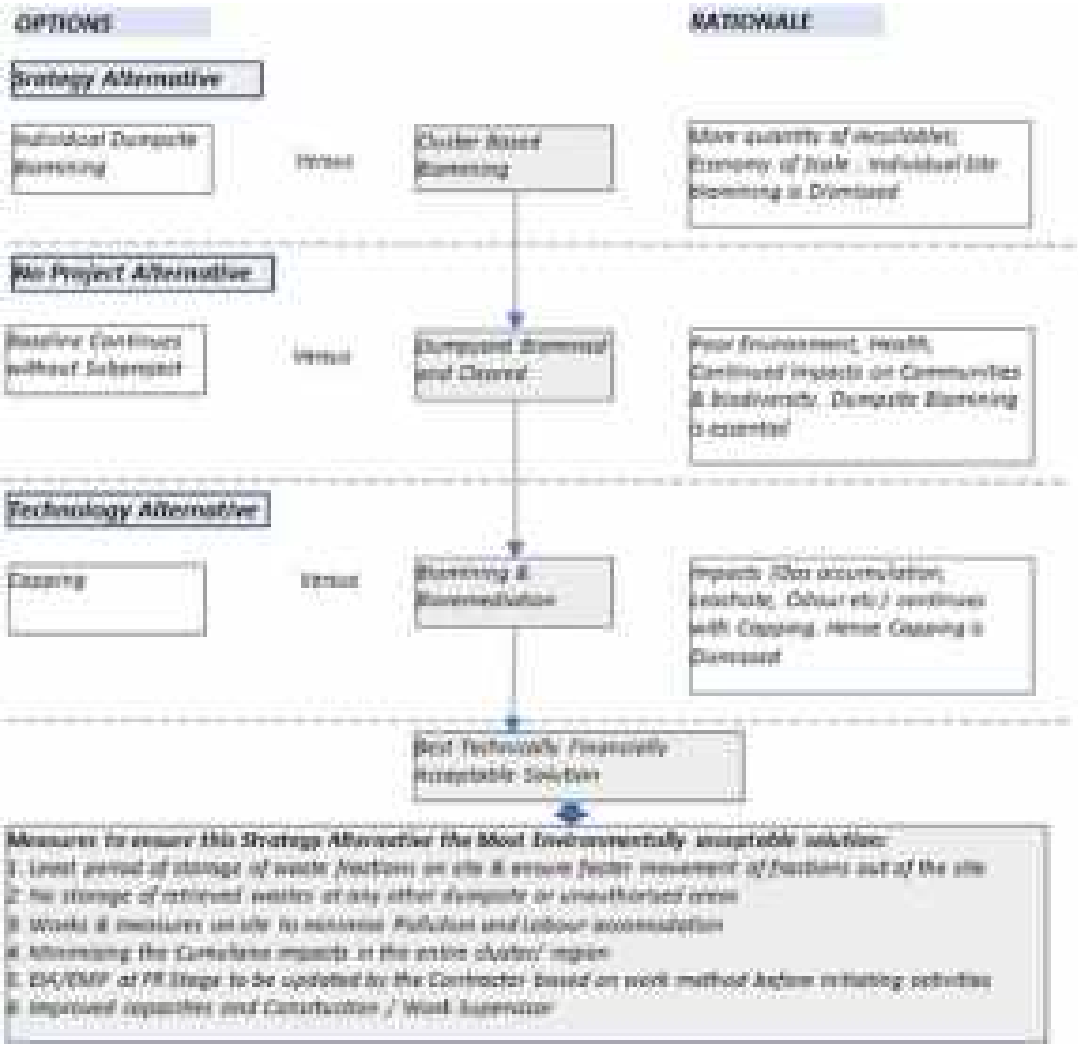



***Figure 4.2 Analysis of Alternatives***

*Source: World Bank

5

# ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

Biomining and bioremediation of existing legacy dumpsites beings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more mandays at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, biomining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration) are important in this case. In addition, cumulative impacts of simultaneous biomining of multiple such legwork on the environment is important. Especially with respect to (i) drainage and leachate flow into regional waterbodies (& esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies, (ii) pollution on land/soil, dust and odour nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks, (iii) Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and (iv) Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at ths stage, while some would be known only based on the project details that would be known from the work plan of the contactor once s/he is on board.

Source -pathway receptor study.

## 5.1 Source Pathway Receptor Analysis

### 5.1.1 Source:

Legacy waste remaining and being deposited at the Ugrankunnu closed dumpsite may act as a source of contamination, more specifically the probalble landfill gas and leachate generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. In this case the waste is 30 years old, as dumping had started in year 1994 and ceased in 2018 Initially the dumpsite was acting as a burial ground. The total waste volume is 24327cu m with the dumpsite spread over 0.15 ha and rises to a height of approximately 4.3 m from the base. Waste is seen 4.3 m above ground level and 6.3 m below ground level. In addition to the landfill gas and leachate, material spill over from the existing MCF in the compound and windblown dust and litter may also be considered as sources of contamination.

### 5.1.2 Pathways:

The following pathways for migration of contaminants have been identified: Wind The main pathway for litter and dust dispersion is the wind. As long as the waste is kept uncovered, the dust and litter will

continue to be blown off the dumpsite to the surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. Rainwater runoff through the dumpsite acts as a pathway for transport of leachate to the soil and groundwater. The rainwater flowing off the dumpsite along the slope towards South Eastern and South Western side acts as a pathway for the uncovered waste to flow into unlined drainage canal along the boundary to Eastern side, which runs along the boundary of the compound wall of the dumpsite and then exit onto the road.

Lateritic Soil acts as a pathway for transport of leachate to the groundwater and for uptake of contaminated surface run-off.

The leachate flows with groundwater and acts as the pathway. Surface water Contaminants like run-off from the dumpsite, leachate and windblown dust and litter that reach nearby surface water bodies like canals, rivers and streams are further transported by surface waters and in this case the surface water acts as the pathway.

### 5.1.3 Receptors:

Air, surface water (drain passing through residential areas), ground water including drinking water sources (for 17 number of families, Ugrankunnu Devi temple etc), soil, flora, fauna and humans. In the case of remediated dumpsite, the most prominent group of receptors are the residences and institutions living nearby in Ugrankunnu As the dump is not contaminated, remediaion would improve the pollution scenario provided the bioearth used is pollution free and of good quality. However, other impats are expected on the final destinatons of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF/MRFs in the region. Depending on the locations of end use of fractions retrieved from biomining, the contractor shall assess the impacts on communities and workers on site & nearby; and near locations of end-use. Key impacts may result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after biomining activity, activities in biomined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post biomining activity.

## 5.2 Impacts on Air Environment

Key impacts on air include:

- Emission of Methane and other Greenhouse gases; and its impacts on workers on site/other facilities on site (MCF in this case), nearby communities of Ward 26 /Railway Station Ward.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odour, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.
- When the legacy site is opened, existing gases would get emitted. Further, any delay / unexpected stoppage of biomining activity, might further the process of gas formation be depending on waste composition, odour and fire risks. In the case of Ugrankunnu, since the analysis of wastes shows calorific value of 844 for whole waste with around more than 90% of soil/Bio Earth, the chances of fire are less.

## 5.3 Impacts on Water Environment

### 5.3.1 Ground water

- The decadal average water level of the Ugrankunnu dumpsite area ranges from 10-15m. Borehole data indicates waste upto depth of 6.3m with hard lateritic strata after that. Hence it is expected that the ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. But at Ugrankunnu during the site visit no leachate was observed around the dumpsite and same has been confirmend by the analysis of nearby GW well samples. None of the GW samples were contaminated
- Soil below the waste was analysed and there was no Heavy metal contamination observed in soil samples.

### 5.3.2 Surface water

- Dumspite is situated at a higher elevation, and hence no submergence was experienced at the site during the floods. The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas.
- There are no surface waterbodies near the site, except an abondade quarry pond located at a distance of 152 m
- Predominant slopes are from North Eastern to South Eastern direction.At South Eastern side there are houses The drainage and leachate from the site flows to nearby open drainage channel which flows through residential areas, and ends at main drainage in Kollam Punlaur road It is important to contain and treat leachate from the proposed biomining activities on site. Treated leachate may be recirculated or used for other purposes.

## 5.4 Impacts on land/soil

- Historic landuse assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it shall be excluded from the site as biomining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.
- Spillover of activities to nearby road, and land would result in pollution of all types on thse areas. Hence it is important to restrict all activities to the site for legacy waste biomining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.
- Ground beneath dump remain polluted if heavy metal/other parameters exceeds limits in leachate, soil, water. In Ugrankunnu all parameters including heavy metals were found within the limit. Ugrankunnu does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste (including legacy asbestos), e-waste or biomedical waste is found while biomining, same shall b transported, treated and disposed as per specific waste guideline of the CPCB, Guidelines of CPCB on Legacy Waste Biomining of dumpsites and WB EHS. A plan shall be auditing of all wastes, management, eliminating

pollution & OHS risks; and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.

- Wherever fuel, combustibles and retrieved waste is stored, it shall be on impervious surface, at appropriate elevation, protection against rains, flooding (such as cut off drains, berms etc.), wind and fly / pest menace (screens, green cover etc), intruders (compound wall (existing at Ugrankunnu), watch and ward, lighting, remote monitoring measures etc). Risk of fire, dust and leachate contamination shall be well assessed by the contractor. Emergency Action Plan shall be prepared and mitigation measures shall be updated based on work plan/DPR, and implemented. Communities shall be made aware of works and advice to follow measures such as use of fly/dust covers/nets on wells etc.
- Of the waste samples analysed, 90 percent comprises of Bio earth and C/N ratio greater than 30 indicating slight unpleasant odour (high Nitrogen; releasing ammonia) less than that suitable for good compost.

## 5.5 Impacts due to Noise/Vibration

- Various machines vehicles and activities contribute to noise and vibration on and off site. This includes vehicles carrying recyclables, operation of JCB, and other machines, diesel generator sets, motors on site, etc. In addition, activities on the site and in relation to the existing MCFs such as vehicles transporting the dry waste from households to MCF, loading / unloading of collected waste materials, and workers activities on site would add to noise and vibration. Impacts include disturbance to fauna flora on site, health impacts on communities around due to exposure to large volume of sound.

## 5.6 Other impacts on biodiversity-Fauna/Flora

- Contaminants in soil and water: Direct or indirect contact with polluted soil or water by neighboring water users. Additionally, because of their locations, recovered lands are subsequently used as parks, or for SWM facilities or office spaces etc. This may pose risk of bioaccumulation of metals which can constitute a health risk. Also impacts on buildings due to gaseous emissions, risk of fire etc if used after clearing.
- Health Risks: One of the primary health risks of dumps is the spreading of diseases - diarrhea, hepatitis etc. The ways such infection can be spread are numerous but are often related to direct contact with the waste (e.g., clinical waste, faecal matter) by scavengers and other unauthorized persons being on the site. The other main pathway is by vectors such as, foraging animals, rats, birds, flies and mosquitoes etc. - Flies, mosquitoes, rodents, crows, pigeons, pest menace on site, for workers & communities & their assets (such as wells) due to exposure of putrefied wastes.
- Impacts if separate common site/s or a site among these dumpsites is chosen to store wastes from other dumps till it is disposed, or as transfer stations or for common processing of certain fractions: Such activities would result in Air, odor, dust, noise, water, vibration, flora, fauna, communities around the new site. There is also risk of contamination due to newly placed wastes, and pollution impacts and disturbances to communities due to works/activities on this site. Such sites and activities shall be avoided, and if quintessential for the project, be carefully chosen and approved only after thorough discussions with KSPCB, and all stakeholders. An assessment of their sensitivity and appropriateness shall be undertaken considering the environmental risks. They shall be audited and assessed for existing and future environmental impacts of such activities and mitigation shall be

implemented. However, details on such sites shall be known only based on the final schema of implementation proposed by the contractor. Hence, the Contractor shall update EIA based on this before starting any activity on site.

- OHS impacts: Infectious wastes, faecal matter, clinical wastes and sharps; batteries, e-waste and possible bursting; Hazardous wastes like asbestos and other chemicals dumped; pesticides / insecticides, inoculum storage, handling and use on wastes/land leading to diarrhoea, hepatitis, insect & reptile bites, interactions with foraging animals like rats, dogs, cattle, vector (mosquitoes, flies etc) transmitted diseases etc.
- Worker facilities in the labour Camp if any, & site are important, as the density of population is high in Kerala. It is important that camp sites are not set up in the land to be remediated. Periodic health checkups (once a week) are very important as the work involves handling of waste. It is important to also provide periodic health check up and co-ordination with local PHC/CHS for medical camps for residents, schools and others during the biomining period.
- Risk of Fire during biomining and due to retrieved material storage; possible Burning of retrieved materials; storage and use of firewood for various purposes, fuel for vehicles. The smoke from burning solid waste can result in respiratory complaints, dizziness, and headaches in the short-term, as well as potentially more serious diseases such as cancers and heart disease in the long term.
- Impacts of other site development works shall be well assessed, EIA/EMP updated, and mitigation measures included in Project costs and implemented by the contractor/ULB (whoever is responsible as per FR/Final Bid document).

## 5.7 Visual impacts, Noise, Odour, Vibrations

- Odour & impacts on workers and communities during biomining, storage and transport are key determinants of community agreement to the activity. Such odour would attract flies and vectors in large numbers, who may also contaminate the food, and water sources of nearby communities. It is important to minimize odor emission as guided by the CPCB Guidelines on Legacy Waste Biomining, 2019. also provide periodic health checkup and co-ordination with local PHC/CHS for medical camps for residents, schools and others during the biomining period.
- Visual impacts of the waste being dug up, screened ad heaped/stored is not appealing. It is important to mask this appropriately

## 5.8 Traffic impacts

- Impacts due to new access road construction/upgradation. New roads in the site will be unpaved and slushy during rains. It is important to minimize temporary pollution due to increased movement men, and materials from and to the site during biomining activity and beyond as it is proposed to store material on site including air and noise pollution, access restrictions to properties nearby, and vehicular conflicts.
- Large vehicles moving in and out of the site carrying materials, tools, equipment & pedestrian/worker -vehicular conflicts; increased traffic on roads, large equipments & vehicles, noise, air pollution: vehicle emissions, DG sets
- Vehicles, equipment's not adhering to pollution standards

## 5.9 Other impacts on existing or proposed activities on site/s

- There may be approvals from various agencies for biomining activities and associated facilities; depending on utilities and uses on site. & associated activities. These permits shall be obtained prior to initiating activities on site.
- Impacts of biomining on existing facilities on site such as MRF, MCF etc (disturbance to activities & people due to dust, leachate, noise, odour; additional load of wastes to these facilities, vibration impacts & structural damage, etc).
- Post biomining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped & impacts if this is dumped elsewhere or not processed. This alternate location, being associated facility need mitigation measures to avoid/minimize pollution, H&S impacts on workers, communities. Also forward linkages are considered as associated facilities/linked activities. Impacts of Transportation of these fractions (traffic increase, odor, leachate, dust) impacts during rains & emergencies, and its handling, storage at the identified locations, reuse etc. shall be mitigated.

## 5.10 Impact/Risk Assesment Methodology

The analysis of environmental impacts/risks is done in terms of their likelihood and severity. The criteria used to determine significance are summarized in **Table 5.2**

*Table 5.1: Criteria Used to Assign Level of Significance*

| Likelihood - the likelihood that an impact will occur | |
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| **Unlikely** | The impact is unlikely to occur. |
| **Likely** | The impact is likely to occur under most conditions. |
| **Definite** | The impact will occur. |

### 5.10.1 Magnitude and duration of the Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Biomining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;
- The spatial extent of the potential impact;
- Reversibility of the Impact;
- Legal standards and established criteria.
- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table 5.3 Aspects for Determining the Magnitude of Impacts. Magnitude is assessed as medium, considering shorter duration of the activity. However, magnitude of cumulative impacts of various dumpsite remediation might be High.

*Table 5.2: Magnitude of Impacts*

| Aspects | Large | Medium | Small | Negligible |
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| *Duration of the potential impact* | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or Less than the lifespan of the program (Likely) | Temporary with no detectable potential impact |
| *Spatial extent of the potential impact* | Regional – reach beyond project boundaries | Beyond immediate Program components, site boundaries or local area | Within program boundary (Likely) | A specific location within program component or site boundaries with no detectable potential impact |
| *Reversibility of potential impacts* | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months(Likely) | Baseline remains constant |
| *Legal standards and established professional criteria* | Against national/approved standards and or international guidelines/obligations | Complies with limits given in national standards but not confirming to international lender guidelines in one or more parameters | Meets minimum national standard limits or international guidelines(Likely) | Not applicable |
| *Likelihood of potential impacts occurring* | Commonly occurs under typical operating or construction conditions (Definite ) | Usually seen occurring under most situations (Likely) | Occurs under abnormal, exceptional or emergency conditions (Occasional) | Unlikely to occur |

### 5.10.2 Sensitivity of the Receptor

The dumpsite is surrounded by residential buildings and rubber plantations, during the time of site assessment the experts observed, some sensitive receptors within 200m from the site. Namely some College, religious places and households. The project lies near residences, within a 200-meter radius, and its potential air, odour, fire, noise, vibration, ground water impact on over 17 families over a duration of 5 to 6 months. The sensitivity of these receptors is High, in addition, the surface run off from the dumpsite drains through the residential areas of Ugrankunnu this include the leachate that may be generated during bio mining from the site. The sensitivity of this receptor is also estimated as High.

### 5.10.3 Significance of the Impact

Significance if the impact is high as it would even result in community resistance to biomining and bioremediation. Since the project operational time 5 to 6 months, then the magnitude of the negative impact can be considered as small and medium sensitivity. In other hand magnitude of the positive impact, after the biomining of the existing land can be used for the recreational park for the public use or for any other development projects proposed by Kottarakkara Muncipality

# 6

# ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN

## 6.1 Scope of Environmental Management Plan

The Environment Management Plan (EMP) is a site-specific plan developed to ensure that the project is implemented in an environmentally sustainable manner where all contractors and subcontractors, including consultants, understand the potential environmental risks arising from the project and take appropriate actions to properly manage that risk.

EMP ensures that the project implementation is carried out in accordance with the design by taking appropriate mitigation actions to reduce adverse environmental impacts during its life cycle. The plan outlines existing and potential problems that may adversely impact on the environment and recommends corrective measures where required. Also, the plan outlines roles and responsibility of the key personnel and contractors who will be in-charge of the responsibilities to manage the project site.The Environment Management Plan (EMP) would consist of all mitigation measures for each component of the environment due to the activities during the pre biomining phase and bio mining phase and to minimize adverse environmental impacts resulting from the activities of the project.

*Table 6.1: Environmental Management Plan*

| Sl. No | Probable impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| *Pre Bio mining Phase/Preparatory phase* | | | | |
| 1 | Biomining & Remediation Plan & Capacities | Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / biomined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these biomined material in line wit the agreements with such facility owners and National, State regulations and WB EHS<br>Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate management Plan.<br>The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers. | Contractor | SPMU/DPMU/ULB |
| 2 | *Non-compliance with applicable rules*<br><br>Site /Dumpsite Initial preparatory works | Site clearance / obtain NOC from the revenue authorities for obtaining the permissive use of land and council approval.<br><br>Consent to establish from the KSPCB has to be obtained for starting construction work related to the sub-project. | Contractor/ULB | SPMU/ULB |
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – *impact on air quality, odor, water contamination due to leachate, health and safety impacts of the people working in the site assessment* | Carry out site assessments as per Guidelines for Biomining of Legacy waste Dumpsites of CPCB<br>Consider safe biomining & gas / leachate generation from existing capped portion of the site<br>Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means<br>Provision of appropriate PPE's to the team undertaking the site assessments | TSC, ULB, Contractor | SPMU/DPMU/ULB |

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| | | Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits<br>Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>Plan for machinery operated which will be operated by skilled operators at all times.<br>Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures.<br>Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | | |
| 4 | *Operational difficulties to existing MCF/RRF existing in same compound of Dumpsite*<br>-<br>Ugrankunnu dump site is located within the existing RRF and MCF facility.The biomining can affect the operation of existing RRF and MCF | There is provision for separate access to dumpsite and to the RRF-MCF facility.Biomining related vehicles and meachineries should not use acess gate of MCF/RRF<br><br>The pathway to RRF/MCF and dumpsite to be differentiated and hence the operation of the existing RRF MCF will not be disturbed.<br><br>But at present dumpsite area is accessible to all as there is no gates present. During the biomining phase the access to the dumpsite will be gated and closed and authorized personnels will be allowed inside.<br><br>Fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely to avoid risk to the public. | Contractor | ULB/SPMU |

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| | | To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br><br>Grading shall be performed where necessary to provide a neat appearance | | |
| 5 | *Dust impacts due to SitePreparation*<br>Excavation in summer season will result in dust emission to surrounding areas and can have a rise in Particular matter in the area.The increased dust emission can have an effect on nearby rubber plantations | Provide temporary green nets buffers around the site before the start of work to curtail dust emissions. | Contractor | ULB |
| 6 | *Material sourcing, transport, and stacking of construction materials*.<br>Uncontrolled transportation of the equipment /materials will result in increased traffic in existing road.<br>Existing road is having 3 m width, and the increased truck/equipment movement will create traffic blocks<br>Nearby nursing college is utilizing the same route for daily commute the increased traffic will result in there college timing.<br>Material transportation through the dumpsite road and along the kollam Thenkashi road will increase the dust emission and chances of spillage of materials are there.<br>Travelling of vehicles in kacha road inside dumpsite will increase the dust emission<br>Vehicles/Equipments operating in Kacha roads will be having materials sticking onto tyres,when this reach main roads this can create nuisance to public | Vehicles coming to and from dumpsite will be scheduled in a timing which will not affect the oncoming traffic of the nearby college.<br><br>Deploy manpower to control traffic infront of dumpsite and in junction where the road is joining with the Kollam Thenkasi road.<br><br>Materials transportation to and from the dumpsite should be in closed trucks with PUC certificates.<br><br>Kacha roads inside dumpsite to be dampened from time to time | ULB with help of Traffic Police<br><br>Contractor<br><br>Contractor<br><br>Contractor | ULB |
| 7 | *Setting up of Labour camp*<br>Unauthorised creation of labor camp will result in unsanitary conditions in nearby settlements. | Proper residence or accommodation facilities with basic facilities such as toiletries, good drinking water ,food to be provided to workers | Contractor | ULB |

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| 8 | *Contamination of groundwater due to leaching.*<br>During excavation of wastes, there are chances of leachate formation from the wastes, which if not directed properly can reach to ground damaging the soil and if leachate quantity is higher can affect the ground water in the area. | Plan the works on-site only during non-rainy seasons and to complete the works before rain.<br><br>The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata<br><br>Design and maintain the slope and orientation of windrows of mined wastes and/or leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles of mined waste and waste windrows to maximize runoff and hence reduce infiltration;<br><br>Store leachate aboveground storage tanks, and provide for emergency containment additionally<br><br>Provide liner in areas ,where mined materials is stacked | Contractor | ULB |
| 9 | *Transportation of wastes retrieved or other material in overloaded and open vehicles*<br>Impacts caused to Air, Odour nuisances; spills and littering impacts on Air, Water, Land) | All vehicles shall carry only approved load of weight as per SOP<br><br>Regular cleaning of roads & drains and removal of spills if any.<br><br>All Transport vehicles shall be covered<br><br>Ensure provisions of SWM Rules 2016 for all waste / retrieved material Transportation activities | Contractor | ULB |
| 10 | Site Access Closure | The total cessation of dumping in the site will be implemented before any works.<br>All public access to the site, including waste pickers and scavengers should be prohibited via adequate temporary fencing, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public.<br>The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance | ULB or Contractor as per Bidding mechanism | SPMU/DPMU/ULB |

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| | | to indicate that the waste dump has been closed from the operation.<br>To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br>Grading shall be performed where necessary to provide a neat appearance | | |
| *Biomining Stage* | | | | |
| 1 | Impacts due to increased tipper and equipment movement through the narrow road<br><br>In bio mining stage there will be contionious movement of tippers and equipments through the existing roads, that can create dust emissions, noise disturbances to nearby community<br><br>Overspeeding of the vehicles can cause accidents along the route | Tipper movement route ,and timing to be planned and providing GPS tracker to tippers<br><br>Ensure all tippers are having speed limiter installed and provide drivers with awareness regarding over speeding<br><br>Proper lubrication shall be provided to minimize squeaking noise due to friction<br><br>Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br><br>The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public<br><br>Traffic will be managed at the site by providing adequate space for parking of vehicles<br><br>Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design<br><br>No waste or material shall be disposed in any place other than the designated area; including water bodies, coasts/forests, or sensitive areas. | Contractor | 1 |
| 2 | *Exhaust emissions*<br>Idiling of heavy machineries and tippers contribute to increased emissions of air pollutants | No idling of vehicles on site. | Contractor | ULB |

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| | | Regular maintenance of heavy equipment used at the site and waste hauling vehicles toensure their exhaust emissions meet the emissions standards prescribed | | |
| 3 | Vehicular movement through kacha roads /unpaved roads<br>During bio mining there will be temporary acces routes created inside the dusmpsites for waste segregation and removing. Movement of tippers /equipments through these roads can create dust emissions at large scale. | Ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Contractor | ULB |
| 4 | Odor<br>The compaction of wastes will generate odor problems and can create nuisance to workers and nearby communities | Proper aeration to be maintained in Windrow Composting and protocol for the Windrow composting shall be observed | Contractor | ULB |
| 5 | *Contamination of groundwater due to leaching*.<br>In mining area, there are chances of leachate formation from the wastes, which if not directed properly can reach to ground damaging the soil and if leachate quantity is higher it can affect the ground water in the area. | Installation of leachate collection facility at site<br><br>To re use the leachate collected onto wind-rows as a type of bio culture<br><br>To prevent the entering of run off water from the surrounding area into mining area,a garland drains shall be constructed around the mining area. | Contractor | ULB |
| 6 | *Impact on the ambient noise quality during the operations*<br><br>Heavy machinery operations and vehicular traffic can increase the noise levels to considerable levels. | Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines;<br><br>Use modern, well-maintained and regularly serviced vehicles;<br><br>Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br><br>Provision of earmuffs and ear protection to workers and employees in high noise areas | Contractor | ULB |

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|---|---|---|---|---|
| 7 | *Pest / Vermin Control*<br>Odour, flies, rodent / other pest menaces<br><br>During the waste segregartion, there will be increase in pests, insects and rodents in the area. If it is not controlled these can reach on to nearby communities and can create health issues | Regular cleaning and approved pest control measures to be adopted<br><br>Pest Traps/Biopesticides / biological control shall be followed.<br><br>Banned pesticides/insecticides shall not be used.<br><br>Workers shall be made aware of storage and use of pest control measures and PPEs to be used | | |
| 8 | *Fire Accidents*<br>Since there will be chances for emission of sparks from exhausts of vehicles, causing fire<br><br>Equipments /Vehicles catching fire | To provide spark arresters to the vehicles inside the mining area<br><br>To provide suitable no of different types of Fire extuinguisher for handling different types of fire .<br><br>Training to be given to worforce in fire safety<br><br>(Fire Risk assement details are provided in Section 6.4 ,Table 6.3) | Safety officer/Contractor | ULB |
| 9 | *Occupational health and Safety Impacts of the workers*<br>Health impacts to workers due to conitionous exposure to harmful pollutants<br><br>Electrical ,Fire hazard causing damage to materials and worforce<br><br>Finger/hand injuries/Cuts | Safety officer to be present at site<br><br>Permit System can be implemented at site before major works .No permit no Work Policy to be implemented<br><br>Tool Box talk to all workers and Staff daily before commencing of work ,and safety officer to insure that it is implemented regulary<br><br>Weekly and Monthly Campaingns at site regarding electrical safety,Fire Safety ,Trip Hazard .Posters to be displayed on site on each campaign<br><br>Safety training to worforce Topics like safe usuage of Fire extuinguisher, Electrical Safety can be discussed<br><br>Once in a month conduct Safety Mock Drills on varios topics like Oil spillage,Fire ,Electrical hazard etc… | Safety officer/Contractor | ULB |

| | | | | |
|---|---|---|---|---|
| 10 | *Land /Space Constriaints*<br><br>For the efficient and sustainable bio mining the present dumpsite area is not sufficient An additional area of 1500m$^2$ in minimum is required for setting up the bio mining activities | Nearby land, which is currently a vacant land with no major trees can be leased (The land owner showed willingness to lease out) | | |
| *Disposal phase of By-products from Bio-mining process* | | | | |
| 1 | Impacts due to diesel emission due to long travel of by products loaded truck | The effort to identify the disposal site within Kerala state Only to travel outside state when no options are available within state<br><br>Idiling of vehicles to be minised to maximum<br><br>Regulary maintained trucks to be used for long distance travel with vaild PUC certificate | Contractor | ULB |
| 2 | Unauthorised usuage of by products<br><br>Ilelgal Dumping of by products | GPS system to be installed in trucks for there tracking<br><br>Waste Consignemnt notes system to be implemented and driver to get sign and seal from disposal facility/company<br><br>Imposition of fine/blackilsting of contractor | Contractor | ULB |
| 3 | Recovered Soil degradation by excessive compaction | The compaction process should be monitored to avoid excessive soil compaction | Contractor | ULB |

## 6.2 Scope of Environmental Monitoring Plan

The critical environmental and social attributes which are indicative of environmental and social performance of the project should be periodically monitored and analyzed during the biomining phase and post bio mining phase of the project. Environmental Monitoring Plan for each of the environmental components specifies the technical aspects of monitoring like locations of monitoring: frequency of monitoring and duration, parameters to be monitored and their budget The environmental monitoring plan is presented in **Table 6.2** and Social Monitoring Plan is illustrated in Chapter 7.

*Table 6.2: Environmental Monitoring Programme*

| Monitoring media/parameters | Items and parameters | Frequency | Location | Budget |
|---|---|---|---|---|
| Leachate | pH<br>Biological Oxygen Demand- BOD<br>Chemical Oxygen Demand-COD<br>Nitrogen (Ammonia, Nitrate, Nitrite)<br>Oxidation-Reduction Potential- ORP<br>Electrical Conductivity-EC<br>Total Organic Carbon (TOC) Dioxins | Middle of the project and end of the project | @ One leachate generation point ,if leachate generation is observed | [redacted] |
| Noise Monitoring | Day time and Night time Leq Monioting | Once during bio mining phase | Entrance of dumpsite | [redacted] |
| Gas Accumulation at Disposal Site | Oxygen (O2)<br>Nitrogen (N2)<br>Methane (CH2)<br>Carbon anhydride (CO2)<br>Hydrogen sulphide (H2S)<br>Temperature | Gas monitoring should be conducted at leastwice a day for about 7 consecutive days' during the bio mining phase and then after end of the bio mining phase one time sampling to be done | Windwards side and at center of mining area (2 points ) | [redacted] |
| Ambient Air | PM10, PM2.5, NOx, CH4, CO, Ammonia, dust and Odour | Once during bio mining phase | Downward side 1 near by residential areas/sensitive receptors<br><br>Ugward side 1 near by Vijaya College of Nursing | [redacted] |
| Groundwater quality | pH,Color ,Turbidity,Electrical Conductivity,Total Dissolved Solids,Total Suspended Solids,Total Hardness as CaCO3,Total Alkalinity as CaCO3,Chloride as Cl-,Sulphate as SO4, Nitrate as NO3,Fluoride as | | Middle of the project and during the end of the project period.<br><br>Downstream side 2 wells.(Same wells used in prior project monitoring can be utilized /retained) | [redacted] |

| | | | | |
|---|---|---|---|---|
| | F,Nickel as Ni,Cadmium as Cd,Lead as Pb,,Copper as Cu,Manganese as Mn,Mercury as Hg,Zinc as Zn,Iron as Fe,<br><br>Parameters will be defined and sampling, preservation, and analysis of water will be carried out following those stipulated in the subsections below and Standards Methods for Testing Water and wastewater, 21st edition, published by American Public Health Association | | | |
| **Total** | | | | [redacted] |

*Source: TSC Package A

## 6.3 Disaster Management and Emergency Preparedness

National Disaster Management Act, 2005 (DM Act, 2005) is the basic legislation in the purview of Disaster Management (DM). DM Act defines disaster as "a catastrophe, mishap, calamity or grave occurrence in an area, arising from natural or manmade causes, by incidence or negligence which results in substantial loss of life or human suffering or damage to and destruction of property or damage to, or degradation of environment of such a nature or magnitude as to be beyond the coping capacity of the affected area". They can be natural, manmade or hybrid based on the cause of their occurrence.

DM Act defines disaster management as a "continuous and integrated process of planning, organizing, coordinating and implementing measure which are necessary or expedient". It can be divided into the following steps:

- Prevention: Preventing threat of any disaster which is possible to a great extent in the case of a manmade disaster.
- Preparedness: Contingency planning, stockpiling of equipments and supplies, arrangements for inter-agency coordination, preparation of evacuation plans and public awareness, capacity building and associated training and mock drills.
- Response: Prompt response to any threatening disaster situation or disaster including evacuation, rescue and immediate relief.
- Recovery & Mitigation: Assessing the severity or magnitude of effects of any disaster. Rehabilitation and Reconstruction and implementing measures for reduction of severity or consequences of a disaster

So, in case of disaster management, the phase wise activities required could be summarized as in **Figure 6.2**.

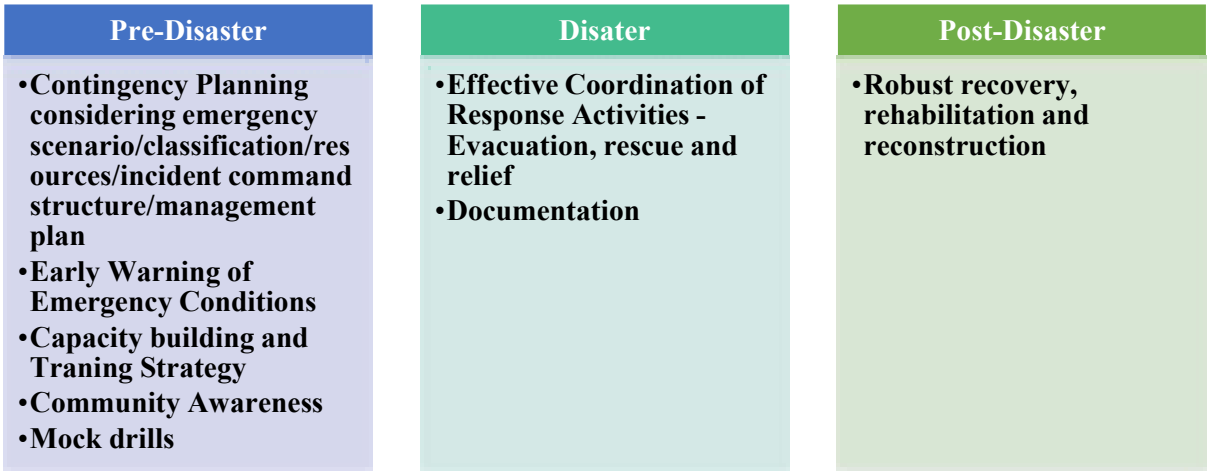



***Figure 6.1 Various Phase of Disasters and Activities Involved – On a Broader Profile***

Towards identification of the probable disasters associated with the project, a hazard risk, vulnerability and capacity analysis were carried out as presented below.

### 6.3.1 Hazard, Risk, Vulnerability and Capacity Analysis (HRVCA)

The project components include the mining of legacy waste, windrow formation and seperation of waste and inerts and soils Hazards due to the project may be natural or manmade which may turn out in to a disaster during bio mining phase. Towards deriving the disaster management plan, the probable hazards along the project area and activities were identified followed by risk assessment.

A hazard is defined as an agent, which has the potential to cause harm or damage to a vulnerable target i.e. people, property or environment. Historical analysis has been carried out based on the literature review to understand the hazards associated with bio mining operation. The accident data were analyzed to delineate the major hazard as well as the causes of hazard and further the same was analyzed w. r. to their applicability for cruise operation in cruise route.

The hazards could be categorized as natural and manmade. Natural hazard include flood, tsunami, earth quake etc., and manmade hazards include chemical disasters, road accidents etc. An extensive literature review was carried out for the various causes and contributing factors of bio mining accidents worldwide and probability of the same w.r.to the project region was assessed with specific reference to the local factors which may have an additional influence on the risk profile.

*Table 6.3 Probable Disasters due to Natural Hazards*

| Sl.No | Risk Factors | Disaster |
|---|---|---|
| 1 | Bad Weather Condition /Natural Hazard | |
| 2 | Storm | Destruction of Temporary site facilities<br>Falling of stack piled materials /wastes<br>Vehicle/Equipment tip overs due to soil erosion |
| | Flood | |
| | Earth Quake | |
| | Cyclone | |
| | Tsunami | |

*Source: TSC Package A*

Risk factors w r.to vessel operation include channel related risk as well as vessel related risk and leading to the probable disasters are as presented in **Table 6.4**

*Table 6.4 Probable Disasters due to Bio mining Activities*

| Sl.No | Risk Factors | Probable Disaster | Control Measures |
|---|---|---|---|
| 1. | Excavations: | $H_2S$ gas Emission,Other Obnoxious gases emission, Subsidence of surround earth banks during bio mining | Risk can be mitigated by the following<br>▪ Mining shall be done in such a way that the extraction activity do not make much impact on surrounding area.<br>▪ No water accumulation<br>▪ Only positive-pressure self-contained breathing apparatus (SCBA) or positive-pressure air-line units with an emergency egress bottle shall be used in any known or suspected $H_2S$ environment of 10 ppm or greater in the breathing zone |

| Sl.No | Risk Factors | Probable Disaster | Control Measures |
|---|---|---|---|
| | | | • Emergency Plan |
| 2. | Electrical Hazard | • Electric wires if any damaged<br>• Poorly insulated<br>• During temporary repairs<br>• Circuits overloaded may lead to major accident | Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit.<br><br>Circuit breakers to be provided as per requirement. |
| 3. | Fire Hazard | Fire risks may occur due to the following<br>• Storage of flammable liquids / Gas LPG, Diesel<br>• Any combustible materials<br>• Sparks<br>• Open flames<br>• Chance of fire hazard from the exhust of vehicle | • Fire protection arrangements shall be provided at site as per the conditions stipulated in clearance from the Fire and Rescue Dept.<br>• Proper Class of Fire extinguisher to be made available to follow IS Standard IS 2190:1992<br>• Fire hydrant Network with reserve water (As per NFPACode) should be made available.<br>• Emergency Plan in case of fire<br>• Spark arresters to be used in vehicles |
| 4. | Working at height | *Ladders*<br>Risk may occur due to the following<br>• Not secured against dislodgement<br>• Defective ladders<br>• Not sufficient length<br>• Incorrectly placed | Ladder risk can be mitigated by the following<br>• Secured against movement or footed<br>• Ladders in good condition<br>• Regular inspection<br>• Ladder should be extended one (1m) meter above platform to avoid injuries |
| 5. | Falls and Slips at the dumpsite | Slippery surfaces or uneven surfaces and poor access to work areas climbing on and off plant | • Housekeeping Practice and importance of it to be conveyed to workers<br>• Proper PPE to be provided to workers . |
| 6. | Oil Spill | Oil Spills can happen during Genrator maintance and recharge of fuel<br>Breakdown of equipment/Vehicles . | • To provide Spill kit at site<br>• Contamined soil to be recovered and disposed as hazardous waste |

*Source: TSC Package A

### 6.3.2 Disaster Management Measures

Management Measures to be adopted for the reducing the impact of the expected disasters are discussed in the following section.

#### *6.3.2.1 Constitution of Onsite Disaster/ Emergency Management Cell (EMC)*

An Emergency Management Cell (EMC) will be constituted before the operation phase towards the better coordination and implementation of disaster management measures. The EMC proposed is as presented in **Figure 6.3.**

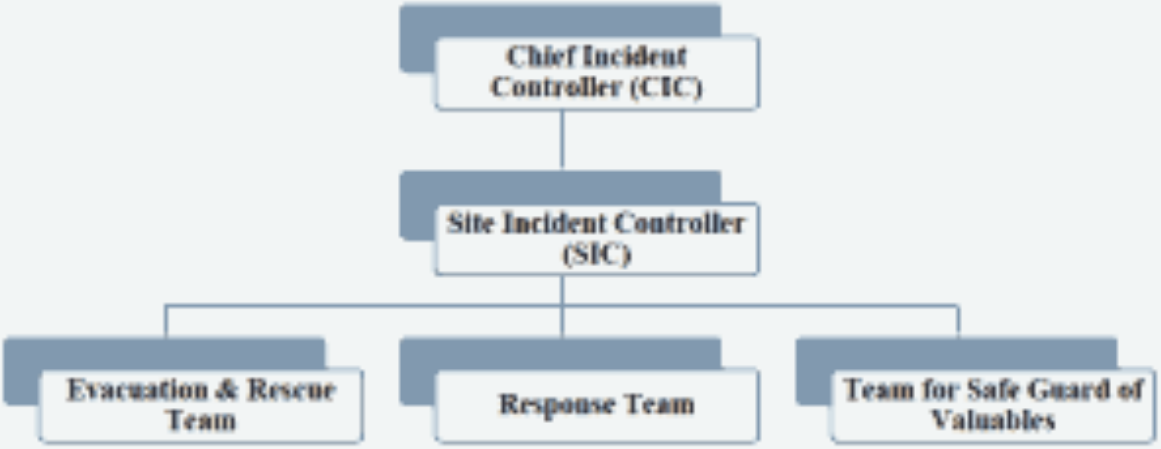



*Figure 6.2 The Emergency Management Cell proposed for the Ugrankunnu Dumpsite*

The EMC shall meet monthly to review the working of contingency plan, problem faced in recent disaster and amendment modification to be adopted in future. The Committee will be responsible for overall managing the disaster situation, take administrative decisions as and when required, review the disaster plan and to inform the Government on the situation. ULB shall coordinate with KSDMA and formulate the EMC cell. (To be included in bid document)

An Emergency Response Centre (ERC) should be maintained and put in action within the facility which would co-ordinate with various state departments to ensure planning, response and recovery. The responsibility allocation of each member EMC during a disaster management is presented in **Table 6.5.**

*Table 6.5 Responsibility Allocation of each Member in EMC*

| Sl. No. | Designation | Responsibilities |
|---|---|---|
| 1 | Chief Incident Controller (CIC) | Overall, In charge of the Incident.<br>Coordination with Management/ mother Department District Disaster Management Authorities, external agencies, media etc.,<br>Appraise the incident and give proper directions to the SIC and his team from time to time.<br>Declare emergency as well as issue 'ALL Clear' order after emergency. |
| 2 | Site Incident Controller (SIC) | Analyse the onsite emergency response requirement and request for the same to CIC from time to time.<br>Deploy the team members and supervise their operations.<br>Support CIC for coordination internal and external communication and administration. |
| 3 | Response Team headed | Initiate response with equipment and facilities available at site.<br>Report regarding the adequacy of existing equipment and provide the requirement for additional facilities.<br>Identifying safe route for firefighting, ambulance, medical team etc., |
| 4 | Evacuation & Rescue Team headed | Alert the occupants about the emergency<br>Blow siren |

| Sl. No. | Designation | Responsibilities |
|---|---|---|
| | | Show evacuation paths. Assembly points and site self-protection measures.<br>Arrange for rescue and first aid with the help local and occupant volunteers.<br>Arrange for sending causalities to hospitals. |
| 5 | Team for Safe Guard of Valuables headed | Take appropriate actions for the safe guard of valuables and assets such as important documents, cash chests etc.,<br>Take head count (Live/Injury/ Death) after emergency. |

*Source: TSC Package A

#### *6.3.2.2 Fire Alarms/Other Measures*

Sufficient fire and smoke alarms at common areas shall be provided, so that visitors and all the staff will be are informed in the event of the disaster for initiating appropriate measures for rescue.

#### *6.3.2.3 DO's and Don'ts Pamphlets*

Dos and Don'ts pamphlets for the visitors towards each disaster will be prepared and displayed in prominent places.

### 6.4 Environmental Budget

The details of Environmental Budget for Implementation and Supervision of Environmental Management Measures suggested is given below

***Table 6.6 Anticipated budget for Environment Management***

| S. No. | Description | Frequency | Unit Price | Qty | Amount in Rs |
|---|---|---|---|---|---|
| 1 | Deodorizer equipment (power sprayer) | Only Once | [redacted] | [redacted] | [redacted] |
| 2 | Green Net for covering site premises | Based on requirement | [redacted] | [redacted] | [redacted] |
| 3 | Spill Kit | Only Once | [redacted] | [redacted] | [redacted] |
| 4 | Training on capacity building | Entire Process | [redacted] | [redacted] | [redacted] |
| 5 | Temporary leachate collection tank -500L | Only Once | [redacted] | [redacted] | [redacted] |
| 6 | Personal protective equipment | Only Once | [redacted] | [redacted] | [redacted] |
| **TOTAL** | | | | | [redacted] |

*Source: *TSC Package A*

*Note: This can be captured in allocated ESIA Budget , ULB/TSC shall be monitoring and reporting during the implementation phase*

# 7

# INSTITUTIONAL ARRANGMENTS

## 7.1 Proposed Institutional Arrangement

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of ToR for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation. The Support Organisation will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments.

Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level. The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances. The PIU will submit the compliance reports on clearances, permits, and environmental and social safeguards to D-ESDU.

## 7.2 Capacity Building

The major objective of capacity building under Solid Waste Management Programs is to develop a basic understanding about the waste management in various process such as the waste generation, segregation, primary collection, secondary collection, transportation, processing and disposal. It focuses on institutional development, community participation and strengthening of managerial system. The capacity building program shall ensure to improve the capacity of service providers in the Waste management System and to generate sense of responsibility among the waste generators. Capacity building shall focus on sensitization and orientation of various stakeholders of SWM project with adequate information on various project components.

- Training to contractors and labourers on labour laws, Gender Based Violence (GBV), Health and Sanitization etc.
- Training program for Haritha Karma Sena (HKS) on health and hygiene, Waste segregation, source level treatment, primary transportation, baling and shredding, fire and safety etc.
- Awareness programme on the proposed "Dumpsite Remediation" project for ULB councillors and officials.
- Awareness program for school and college students on Solid Waste Management.
- Massive awareness campaign on 5Rs (Reuse, Recycle, Repurpose, Reduce and Refuse).

A schedule for capacity building of stakeholders is incorporated in the Social Impact Assessment and Social Management Plan of dump site remediation. The components included in capacity building are livelihood, labour, gender and social parametres. Multifaced intervention for officials, service providers, waste generators and local public are emphasised. Local specific issues on the said components will be mitigated through the capacity building program envisaged.

## 7.3 Grievence Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizen can lodge complaint either directly to ULBs, toll free number or through digital platforms (website/email – grmkswmp@gmail.com / Toll free number-18004250238). The complaint will automatically be recorded in login of ward level official of ULB and an escalation system is constituted according to the category of each complaint to close the complaint in time. The complainer can close the complaint through a feedback form according to their satisfaction.

# 8

# PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

## 8.1 Approach to Public Consultation

As a part of the project preparation and to ensure that the community support is obtained and the project supports the felt needs of the people; public consultations were carried out as an integral component. A continuous involvement of the stakeholders and the affected community was obtained. The feedback in the consultation sessions has led to substantial inputs for the project preparation including, influencing designs. Consultations involve soliciting people's views on proposed actions and engaging them in a dialogue. It is a two-way information flow, from project authorities to people and, from people to project authorities. While decision making authority would be retained by the project authority, interaction with people and eliciting feedback allows affected populations to influence the decision-making process by raising issues that should be considered in designing, mitigation, monitoring and management plans and the analysis of alternatives.

Well planned public consultation meeting can lead to reduced financial risks of time and cost over- run, legal disputes, and negative publicity, direct cost savings, increased market share through good public image, and enhanced social benefits to the affected local communities. Public Consultation Meeting (PCM) provides an opportunity for the general public, private and community bodies to know the environmental and social impacts as a result of project implementation.

Major purpose of the public consultation of environmental and social issues in the ESIA study is to appraise the stakeholders on potential environmental impacts and collect their feedback so that adequate safeguards can be considered during the planning phases. The objectives of consultation sessions, the procedure adopted and the outputs of the consultation conducted have been described in the following sections.

## 8.2 Objectives

The main objective of the consultation process is to minimize negative impacts of the project and to maximize the benefits from the project to the local populace. The objectives of public consultation as part of this project are:

- To obtain the information on baseline scenario
- Promote public awareness and improve understanding of the potential impacts of proposed projects;
- Identify alternative designs, and mitigation measures;
- Solicit the views of affected communities / individuals on environmental and social problems;
- Improve environmental and social soundness;
- Identify contentious local issues which might jeopardize the implementation of the project.
- Establish transparent procedures for carrying out proposed works;

- Inform the affected populace about the entitlement framework and to settle problems with mutual consent; and
- Create accountability and sense of local ownership during project implementation

## 8.3 Type of Stakeholders

For the subject project, following major groups of stakeholders were identified for consultations at screening stage:

- **Primary Stakeholders** are local people including nearby residents, HKS members, College bus Drivers, Rubber Plantation owners surrounding the dumpsite, Schools, Colleges, Hospitals and Bus Stops, etc.; and
- **Institutional Stakeholders** such as concerned Govt. departments etc.

The stakeholder consultation adopted was rapid appraisal methodology which included face-to face interviews and in-depth interviews institutional stakeholders.

Consultations were done using various tools including, interviews with government officials, dialogues were set-up with the community through structured questionnaire and general environment & social aspects related questions. The public consultation carried out at the various stages of the study has been summarized in this section.



***Figure 8.1 Stakeholder Consultation***

*Source: TSC Package A

# ANNEXURES

*Annexure I-Environmental Screening Checklist*

*Annexure II- OHS RISK ASSESMENT*

*Annexure III-Fire Risk Assesment*

ANNEXURE I

Section II: Environmental Screening Form

INITIAL ENVIRONMENTAL EXAMINATION

Environmental Screening during the Initial Environmental Assessment Stage has been provided below:

Sub-project Details

| | |
|---|---|
| **Name of Sub-project:** | Dumpsite remediation |
| **Sub-project Components:** | Biomining of dumpsite |
| **Sub-project Location (City/Town/Village with ward numbers):** | Ugrankunnu,Kottarakkara,Ward No:26 |

**Stage1: Exclusion List**

| ***Sl. No:*** | ***Non-permissible Activities*** | ***Applicability*** |
|---|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i)any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to sitting criteria as per SWM Rules2016, or (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards sitting criteria for specific industry (various types of treatment plants)types(where mitigation measures are not possible). | Not Applicable |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas | Not Applicable |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides | Not Applicable |

## Stage 2: Environmental Screening Checklist

| Project Details | | |
|---|---|---|
| **Sl.No** | **Components** | **Details** |
| 1 | Project components | Remediation of dumpsite waste in Ugrankkunu |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste management, centralized non-biodegradable waste management facilities, centralized biodegradable waste management facilities, sanitary landfills, biomining of dumpsites, including for Linked activities/associated facilities) | Biomining of dumpsite<br><br>The project duration is 5 months. It is expected that Mobilisation, machinery installation period is concurrent and is required to set up a 100 to 120 TPD production output sieving and sorting plant and machinery infrastructure. Mobilisation period of one month and operational period of 4 months at site and transportation of material is concurrent. The design considers 3 months of sieving operations/Baling with completion of mobilisation and setting up of plant within 30 days of commencement of Contract. Based on this, an average of 100 to 120 tonnes per day of excavation is to be carried out. |
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project; including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination)<br>Site Survey No:/s (attach map) with ownership details, Geographical co-ordinates of the site location [including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | Lat: 9° 0'5.18"N<br>Long: 76°45'33.09"E<br><br>Survey No:49/1,2,4,10<br><br>Historical Landuse: Originally a burial ground Dumping of solid waste at Ugrankunnu started in 1994 and continued till 2018, was stopped due to public protest<br><br>Land Ownership:ULB<br><br>Site Plan and Site map is attached in main ESIA report<br><br>Predominant Landuse:Dry agrcultural area<br><br>The area belongs to Sesimic zone III |
| 4 | Land Area proposed to be used: Location wise (in sq.km/sq. m) | 4500 sq m(Including Dumpsite and proposed lease land) |
| 5 | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | No construction.<br>During bio mining stage .GW can be utilised for domestic purposes, as there is one bore well present in the MCF/RRF area. Additionaly KWA connection can be taken for any other uses |

| | | |
|---|---|---|
| | | Water Requirement:250 LPD |
| 6 | Power Required and Source of Power | Source of power : KSEB<br>DG will be used incase of any power interruption of KSEB supply |

| **Machineries** | **Required Electrical Load (KW)** | **Working Hr.** | **Total Units (KW-Hr)** |
|---|---|---|---|
| Bailing Machine | 5 | 4 | 20 |
| Ballistic Separator | 15 | 6 | 90 |
| Magnetic Separator | 5 | 6 | 30 |
| Total | **25** | | **140** |

***Baseline Environmental Conditions***

| ***Sl. No*** | ***Environmental Aspects*** | ***Yes*** | ***No*** | ***Details*** |
|---|---|---|---|---|
| 1 | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers) | | No | |
| *(i)* | Critically Vulnerable Coastal Areas (CVCAs), Eco-sensitive Areas (ESAs) | | No | Not applicable |
| *(ii)* | Cultural Heritage site, Protected monuments-listed by ASI/State | | No | Not applicable |
| *(iii)* | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensitive area, with any schedule 1 species?<br>If Yes, which is the area? | | No | Not applicable |
| *(iv)* | Other Wetlands/Mangrove/Estuarine Region | | No | Not applicable |
| *(v)* | Natural Habitat areas, roosting / nesting areas, Spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves | | No | Not applicable |
| *(vi)* | Other Sensitive Environmental Components listed in EMF | | No | Not applicable |
| *(vii)* | Drinking water source, upstream and downstream uses of rivers, etc. | | No | Not applicable.<br>One unused quarry, with a pond exists around 165m aerial distance from site. But the water is not used for any purpose by nearby residents. One pond exists at a distance of 370 m aerial distance from North West Boundary of the MCF/RRF compound |
| *(viii)* | Low-lying areas/areas of Tidal Influence (provide CRZ details) | | No | Not applicable |

| | | | | |
|---|---|---|---|---|
| *(ix)* | Sensitive Receptors a) Habitations/ Households/ Hostels, other special areas, etc.<br>b) School<br>c) Religious Places<br>d) Tourist Areas | Yes | | Religious places: Ugrankunnu Devi temple located at Southern Side with a distance of 130m<br><br>College:Vijaya college of Nursing .located at Northern side with a distance of 435m<br><br>Habitations:Nearest house located at a distance of 90m from the entrance of dumpsite area in Eastern direction. |
| *2* | Is the site in Critical/Over Exploited Ground Water Block. Provide the level of the ground water table | | No | Not applicable |
| *3* | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other(specify) | | No | Not applicable |
| *4* | Describe the type of soil and vegetation onsite | | | Laterite soil,Fodder land with weeds and shrubs |
| *5* | Is the site present in the flood plains as recorded in the last 100 years? Provide the HFL level of the site/region | | No | Not applicable |
| *6* | Existing pollution/contamination or degradation onsite | Yes | | Unscientifically soil capped Dumpsite exists with legacy waste |
| *7* | Any other remark on baseline condition | | No | |

### *Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology and Soils*

| *Sl.No* | *Impacts on Land/Soil Environment* | *Yes* | *No* | *Remarks* |
|---|---|---|---|---|
| *8* | Total extend of land to be covered/built | | | NA |
| *9* | Total extend of land where the waste will be dumped openly/or expected to get contaminated<br>By waste or leachate/material storage | | | NA |
| *10* | Extend of Land to be remediated | Yes | | 1524 Sq. m |
| *11* | Extend of land expected to be under green belt | No | | Project does not have scope to provide green belt as the time frame is very limited |
| *12* | **Will the proposed project cause the following on Land/Soil**: | | | |
| *(i)* | Impact on Surrounding Environmental Conditions<br>Including Occupation on Low-lying lands/floodplains | | No | The project area is not in flood plain/or lowlying area |
| *(ii)* | Substantial removal of Top soil (mention area in sq m) | Yes | | |
| *(iii)* | Any degradation of land/eco-systems expected due to the project? | | No | There will not be any significant changes expected due to biomining |
| *(iv)* | Loss or impact on Cultural/heritage areas/properties | | No | There are no heritage centers nearby |
| *(v)* | Does the project activity involve cutting and filling/ blasting etc? | | No | |
| *(vi)* | Will the project cause physical changes in the project area(e.g., changes to the topography) due to excavation, earth work, or any other activity? | Yes | | Positive change occurs as the waste dump will be removed |
| *(vii)* | Will the project involve any quarrying/mining etc? | Yes | | There will be mining of legacy waste within the existing dump |
| *(viii)* | Will the project/ any of its component contaminate or pollute the Land? | Yes | | There are chances of leachate generation .If not treated there are chances of contamination |
| *(ix)* | Will the project contribute to any long term significant adverse(negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | No | Post Project, the land and environment aspects of the area will improve |
| *(x)* | Will the Project or related activities cause negative impacts on the land in combination with other anticipated/ existing projects in the region? | | No | |

| *Sl. No* | *Impacts on Air and Noise Environment* | *Yes* | *No* | *Remarks* |
|---|---|---|---|---|
| *13* | Will the project cause or increase air pollution due to dust and/or vehicle emissions? | Yes | | During Bio mining there will be increased truck traffic, which may cause air pollution due to truck/machinery emission |
| *14* | Will the project cause or increase pollution due to GHG emissions? | Yes | | Bio mining process release methane gas |
| *15* | Will the project cause or increase odor nuisance? | Yes | | But if bio mining is done in a systematic way odor problem can be reduced |
| *16* | Is there a potential for release of toxic gases or accident risks (eg: potential fire out breaks) | Yes | | Fire fighting measures will be adopted |
| *17* | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | Yes | | Heavy machinery operation and truck movement |

| *Sl.No* | *Impacts on Water Environment* | *Yes* | *No* | *Details* |
|---|---|---|---|---|
| *18* | Will the activities have proposed at the site(s) impact water quality (surface or ground) leachate, runoff, wastes deposition, erosion? | Yes | | Leachate if not treated can create impact on GW |
| *19* | Will the activities proposed at the site(s) impact water resource availability and use-leachate, runoff, wastes deposition, erosion? | Yes | | If bio mining is carried out in Summer season then the chances of run off and leachate is less |
| *20* | Chances of Pollution of Water bodies/ ground water wells, nearby or downstream | Yes | | |
| *21* | Will the activities proposed at the site(s) hinder natural drainage | | No | |
| *22* | Will the activities proposed at the site(s) decrease permeability/rain water percolation | | No | |

| *Sl. No* | *Impacts on Biodiversity and Host Communities* | *Yes* | *No* | *Remarks* |
|---|---|---|---|---|
| 23 | Will the project necessitates cutting of Trees /Loss of Vegetation | Yes | | The plants grown on top of dump site will be removed .The same can be compensated through green belt development after the land has been transfered back to ULB for future projects Also there is proposal to take land area of 1500-2000$m^2$ for bio mining then there is chances of trees cutting .It will be very minimum |

| *Sl.No* | *Impacts on Biodiversity and Host Communities* | *Yes* | *No* | *Remarks* |
|---|---|---|---|---|
| 24 | Will the project necessitate substantial removal of Top soil (mention area in sq.m) | Yes | | |
| 25 | Any degradation of land/eco-systems expected due to the project? | | No | |
| 26 | Will the project result in Health & Safety Risks in the neighborhood including the release of toxic gases, leachate, accident risks | Yes | | Management measures are suggested in EMP |
| 28 | Potential Noise, Light Pollution/ movements causing disturbance to nearby habitats/communities | Yes | | Management measures are suggested in EMP |

| | | | | |
|---|---|---|---|---|
| 29 | Potential disruption to common property, accessibility, traffic disruptions, conflicts, or disruption to the local community within the sub-project area? | Yes | | Trafiic map and Control Measures are provided in ESIA report |

### *Project Categorisation and Need for Safeguards Instruments, Oversight*

| *Project Category* | **E2** |
|---|---|
| **Key Reasons** | Bio minning process can create moderate impacts impact to the base line environment, land/ soil / water /noise environment, biodiversity or to the community.<br><br>Site is not close to any Environmental Sensitive Receptor<br><br>Site specific EMP will be formulated for tackling the impacts<br><br>No heavy metal contamination observed from the labortary analysis of waste samples<br><br>EC/CRZ clearance are not applicable<br><br>Land will be remediated and ULB my use the land for other waste management projects in future |
| **Safeguards Instruments Required** | a) E1: Project-specific EIA (impact assessment considering the project details & location) by Independent Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>b) E2: Project-specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>c)E3: signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities |
| **Additional Responsibilities Expected**(such as i) Specialists to be hired for Physical/Cultural resources, Natural Habitats/others, etc for EIA preparation, and/or supervision),ii)Consultations, iii)<br>Any other aspect | . |

| *Status* | *Agency/Official* | *Name, Signature with Date and Seal* |
|---|---|---|
| **Prepared by** | PIU or ULB (project in-charge) | |
| | Environmental Engineer | |
| **Checked, Categorized as E2 & ToR issued by** | DESDU/SESDU | |
| | Environmental Specialist | |

## Annexure -II-OHS RISK ASSESMENT

### Introduction:

Open dumpsites and landfills have been created throughout the world, with serious impacts on the environment and public health. In such a context, occupational health and safety (OHS) issues related to workers that have to deal with landfill characterization or management have not been considered sufficiently.

### Scope:

The major scope is of identifying the risks of biomining process and what are the factors contributing to these risks and how these risks can be avoided. The risk is assessed based on the proposed activities during the bio mining phase

### OHS Risk Assessment

In dumpsite remediation and management activities, major risks for workers can derive from the fluxes of contaminants released by dumps, in such an environment, gases, leachate, and dust can be found. The presence of gases can lead operators to states of illness and even generate explosive climates. Moreover, toxic gases could be generated by waste burning, which is not unusual in landfills.

Another aspect that should be taken into account is represented by the effects of both the anaerobic degradation of organic material and the infiltration of rain. The resulting leachate can have negative consequences for the workers both in case of direct exposure (e.g., contact with skin or ingestion) as well as in case of indirect exposure, such as the inhalation of gases and vapours.

Solid waste can also cause injuries due to the presence of sharp objects, while its surface can cause falls and could even collapse due to its poor geotechnical stability Surface deformations are caused by the low level of cohesion of solid waste and its friction angles. Accordingly, risks for workers, such as falling from height and cuts, should be considered together with falling objects/materials and entrapment due to the presence of sinking areas.

Finally, it is worth noting that additional risks derive from the presence of bacteria and animals (e.g., rats and snakes) that can lead to both diseases and injuries Besides these specific risks, it must be noted that other hazardous situations can be found in construction sites, for example, those related to the use of machinery, hazardous substances (which are needed for field tests), and the presence of falling materials and electricity As previously remarked, only a few studies deal with OHS risks in these activities, underestimating the fact that landfill personnel work in direct proximity to numerous sources of danger

In below table, the risk exposure per main activity carried out in dumpsite remediation is illustrated

**Table A1: Risk exposure based on activities**,

| Acitvity | Hazards | OHS risks |
|---|---|---|
| Topographic measures | solid waste, cutting objects, toxic gases, electricity, bacteria, and pathogens | biologic risk, fire risk, chemical risk, electric shock |
| Sampling | solid waste, cutting objects, toxic gases, geotechnical instability, leachate, flammable waste, | biologic risk, chemical risk, slipping and tripping, fire risk, risk of falling from height, risk of |

| | | |
|---|---|---|
| | machinery, bacteria, and pathogens | falling materials, risks related to machinery |
| Preliminary site visits | solid waste, cutting objects, toxic gases, leachate, bacteria, and pathogens, geotechnical instability | risk of falling materials, slipping and tripping, fire risk, biological risk, chemical risk |
| Working area set up | solid waste, cutting objects, machinery, contemporary presence of different contractors | risk of falling materials, slipping and tripping, machinery-related risks, interferential risks |
| Remediation activities | solid waste, cutting objects, toxic gases, leachate, bacteria and pathogens, machinery, geotechnical instability | risk of falling materials, biological risk, chemical risk, slipping and tripping, fire risk, machinery-related risks |
| Logistics/transportation | machinery, vehicles, contemporary presence of several workers | machinery-related risks, transportation-related risks |

**Risk Mitigation measures**

The risk assessment has illustrated the various risks that may come due to the various activities during the bio mining phase, Following levels of control measures can be adopted in order to minimize the impacts of these risks,

*Electrical safety*

• Adequately rated and quick response circuit breakers, aided by reliable and selective digital or microprocessor based electromagnetic protective relays would be incorporated in the electrical system design for the proposed activities.

• The metering and instruments would be of proper accuracy class and scale dimensions

*Fire Fighting Facilities*

- All the fire extinguisher system will be controlled by the Safety Department(officer).
- Safety officer with (OHS risk management experience) and one supporting staff.
- Portable fire extinguishers
- Fire Hydrant system (optional)
- Sprinkler system employed near fire prone areas (optional)
- Fire Buckets

*Personal Protective Equipment (PPE)*

Personal Protective equipment kept onsite is made readily available to plant personnel. Below Table shows the lists of recommended Personal Protective equipment (PPE) onsite.

**Table A2: Summary of recommended PPE according to Hazard**

| Part of body exposed Workplace Hazards Suggested PPE | Part of body exposed Workplace Hazards Suggested PPE | Part of body exposed Workplace Hazards Suggested PPE |
|---|---|---|
| Eye and face protection | Flying particles, molten metal, gases or vapors, light radiation | Safety glasses with side-shields, protective shades, etc. |
| Head protection | Falling objects, inadequate height clearance, and overhead power cords Plastic helmets for top and side impact protection | Plastic helmets for top and side impact protection |
| Hearing protection | Noise | Hearing protectors (ear plugs or ear muffs) |
| Foot protection | Failing or rolling objects, points objects. Corrosive or hot liquids | Safety shoes and boots for protection against moving and failing objects, liquids and chemicals |
| Hand protection | Hazardous materials, cuts or lacerations, vibrations, extreme temperatures | Gloves made of rubber or synthetic material (Neoprene), leather, steel, insulation materials, etc. |
| Respiratory protection | Dust, fogs, fumes, mists, gases, smokes, vapors | ➢ Facemasks with appropriate filters for dust removal and air purification (chemical, mists, vapors and gases).<br>➢ Single or multi-gas personal monitors, if available |
| | Oxygen deficiency | Portable or supplied air (fixed lines). Onsite rescue equipment |
| Body / leg protection | Extreme temperatures, hazardous materials, biological agents, cutting and laceration | Insulating clothing, body suits, aprons etc. of appropriate materials |

*Administrative Controls:*

Developing standard operating procedures (SOPs) for Biomining operations. - Implementing a comprehensive training program for all personnel involved in the project. - Scheduling regular breaks and rotation of tasks to minimize fatigue.

*Environmental Monitoring: -*

Regular monitoring of air and water quality to ensure compliance with safety standards. - Establishing emergency response protocols in case of any unexpected environmental events. Further Disaster management details are provided in ESIA report in Chapter no.6.

**Conclusion**

Waste landfills/Dumspite represent a significant concern worldwide due to the extensive environmental pollution and the related risks to human health and environment. Occupational risks to which the personnel working in these sites is exposed to are scarcely addressed. Occupational Health and Safety Risk Assessment aims to ensure the safe and successful execution of the dumpsite remediation Project

through Biomining. Continuous monitoring and improvement will be essential throughout the project tomaintain a safe work environment

## Annexure III: Fire Risk Assessment

**Introduction:**

Fire Risk assessment are collection of fire prevention measures that identified links and equipment which could cause a fire within a certain area. The assessment aims to identify potential fire hazards, assess the level of risk they pose, and recommend measures to mitigate or manage those risks effectively.

**Fire Risk Assessment**:

The major fire risk causing factors in dumpsite are,

- Fresh solid dumping (Not applicable to Ugrankunnu as the dumpsite is closed)
- Fire incidents have been reported at locations where fresh waste is being dumped
- Inaccessible slopes of garbage were observed (At present covered with vegetation)
- No standard operating plan in place for prevention and management of dumpsite fires
- Cause of fire incident reported is excess release of Methane ($CH_4$) gas due to anaerobic decomposition of the bio-degradable organic waste, high temperature and dry atmospheric conditions.
- Patrolling the site not observed.
- No fire tender (Emergency vehicle) observed at site.
- No Anti-Smog Gun at dumpsite

*Source:CPCB*

**Tentative Mitigation Measures**

**Disposal of Waste:** Fresh waste not to be disposed at the dumpsite where bio-remediation is being undertaken. Organic waste from slaughter house, fish market etc., industrial waste not to be disposed at the dumpsite. It is to be further ensured that industrial waste / E-waste / lithium battery is not dumped at the site. Waste that is being unloaded at the site should be examined visually for potential fire sources fire sources when located, should be neutralized with cover material immediately. Emergency tipping area to be provided to set aside from the immediate working area where incoming loads of material known to be on fire or suspected of being so can be deposited, inspected and dealt with.Adequate compacting of waste to be done to minimize formation of air or methane pockets which can lead to subsurface fire at site.

**Monitoring at dumpsites:** Methane Gas Detectors (on downwind side) to be installed at site so that area with high methane concentration can be identified and preventive actions be undertaken. Further temperature at windrows to be monitored with non-contact infrared thermometer (as used for monitoring human body temperature under COVID circumstances) and records be maintained for any major deviations. The temperature is to be in the range of 35°C to 59°C. Treated leachate / water to be sprayed on the waste when rise in temperature is observed at the bioremediation site. Provision of fencing & frequent patrolling to be done for checking unauthorized entry at dumpsite.

**Arrangements for Fire Extinguishing**: Arrangements for adequate storage of sand / chemical fire extinguishing medias such as foam or powder at site to be made to douse fire in case a fire incident is reported. Usage of water for dousing fire to be avoided. Isolation and allowing rapid natural burnout or smothering with soil to be done for dousing dumpsite fires. Dedicated fire tenders (preferably chemical extinguishing media) and adequate fire safety measures are to be deputed, specifically during summer

season when dumpsites fire is more likely to take place. All mobile equipment or vehicles should be fitted with fire extinguisher and spark arrester.

**Health &Safety of Workers**: Fire protection measures and safety equipment to be provided to all workers at the site and checked before entry to the dumpsite. Workers to be trained for detection of fire and necessary action to be taken in case of fire. Periodic training of workers be conducted in Safe handling of Waste, PPE's, Health & Safety issues etc.

**Mock Drills**

Periodic mock drills to be conducted to prevent fire accidents at dumpsites. Mock drills will make the workers and staff more familiar with fire incidents and hence easy remediation



Feasibility Report

*Volume I*

# Remediation of Solid Waste Dumpsite at Ugrankunnu, Kottarakkara Municipality, Kollam Dist., Kerala



Submitted to

**Kerala State Solid Waste Management Project**

KSWMP

Prepared By

**Technical Support Consultants (TSC)**

**Package A**

(Thiruvananthapuram, Kollam, Pathanamthitta)

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Centre for Environment and Development

ORION

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**Nov 2023**

KSWMP/A/2023/40

# Feasibility Report- Vol I

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# ABBREVIATIONS

| | |
|---|---|
| APHA | American Public Health Association |
| BDL | Below Detectable Level. |
| BGL | Below Ground Level |
| COD | Chemical Oxygen Demand |
| CPCB | Central Pollution Control Board |
| CPHEEO | Central Public Health and Environmental Engineering Organisation |
| FR | Feasibility Report |
| GoI | Government of India |
| GoK | Government of Kerala |
| IS | Indian Standard |
| KSDMA | Kerala State Disaster Management Authority |
| KSWMP | Kerala Solid Waste Management Project |
| LSGD | Local Self Government Department |
| MCF | Material Collection Facility |
| MDL | Minimum Detection Level |
| MoEF&CC | Ministry of Environment, Forests and Climate Change |
| MoHUA | Ministry of Housing and Urban Affairs |
| NABL | National Accreditation Board for Testing and Calibration Laboratories |
| NBDW | Nonbiodegradable waste |
| NGT | National Green Tribunal |
| NH | National Highway |
| NOC | Non Objection Certificate |
| NTU | Nephelometric Turbidity Unit |
| O&M | Operation and Maintenance |
| PCB | Pollution Control Board |
| PSARA | Private Security Agencies (Regulation) Act |
| RRF | Resource Recovery Facility |
| SWM | Solid Waste Management |
| TOC | Total Organic Carbon |
| TPD | Tonnes per day |
| TSC | Technical Support Consultant |
| ULB | Urban Local Body |

# Executive Summary

The dumpsite of Kottarakkara ULB is at Ugrankunnu (9°0'4.68"N 76°45'33.73"E) is about 3 km away from the Municipal Head Quarters. Dumping of solid waste at Ugrankunnu started in 1994 and continued till 2018 and was stopped due to public protest. At present, the municipality collects only dry waste from residences and institutions and store in MCF and the materials are recovered and sorted at RRF.

Originally a burial ground, the site had an area of 0.24 hectares (60 cents) and before converting it to a waste processing area, an additional land of 0.4046 hectares (1 acre) adjacent to it was acquired.

Almost 30 years old legacy waste of Ugrankunnu dumpsite was capped with 40 cm thick soil. This soil capping is not done scientifically, and the waste still remains. Current condition of the legacy waste in Ugrankunnu is a mixture of soil and vegetation.

The proposal is to remediate the dumpsite in compliance with the Municipal Solid Waste Management Rules 2016 and other National and State Guidelines for management of Solid Waste by sustainably removing the accumulated legacy waste and to use the site for other activities.

A study of the baseline environmental quality was done to assess the level of impact on the environment due to the dumping of unprocessed solid waste in open area.

Sampling and testing to assess the contamination levels of the source and to identify the major pathways and receptors of concern were done and are detailed in the subsequent sections. Results of physical and chemical analysis of legacy waste collected from the dumpsite using borehole technique are also detailed in this report.

Sampling and analysis of physical and chemical characteristics of legacy waste, soil, air, noise and water reveals that these environmental components are not much contaminated due to dumping of waste. It can be inferred that the waste dump with soil cover in between and red soil top covering helped the degradation of organic matter. The impermeable sub strata of laterite, rocky terrain may be another reason for not polluting the ground water and surrounding water bodies.

Total station survey was carried out to estimate the quantity of legacy waste which is predominantly of a mix of inorganic material, stones, including silt material. Based on the Total Station survey details the total volume of legacy waste spread over 37.66 cents and 4.3 m height is 8245 cubic meters. With a density, considered to be 1.042 Tonnes/cu m, the total quantity of waste dumped is estimated as 8591 Tonnes.

It is estimated that out of 8,591 Tonnes of legacy waste, approximately there are 7,803 Tonnes of soil/earthen materials, 518 Tonnes of materials for RDF/plastics, 109 Tonnes of Recyclables/Glass along with an expected 2% Inert, which is approximately 160 Tonnes.

Evaluation of various techniques for remediating the existing dumpsite reveals that biomining is the best option for remediating the dumpsite at Ugrankunnu. The remediated land can be utilised for establishing other solid waste management activities of Kottarakkara Municipality. The bioremediation works has been designed on the basis of physical analysis, chemical analysis reports, field inspections, topographical conditions.

As Kerala does not have facilities to consume the RDF generated, it has to be transported to factories in neighbouring States and this would enhance the cost of the bio-remediation. The possible forward linkages are identified in the nearby state, Tamil Nādu and is approximately 390 km from dumpsite at Ugrankunnu. This implies that the cost of transportation of the RDF will be high. Recyclables would be predominantly glass, which would be sent to approved recyclers and traders of recyclables. However, there are possibilities for utilisation of recyclables/RDF in the neighbouring state and is recommended to be the responsibility of the successful bidder.

Soil and stones can be used for filling of land for playground, formation of medians in the ongoing highways, ring road projects or Vizhinjam port, and similar construction sites. A part of soil/stones can also be disposed in low lying areas within the site. It is advisable to avoid use of this soil for agriculture/ fruit bearing tree plantations. Another feasible option is to use as daily cover in sanitary landfill facilities.

The project duration is proposed to be 5 months. It is expected that the time for mobilisation, and installation of machinery would be concurrent. It is required to set up a 100 to 120 TPD production output sieving/sorting plant and machinery infrastructure. The design considers 3 months of sieving operations/baling with completion of mobilisation and setting up of plant within 30 days of commencement of contract. Based on that, the excavation capacity is to be on an average of 100-120 tonnes per day.

Total Project cost including all machineries required for processing, transporting is estimated to be [redacted] which accounts to be about [redacted] per cum (including GST, EMP and SMP cost and cost index).

# സമഗ്ര സംക്ഷിപ്തം

[redacted]

# 1. INTRODUCTION

Kottarakkara Municipality proposes to remediate the old solid waste dumpsite following the Norms, Guidelines and Standards notified at National and State level. Dumping of municipal solid waste was started in 1994 and continued till 2018 when public protest led to stopping of the practice. The old dumpsite is covered with ordinary soil and it is a non-active dumpsite. It is proposed to remediate the site for establishing an MCF for the management of NBDW in the recovered land. The land is valuable as there is no other land available for establishing solid waste processing facilities, therefore, remediation of the existing dumpsite is essential for upgrading the existing NBDW facilities.

A study/assessment of the baseline environmental quality was done to assess the level of impact on the environment due to dumping of unprocessed solid waste in the open area. This feasibility report is proposed for the remediation of dumpsite in the Ugrankunnu area of Kottarakkara Municipality in Kollam District, Kerala.

The Feasibility Report (FR) is prepared following guideline/norms specified by the Central Public Health and Environmental Engineering Organisation (CPHEEO), Government of India (GoI); Ministry of Housing and Urban Affairs (MoHUA), GoI; Ministry of Environment, Forests and Climate Change (MoEF&CC), GoI; Central Pollution Control Board (CPCB) and Local Self Government Department (LSGD), Government of Kerala (GoK).

# 2. GENERAL DESCRIPTION OF THE PROJECT

The dumpsite is located at Ugrankunnu (N 9°0’4.58”, E 76°45’32.29”), a hillock in Kottarakkara Municipal area, and about 3 km away from the Municipal Head Quarters. It was a burial ground, with an area of 0.24 hectares (60 cents) and before converting it to a waste processing area, an additional land of 0.4046 hectares (1 acre) adjacent to it was acquired. Therefore, now a total area of about 0.6446 hectares (1.5 acres) is available in the solid waste processing plant compound. The area of dumpsite is only 0.24 hectares, remaining area is utilised for managing NBDW.

Kottarakkara was a Grama Panchayat and on January 14, 2015 it has been upgraded into a Municipality. At present, the municipality is collecting only dry waste from households and institutions and the dry waste is stored in sheds situated near to the dumpsite. The site is about 3 km away from the Municipal Head Quarters. Location of dumpsite is shown in the map given below Figure 1 and details of the dumpsite are provided in Table 1.

**Table 1: Dumpsite Details**

| | |
|---|---|
| Name of Muncipality | Kottarakkara |
| District | Kollam |
| Location | Ugrankunnu,Kottarakkara |
| Geo Coordiantes | 9°0'4.68"N 76°45'33.73"E |
| Total Land area | 1 Acre 50 Cents |
| Dumpsite area | 37.66 Cents |

**Source :ULB data*

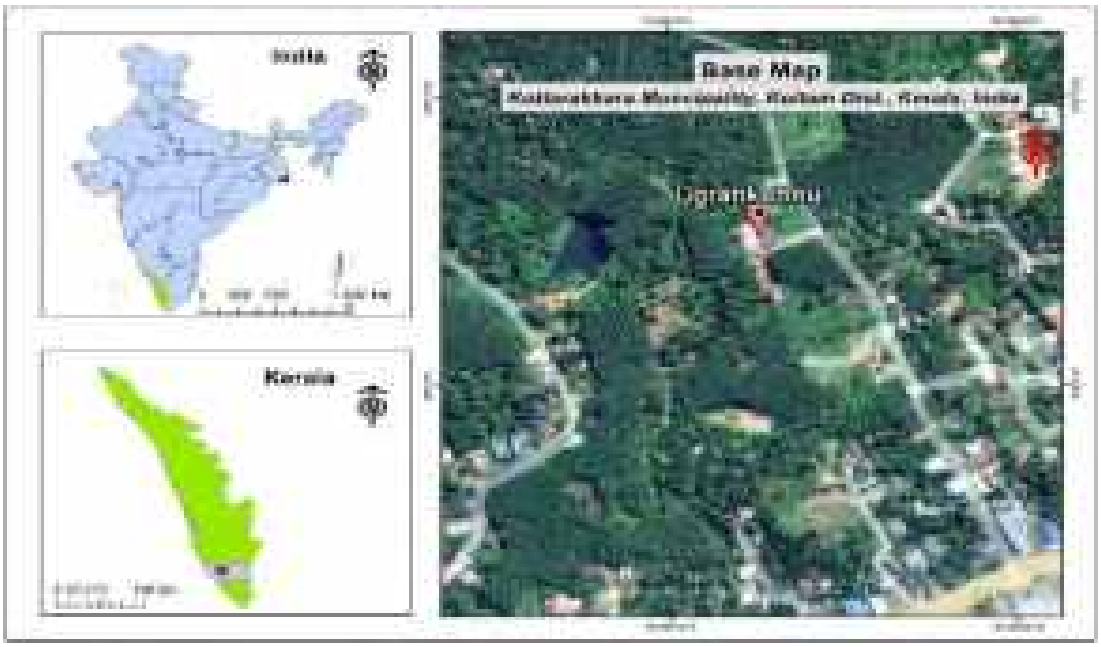



**Fig.1: Location of the dumpsite at Ugrankunnu, Kottarakkara Municipality**

*Source :TSC Package A*

# 3. DEMOGRAPHY

## 3.1 Demography

As per the Municipality survey, 2022 The present population of the Kottarakkara Municipality is 33,772 with 9,273 residential units. Ugrankunnu dumpsite at Ward No. 26, has a population of 1,188 as per the Municipality statistics

## 3.2 Access

Kottarakkara Municipality in Kollam district is at the meeting point of National Highway (NH 744) and Main Central (MC) road. It is at a distance of 27 km from the Kollam District Head Quarters (Chinnakkada), with an extant of 17.67 sq.kms, encompassing of 29 wards, the municipal area falls in the revenue village of Kottarakkara. It shares boundary with Mylom, Melila, Vettikkavala, Ummannoor, Veliyam, Neduvathur Grama Panchayats.

Ugrankunnu dumpsite is at a distance of 0.4 km from the Kollam -Punalur -Thenkashi road. The road in front of dumpsite leads to Vijaya College of nursing, which is at a distance of 0.5 km from dumpsite entrance. Along the road another sensitive receptor Ugrankunnu Bagavathi temple also exists. Road to the site is narrow and steep, with a width of about 3 m. The existing road can be utilised for remediation activity, avoiding public inconvenience and is detailed in Section 3.9, Traffic Management, in ESIA. The transportation layout of the raod network near to dumpsite is illustrated in figure 2

### 3.2.1 Transportation Corridor

- NH Highway 744 – connecting Kottarakkara to Punalur
- State Highway 1 – MC road
- Kottarakkara – Oyur road (PWD)
- Kottarakkara market junction road (PWD)

There are other roads connecting Kottarakkara to Puthoor, Neeleswaram and Sasthamcotta. The main sections for traffic bottlenecks are along NH744, Market road and near Mini Civil Station. Pulamon junction also faces this issue to a lesser degree as it is the location of both the KSRTC bus depot and the Private bus depot. The entry and exist of buses creates traffic blocks near this junction, which in turn increases pressure near the central business district of Kottarakkara town. Kottarkkara also has a railway station some distance away from this junction. All of these factors may contribute to the large traffic volume in this area.

Kottarakkara is connected to Thanjavur in Tamil Nadu through NH 744. Several important forward linkages (namely cement companies) lie along this route, near Thiruchirapalli. Solid waste Transportation vehicles travelling from Ugrankunnu along NH 744 take around 9-12hrs to reach Thiruchirapalli.

Site specific traffic plan is developed and it has been illustrated in ESIA report. Below figure 2 shows the site-specific traffic map developed




**Fig.2: Traffic Map**

*Source: TSC Package A*

## 3.3 Land Use

The existing land uses are classified under several categories namely residential, commercial, industrial, public and semi-public, agricultural, park and open spaces, transportation, water bodies etc. Existing Land use breakup of 2016 and land use map – Kottarakkara Municipality – Kottarakkara Municipality is given in Table 2 and Fig 3.

**Table 2: Existing Land use breakup of 2016 – Kottarakkara Municipality**

| Description | Area (sq. km) | Percentage (%) |
|---|---|---|
| Residential | 7.51 | 42.5 |
| Commercial | 0.33 | 1.87 |
| Institutional | 0.03 | 0.17 |
| Agricultural | 7.84 | 44.36 |
| Recreational, open space (Public and semi-public) | 1.43 | 8.09 |
| Transportation | 0.42 | 2.38 |
| Water bodies | 0.11 | 0.62 |
| Slums | 0 | 0 |
| Forest | 0 | 0 |
| Revenue Surplus land | 0 | 0 |
| Other Vacant land | 0 | 0 |
| **Details of drains in the ULB** | | |
| Open drains | 7 | |
| Closed drains | 14.35 | |

* Source: Land Use Survey, 2016

As per the land use map, Ugrankunnu dumpsite area comes under dry agriculture/residential area. The dumpsite is surrounded by Rubber plantations and some houses in south -eastern side of the dumpsite-MCF/MRF compound.

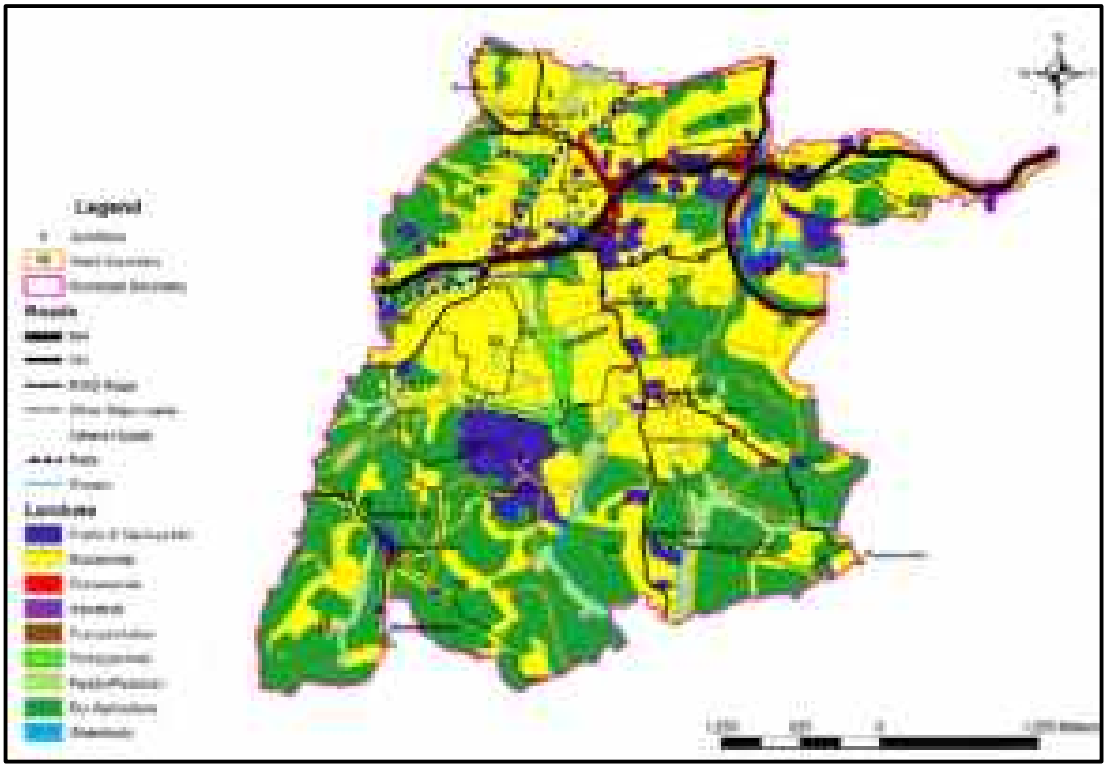
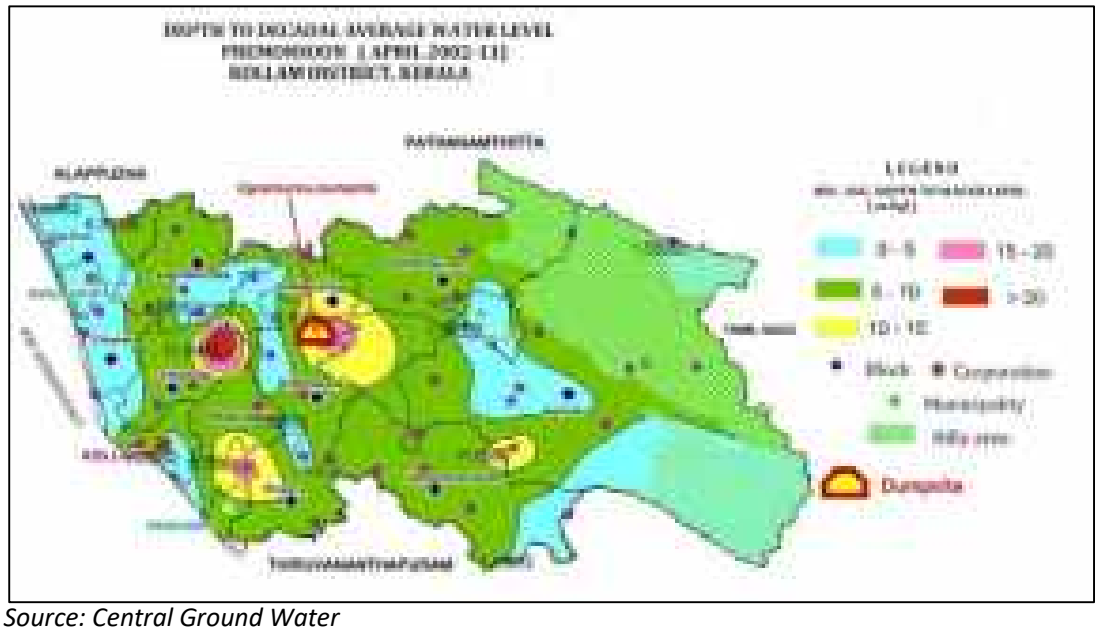



**Fig.3: Land use map – Kottarakkara Municipality**

## 3.4 Water Table

Depth of decadal average water level during pre-monsoon, post-monsoon and hydrogeology of Kollam District is shown below. The Ugrankunnu in Kottarakkara Municipality is shown in the maps.




*Source: Central Ground Water*

**Fig.4: Depth of decadal average water level during pre-monsoon**




*Source: Central Ground Water*

**Fig.5: Depth of decadal average water level during post-monsoon**



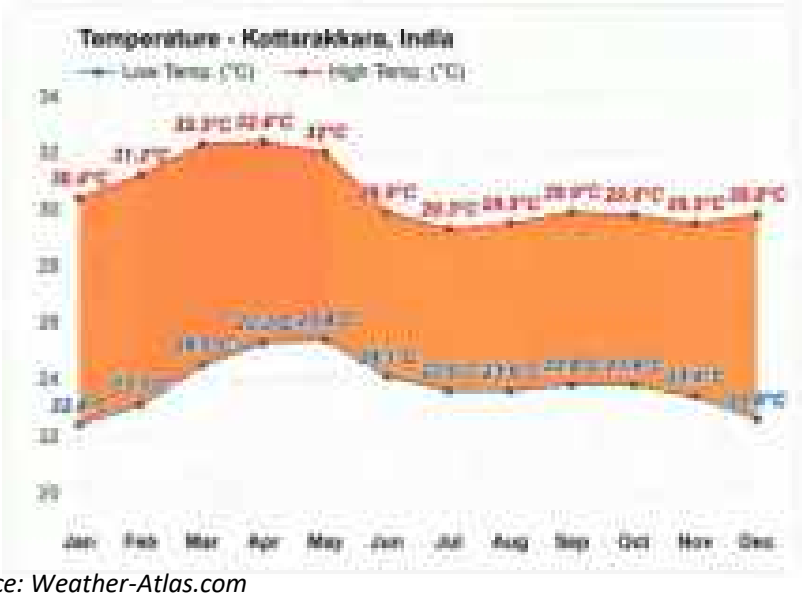

*Source: Central Ground Water*

**Fig.6: Hydrogeology of Kollam District, Kerala**

Depth of decadal average water level at Ugrankunnu, Kottarakkara during pre-monsoon is ranging from 10-15 m below ground level (BGL) and Post-monsoon, the ground water table depth can rise from 10m depth to 5m depth BGL. This data indicates that the dumpsite situated at higher elevation and the water table is well below. Ugrankunnu has hard rock mostly, yielding 1 l/s of ground water, having high iron content.

## 3.5 Climate

Temperature in Ugrankunnu is mostly moderate. The project site experiences three seasons. The winter from December to February is followed by summer between March and May, the monsoon season between June to September and the post-monsoon season between October and November. The place experiences temperatures of 22°C - 32°C. Month wise average temperature of Kottarakkara Municipal area is shown in the chart below:




*Source: Weather-Atlas.com*

**Fig.7: Average Monthly Temperature data of Kottarakkara Municipality**

Kottarakkara Municipality including Ugrankunnu receives an average monthly rainfall of about 209.75 mm with rain around 180 rainy days. The months of July, August, September and October receive highest rainfall. Rainfall is a factor to be considered in the solid waste processing as this contributes in leachate formation. Month-wise average rainfall data of Kottarakkara Municipality is shown in the figure below




*Source: Weather-Atlas.com*

**Fig.8: Average monthly Rainfall data of Kottarakkara Municipality**

## 3.6 Natural Hazards

- **Flood Proneness**

  As per the flood prone area mapped by KSDMA, the Ugrankunnu dumpsite area is not flood prone, at a higher altitude and away from water bodies. Topography of the area indicates easy drainage of storm water. Flood map of Ugrankunnu, Kottarakkara is shown below.



*Source: KSDMA, GoK*

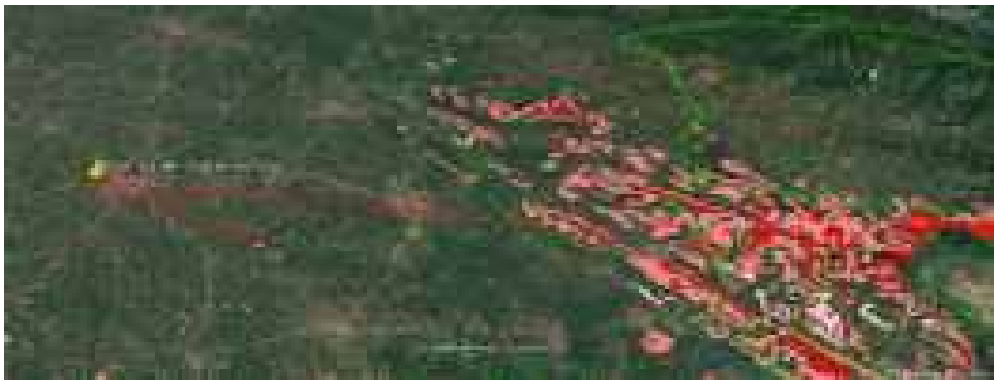
**Fig 9: Flood Map of Ugrankunnu, Kottarakkara**

- **Drought data**

  There is no historical data available on drought affected in Ugrankunnu area of Kottarakkara Municipality, Kollam District.

- **Land Slide Hazard Proneness**

  As per the landslide hazard zonation map published by the Kerala State Disaster Management Authority (KSDMA), the Ugrankunnu site is free from landslide proneness. The high land slide hazard zone is situated at a distance of about 27 km and medium land slide hazard zone is at about 11 km away from the Ugrankunnu dumpsite situated in the Kottarakkara Municipality.



*Source: KSWMP TSC Package-A*

**Fig 10: Land Slide hazard map of Ugrankunnu, Kottarakkara**

- **Seismicity and associated hazards**

As per the seismic map published by the Kerala State Disaster Management Authority (KSDMA), the Ugrankunnu site is not affected by earthquake incidents and lineaments. Kollam district lies in earth quake hazard zone III.

# 4. DESCRIPTION OF THE DUMPSITE

## 4.1 Physical Feature of the Site

The area is at a higher altitude with lateritic soil. Natural vegetation, local species of trees including rubber are the predominant flora of the area. The wastes are covered with a soil capping in Ugrankunu dumpsite. This soil covering is not scientific. The legacy waste in Ugrankunnu which are mixed with soil, bushes and shrubs. The vegetation cover acts as breeding ground for many rodents, reptiles, dogs etc which can cause significant health effects to nearby inhabitants. In same compound RRF/MCF facility of Kottarakara Municipality exists and one crematorium is also being constructed, which is in final finishing stage.

There is one non accessible pond, formed at an abandoned quarry, 165 m away from the dumpsite. There are no natural drains to the pond. The water is not used by any communities nearby.

## 4.2 Current Site Management

Dumping of municipal solid waste was started in 1994 and continued till 2018, when public protest led to stopping of the practice. At present, there is no dumping, and the accumulated waste was covered with red earth in a slopped manner with a height of about 0.40 m and there is only a minimum chance of stagnation of water over the dumpsite. Storm water over the dump area is effectively drained due to the gentle slope of the covered area. There is no rag pickers or labour force available for removal of recoverable material from the dumpsite as it is fully covered with red earth. Land available at Ugrankunnu dumpsite is a part of the new Solid Waste Management Plan for upgradation of existing NBDW facility at Kottarakkara Municipality being finalized.

## 4.3. Site History Including Public Protest

It is learned that there were some public protests due to dumping of waste in Ugrankunnu area during the year 2018. It is also understood that the Municipality discontinued the dumping and the area is maintained by covering the dump with red earth for avoiding bad odour and fly nuisance in the area.



*Source: KSWMP TSC Package-A*

**Fig.11: Ugranknnnn Dumpsite, Kattaraklcara**

## 4.4. Directions From different Statutory bodies

### 4.4.1 NGT Directions & orders

The National Green Tribunal (NGT) has set norms and guidelines (O.A. No. 606/2018) to address legacy waste accumulated at long-operating dumpsites, to mitigate environmental and health hazards. The norms focus on closure and remediation of dumpsites, waste segregation and treatment using appropriate technologies, conducting Environmental Impact Assessments (EIAs), implementing land use planning and zoning regulations, monitoring and compliance measures, and promoting public participation and awareness regarding legacy waste management. These guidelines aim to stabilize dumpsites, prevent further pollution, and involve community's indecision-making and risk education.

### 4.4.2 Local Self Govt. Department-Guidelines

The remediation of dumpsites is further directed by Honourable NGT in its order OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. Remediation of Legacy Waste Dumpsites through Bioremediation – G.O.(Rt)No.2629/2022/LSGD Dated, Thiruvananthapuram, 29-10- 2022.

### 4.4.3 KSPCB – Guidelines for dumpsite remediation

The Kerala State Pollution Control Board (KSPCB) has established guideline (PCB/HO/SEE2/Model City/Kozhikode corporation/2019 dated 09/09/2021) for dumpsite remediation to address the environmental and health impacts of waste disposal. The recommended steps include conducting a site assessment, developing a remediation plan based on risk assessment, selecting appropriate remediation technologies, implementing remediation activities under supervision, verifying the success of remediation, and ensuring long-term management and monitoring of the site. By following these guidelines, the KSPCB aims to mitigate the adverse effects of waste disposal, protect the environment, and safeguard public health.

### 4.4.4 CPCB – Guidelines

Hon'ble NGT warned that due to incremental growth of Municipal Solid Waste (MSW), these MSW dumps are converting into virtual mountains. Hon'ble NGT further directed that every city/town should adhere to clause 'J' of Schedule–I of SWM Rules, 2016. Finally, Hon'ble NGT directed CPCB to propose Standard Operating Procedure (SOP) for implementation of Bio-mining and Bioremediation of legacy solid waste.

### 4.4.5 Swachh Bharat Mission (SBM) advisory

The advisory on dumpsite bioremediation addresses the challenges of legacy waste and promotes sustainable waste management practices and emphasizes the importance of dumpsite bioremediation as a sustainable solution for managing legacy waste. By adopting these guidelines, municipalities can address the environmental and health risks associated with dumpsites and promote a cleaner and healthier living environment for communities.

### 4.4.6 Central Public Health and Environmental Engineering Organization (CPHEEO) guidelines

The guidelines aim to provide a comprehensive approach to remediate dumpsites in a safe and environmentally sustainable manner. Key points from the guidelines include conducting site

assessments, segregating waste, and implementing engineering and biological measures to control contamination, treating leachate to prevent groundwater contamination, and conducting post-remediation monitoring. These guidelines are crucial to ensure effective and environmentally sound dumpsite remediation that protects public health and the environment.

# 5. SCOPE OF WORK AND OBJECTIVE

Though Kerala has made achievements in introducing the practice of source level and decentralised mode of treatment and disposal of municipal solid waste, lack of common facilities force the urban local bodies to use the compound of their Common Treatment Facility for dumping of waste. Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at Ugrankunnu includes the following steps,

- Conducting detailed field investigations – Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. And
- Environmental Baseline and Waste Analysis by M/s Poluchem Laboratories Pvt.Ltd.
- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.
- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the by-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation (100% land recovery – Biomining, Capping partially Biomining & Capping)
- Methods/Technologies (Stationary & Mobile- compact), Implementation mode, Forward linkages
- Utilization/Management of By-products and Environmental & Social categorization as per the Environmental Management Framework – Vol II Part A.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Baseline assessment, impact & risk assessment, mitigations measures and Environmental Management & monitoring plan and its budget.
- Social Safeguards – Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.

- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport, Environmental and social monitoring costs, Revenue from the project, Funding for project
- Project Implementation plan –contractual models and timelines.

## 5.1 Objectives

The objectives of this project are,

a. To assess the existing dumpsite with Historic waste at Ugrankunnu based on the rapid risk assessment comprising of a set of basic technical, environment and social criteria and further technical investigations, test and field surveys.
b. Preparation of a Feasibility Report including the options available for bioremediation, processes, and studies conducted at site, components and equipment required based on the ground conditions at Ugrankunnu.
c. Prepare a project implementation time line based on the final option recommended for bioremediation.
d. Estimating the project cost.

# 6. COMPOSITION, CHARACTERISTICS OF LEGACY WASTE AND ITS IMPACTS

## 6.1 Investigation Strategy

The preliminary assessment was focussed on locations where the highest contaminant concentrations are expected and the locations of the most sensitive land use. It was necessary to verify all potential sources, pathways and receptors at the site.

To achieve this objective, a different investigation strategy was applied for each type of contamination so that the point of attention can be given to the fieldwork and laboratory work which are specified in the Protocol investigation strategy of preliminary site investigation. The following baseline environmental assessment were done at the Ugrankunnu site at Kottarakkara Municipality.

a. Physical and Chemical analysis of Legacy waste, Soil, Air, Noise, leachate, Ground Water and Surface Water analysis
b. Sampling and testing program to assess the contamination levels of the source and identification of the major pathways and receptors of concern as defined below
c. Analysis and interpretation of exploratory data including concentration levels compared with the appropriate standards
d. Risk assessment based on applicable source-pathway-receptor-combinations for human health
e. Reporting
    - Pathways: leachate, surface and groundwater, soil and air tested for parameters as CPCB specified standards
    - Receptors: to identify to locate sampling and testing at the critical locations

## 6.2 Detailed Investigation

The detailed investigations carried out for the legacy waste dumpsite is given in the table 3 below,

**Table 3: Site Investigation carried out**

| S.No | Parameters | Sampling Nos. |
|---|---|---|
| *1* | *Geotechnical Investigation* | |
| A | Boreholes up to 10m depth (as per CPHEEO Manual) | 1 |
| B | Permeability test- (as per CPHEEO Manual) standard penetration test SPT and collection of undisturbed samples - Soil Investigation – Classification, gradation, Atterberg's limit, Bulk density, dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, strength, compressibility (vertically-3 samples per borehole) | 1 |
| *2* | *Waste & Environmental Analysis* | |
| A | Leachate Analysis (TCLP usepa 1311) (SCHEDULE II of SWM rules, 2016), Suspended solids, Dissolved solids (inorganic),pH, Ammonical nitrogen (as N), Total Kjeldahl nitrogen (as N), BOD, COD, Arsenic (as As), Mercury, Lead, Cadmium, Copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds | No Leachate at Site |
| B | Physical Analysis of waste (As per CPHEEO manual) including Density, Bulk Density, Moisture Content, Size of waste Constituents, Calorific Value | 2 |
| C | Chemical Analysis of waste/soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), total Carbon, C/N ratio, calorific value, Bio-chemical – biodegradable factor | 1 |
| D | Ground Water (BoreWell -1 Shallow Well-3): pH, Colour, EC, Turbidity, SS, TDS, TOC, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, TKN, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total Coliforms (IS 10500 – 2012) | 4 |
| E | Ambient Air Quality (Sulphur Dioxide (So2), Nitrogen Dioxide (No2), Particulate Matter 2.5, Particulate Matter 10, Ozone (O3), Lead (Pb), Carbon Monoxide (CO), Ammonia (NH3), Benzene (C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 H | 2 |
| F | Ambient Noise Level (E(p)Rules) for 24 hours | 1 |
| Source: Detailed Investigations Conducted as per PIM | | |

## 6.3 Methodology of Sampling

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed sampling methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat/Long) were considered. Table 4 shows the strategic location details of samples selected for the detailed investigation.

**Table 4: Details of sampling location**

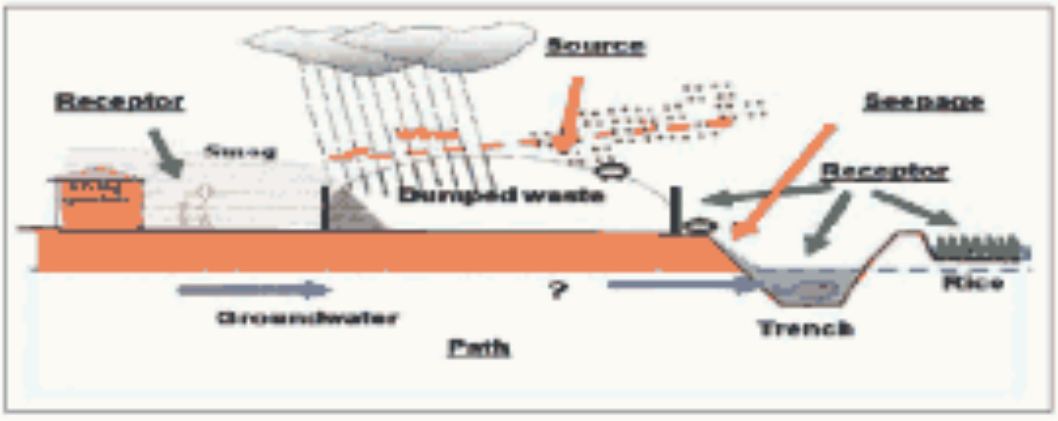
| Sl No | Description | Sampling location | Justification |
|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sensitive receptor<br>Dumpsite entry point | As per the wind rose diagram, the direction and speed of the wind are determined and based on the existing wind-rose data the air sampling location fixed at two locations |
| 2 | Noise (1 Location) | Dumpsite entry point | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. |
| 3 | Ground water (4 Locations) | 1 bore well within the dumpsite area<br>3 shallow wells near to dumpsite area | The dumpsite is located at a higher elevation with slopes in South-eastern and Western direction. Water samples are collected based on this. |
| 4 | Bore Hole (1 Location) | Within the dumpsite area | |
| 5 | Legacy Waste (1 Location) | Within the dumpsite area | |

** Source: TSC Package A*

## 6.4 Environmental and Social Baseline Data

i. **Study Area**

- As a primary requirement of preliminary environment and social assessment, the following areas were covered
  - Source (Existing dumpsite)
  - Receptors (Buffer zone)
  - Collection of primary baseline data within 500 m.
  - Collection of Secondary data




*Source: KSWMP TSC Package-A*

**Fig.12: Flowchart of possible pathways for contamination**

Sampling and testing program were carried out to assess the contamination levels of the source and identification of the major pathways and receptors of concern and are detailed in below tables.

Further Analysis and interpretation of exploratory data including concentration levels compared with the appropriate standards are carried out along with Risk assessment based on applicable source-pathway-receptor-combinations for human health.
Accordingly, Pathways such as leachate, surface water, ground water, soil and air were tested for parameters specified by CPCB. Receptors are identified to locate sampling and testing at the critical locations.

Sampling stations were selected at the dumpsite and around the site based on guideline/norms followed for selection of samples for waste, soil, water, ground water, noise and ambient air. The selected sampling locations for the above components are given in the table 5.

**Table.5: Sampling locations selected in and around dumpsite at Ugrankunnu**

| SL No. | Parameter | Locations | Co-ordinates |
|---|---|---|---|
| 1. | Legacy Waste | Mid portion of the dumpsite | |
| 2. | Soil | Mid portion of the dumpsite below the waste heap | |
| 3. | Air | Near Main Gate, Ugrankunnu Dumpsite | N- 9°00'13.04" E -76°75'93.12" |
| | | Vijaya College of Nursing, Kottarakkara | N- 9°00'44.26" E -76°75'66.10" |
| 5. | Noise | Near Main Gate, Ugrankunnu Dumpsite | N- 9°00'13.04" E -76°75'93.12" |
| 6. | Borewell | Near Ugrankunnu MCF/RRF | N- 9°00'11.66" E -76°75'91.55" |
| 7 | Shallow Well | Mr.Shanavas.S, Ahmilbeedu | N- 9°00'11.45" E -76°76'00.25" |
| | | Mr.Thulaseedharan-Aswathy Bhavan | N- 9°00'48.45" E -76°76'00.25" |
| | | Mrs.Lekha, Pazhankanjivilla | N- 9° 0'10.80" E- 76°45'30.00" |

*Source: TSC Package A*

Sampling and analysis of waste, soil, air, noise and ground water were done following norms/guidelines of CPCB and CPHEEO. Method of sampling and testing was as per IS 3025 and CPCB specified analytical methods. The baseline rapid environmental assessment of the dumpsite was done in and around the dumpsite considering pathways and receptors. Method of sampling and analysis following the approved norms/procedure was ensured through two competent NABL accredited laboratories.

There is no surface water like pond, stream, river etc. near to the dumpsite, therefore unable to collect water samples from such environmental feature. It was identified that there is an abandoned quarry pit situated 200 m away from the dumpsite but there is no chance of contamination of that water body as it is a pit situated within the granite block. Moreover, it is inaccessible due to fencing around the abandoned quarry area.

Sampling stations selected for ground water and ambient air quality monitoring stations shown in Fig 13.




*Source: KSWMP TSC Package-A*

**Fig.13: Sampling and Monitoring Stations**

### 6.4.1 Ambient Air

Baseline ambient air quality monitoring was done near to the site as per the procedure specified by the CPCB by engaging a competent NABL accredited laboratory. Air quality monitoring was done by establishing two monitoring stations. One monitoring station was fixed near to the Main Gate of Dumpsite Ugrankunnu, Kottarakkara Municipality which can be taken as leeward side of the dumpsite. Another monitoring station was fixed near to the major receptor, Vijaya College of Nursing, Kottarakkara which is situated at the forward side of dumpsite which is 420 m away. Monitoring was done for a period of 24 hrs for the common parameters specified by the CPCB and the test result is given in table 6.

**Table.6: Results of Ambient Air Quality Monitoring done near to Ugrankunnu**

| Parameters | Test Method | Locations | | Limits as per NAAQS specified by CPCB |
|---|---|---|---|---|
| | | Main Gate of Dumpsite | Vijaya College of Nursing | |
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 50.3 µg/m³ | 36.5 µg/m³ | 100 µg/m³ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 23.4 µg/m³ | 15.6 µg/m³ | 60 µg/m³ |
| Sulphur Dioxide ($SO_2$) | I S 5182 Part 2 2001 RA 2017 | 13.4 µg/m³ | <1 µg/m³ | 80 µg/m³ |
| Nitrogen Dioxide ($NO_2$) | IS 5182 Part 06 2006 RA2017 | 19.5 µg/m³ | 3.2 µg/m³ | 80 µg/m³ |
| Carbon monoxide (CO) | SOP/PCL/COA/ 17 | 0.8 mg/m³ | 0.4 mg/m³ | 4 mg/m³ |
| Hydrogen Sulphide ($H_2S$) | IS 5182 Part 07 2021 | < 1 µg/m³ | < 1 µg/m³ | -- |
| Methane ($CH_4$) | IS 13270 :19992 RA 2003 | Not Detected | Not Detected | -- |
| Odour | ---- | Unobjectionable | Unobjectionable | -- |

**Source: Pollachem Laboratories Pvt.Ltd*

The baseline ambient air quality monitoring results indicate that all parameters are well within the specified limit. Therefore, there is no air pollution noticed in the dumpsite area

### 6.4.2 Noise

Baseline ambient noise levels were monitored utilizing service of a NABL accredited expert agency, Pollachem Laboratories Pvt. Ltd., Ernakulam. Measurement of Noise levels were made near Main Gate of Dumpsite Ugrankunnu Kottarakkara Municipality. Results of monitoring of ambient noise levels at Ugrankunnu is provided in Table 7

**Table.7: Result of monitoring of ambient noise levels at Ugrankunnu**

| Location | Main Gate of Dumpsite Ugrankunnu Kottarakkara Municipality | |
|---|---|---|
| **HOURLY INTERVAL** | **OBSERVED VALUE** | **LIMITS SPECIFIED BY CPCB** |
| 06.00 Hrs | 53.0 dB (A) | Industrial Area<br>Day Time-75dB(A),<br>Night Time- 70dB(A),<br><br>Commercial area<br>Day Time -65 dB(A),<br>Night Time55dB(A),<br><br>Residential area<br>Day Time -55 dB(A),<br>Night Time -45dB(A),<br><br>Silence zone<br>Day time-50dB(A),<br>Night time-40dB(A)<br><br>Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am |
| 07.00 Hrs | 53.1 dB (A) | |
| 08.00 Hrs | 50.7 dB (A) | |
| 09.00 Hrs | 45.2 dB (A) | |
| 10.00 Hrs | 45.8 dB (A) | |
| 11.00 Hrs | 45.5 dB (A) | |
| 12.00 Hrs | 55.0 dB (A) | |
| 13.00 Hrs | 55.3 dB (A) | |
| 14.00 Hrs | 47.1 dB (A) | |
| 15.00 Hrs | 45.7 dB (A) | |
| 16.00 Hrs | 47.8 dB (A) | |
| 17.00 Hrs | 45.7 dB (A) | |
| 18.00 Hrs | 50.8 dB (A) | |
| 19.00 Hrs | 58.1 dB (A) | |
| 20.00 Hrs | 54.4 dB (A) | |
| 21.00 Hrs | 52.6 dB (A) | |
| 22.00 Hrs | 52.1 dB (A) | |
| 23.00 Hrs | 52.8 dB (A) | |
| 00.00 Hrs | 49.2 dB (A) | |
| 01.00 Hrs | 48.3 dB (A) | |
| 02.00 Hrs | 49.1 dB (A) | |
| 03.00 Hrs | 50.6 dB (A) | |
| 04.00 Hrs | 50.1 dB (A) | |
| 05.00 Hrs | 51.3 dB (A) | |
| $L_{eq}$Day | 50.4 dB (A) | |
| $L_{eq}$Night | 50.2 dB (A) | |

**Source:Polluchem Laboratories Pvt.Ltd*

The results while comparing with Noise standards, it can be seen that at day-time the noise levels are within the prescribed limit. In night-time there is a slight increase of 5 db. There is a mobile tower situated nearby sampling station and during certain occasions there are chances for operation of DG sets attached to mobile tower and the operation of DG set during night-time can affect the noise level.

### 6.4.3 Ground Water Quality Monitoring

Sampling and analysis of borewell and shallow wells were done through an NABL accredited laboratory namely, Poluchem Laboratories Pvt. Ltd. Ernakulam. The water environment was studied by collecting Ground water samples from one bore well within the MRF/MCF/dumpsite compound and 3 Dug well samples from nearby houses

Results of ground water quality monitoring conducted near to the dumpsite in a borewell, and open wells existing nearby area is given in table 8 to 11.

**Table 8: Results of monitoring of Borewell at Ugrankunnu dumpsite**

| Parameters | Test method | Results | Acceptable Limit As per IS – 10500 – 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 7.31 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 0.4 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 210µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 136.5 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL (MDL- 1mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 60 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 83.58 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 14.78 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 2.15 mg/l | 200 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 12 mg/l | --- |
| TOC | APHA5310 | BDL (MDL- 0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL (MDL- 1mg/l) | — |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 4.1 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL- 0.1mg/l) | 1.0 mg/l |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL (MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL (MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL (MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL (MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL (MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL (MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL (MDL- 0.01mg/l) | 5.0 mg/l |

| Parameters | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL (MDL- 0.05mg/l) | 1.0 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL (MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL (MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level
*Source:Pollachem Laboratories Pvt.Ltd*

Results of groundwater sample indicates that all parameters are well within the limits specified as per IS 10500:2012. This indicates that there is no physical and chemical contamination of ground water from the existing dumpsite at Ugrankunnu, Kottarakkara, Kollam.

Results of biological parameters monitored in the borewell/groundwater is given in the following table 9.

**Table. 9: Results of monitoring of Microbiology Analysis of borewell at Ugrankunnu**

| PARAMETERS | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 30 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

**Source:Polluchem Laboratories Pvt.Ltd*

Results of biological monitoring of borewell/ground water conducted at Ugrankunnu indicates that the coliform bacteria is slightly above the acceptable limit specified by IS 10500:2012 (Observed value = 30, Acceptable limit = 0).

Results of water quality monitoring done through NABL accredited laboratory, Polychem Laboratories Pvt. Ltd. Ernakulam, in the three open wells/groundwater situated at upstream and downstream location is given in table 10.

**Table.10: Results of monitoring of water quality of three Open Wells around Ugrankunnu**

| Parameters tested | Test method | Results of shallow well of Mr. Shanavas S, Aluvilaveedu | Results of shallow well of Mr. Thulaseedharan, Aswathy Bhavan | Results of shallow well of Mrs. Lekha, Pazhankanjivila | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|---|---|
| pH | IS 3025 (P) 11 – 1983RA2017 | 5.36 | 5.38 | 5.52 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 3 Hazen Unit | 5 Hazen Unit | 5 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 0.6 NTU | 1.8 NTU | 4.0 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 42 µS/cm | 240 µS/cm | 50 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 27 mg/l | 156 mg/l | 34 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – | BDL (MDL-1mg/l) | BDL (MDL-1mg/l) | BDL (MDL-1mg/l) | --- |

| Parameters tested | Test method | Results of shallow well of Mr. Shanavas S, Aluvilaveedu | Results of shallow well of Mr. Thulaseedharan, Aswathy Bhavan | Results of shallow well of Mrs. Lekha, Pazhankunjivila | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|---|---|
| | 1984RA2017 | | | | |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 2 mg/l | 12 mg/l | 2 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 7.96 mg/l | 48.29 mg/l | 6 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 11.83 mg/l | 11.94 mg/l | 13.93 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | BDL(MDL-1mg/l) | 8.7 mg/l | BDL(MDL-1mg/l) | 200 mg/l |
| C O D | IS 3025 (P) 58 - 2006RA2017 | 6 mg/l | 10 mg/l | 6 mg/l | --- |
| TOC | APHA5310 | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | ---- |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 3.2 mg/l | 3.2 mg/l | 3.2 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 - 2008RA2014 | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | 1.0 mg/l |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL (MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL (MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL (MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.01 mg/l |

| Parameters tested | Test method | Results of shallow well of Mr. Shanavas S, Aluvilaveedu | Results of shallow well of Mr. Thulaseedharan, Aswathy Bhavan | Results of shallow well of Mrs. Lekha, Pazhankanjtvila | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|---|---|
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL (MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL (MDL-0.01mg/l) | BDL (MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL-0.001mg/l) | BDL (MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL-0.01mg/l) | BDL (MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 5.0 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL-0.05mg/l) | 0.32 mg/l | 0.86mg/l | 1.0 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL-0.01mg/l) | BDL (MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL-0.01mg/l) | BDL (MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.01 mg/l |

*Source:Pollachan Laboratories Pvt.Ltd*

Results of physical and chemical quality monitoring of three shallow wells/ground water conducted in and around Ugrankunnu dumpsite indicates that all parameters are well within the limits except pH and turbidity are slightly above the acceptable limit specified by IS 10500:2012 (Observed value of pH = 5-6, Acceptable limit of pH = 6.5-7.5, Observed value of turbidity = 1.8-4 NTU, Acceptable limit of turbidity = 1 NTU).

Results of biological parameters monitored in the shallow/groundwater is given in table 11.

**Table 11: Results of monitoring of Microbiology Analysis of three shallow wells around Ugrankunnu Dumpsite**

| Parameters Tested | Unit | Test Method | Results of shallow well of Mr. Shanavas S, Aluvilaveedu | Results of shallow well of Mr. Thulaseedharan, Aswathy Bhavan | Results of shallow well of Mrs. Lekha, Pazhankanji villa | Limit as per 10500:2012 |
|---|---|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA 2009 | 30 | Absent | Absent | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent /100ml | IS 1622: 1981 RA 2009 | Absent | Absent | Absent | Shall not be detectable in any 100 ml sample |

**Source: Pathachem Laboratories Pvt.Ltd*

Results of biological monitoring of three shallow well/ground water conducted around Ugrankunnu dumpsite indicates that the coliform bacteria are slightly above the acceptable limit specified by IS 10500:2012 (Observed value = 30, Acceptable limit = 0) in one of the wells. The variations in these results are not influenced by the dumpsite. The coliform content presence can be dependent on may other factors, the primary factor is the nearness to septic tank or a faulty septic tank.

## 6.5 Interpretation of Physical and Chemical Characteristics of Legacy waste and its Impacts

### 6.5.1 Waste

Sampling and analysis of legacy waste accumulated at Ugrankunnu Kottarakkara was conducted through an NABL accredited laboratory namely, Matter Material Testing and Research Laboratory Pvt. Ltd. Kozhikode. Results of physical and chemical analysis of legacy waste collected from the dumpsite using borehole technique is given in table12 and table 13 and physical composition is shown in Fig 14.

**Table.12: Physical analysis of legacy waste collected from Ugrankunnu dumpsite**

| Parameters | Sample 1 | Sample 2 | Average |
|---|---|---|---|
| Percentage of Plastic Waste, % | 5.96 | 6.1 | 6.03 |
| Percentage of Glass Waste, % | 1.24 | 1.3 | 1.28 |
| Percentage of Metal Waste, % | Nil | Nil | |
| Percentage of Soil/Earthen Material, % | 92.79 | 92.6 | 92.69 |

**Source:TSC Package A*

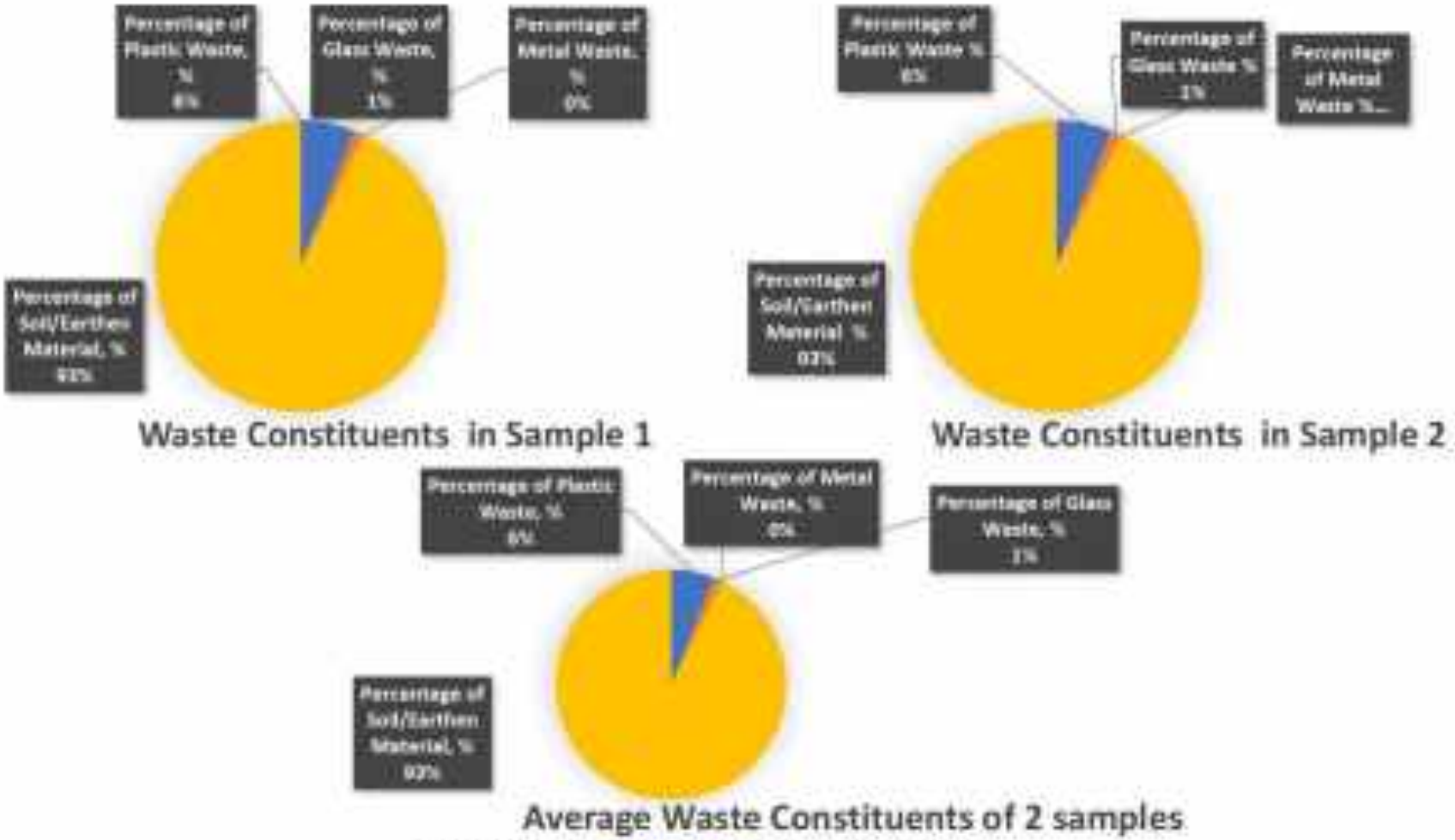



Fig.14: Physical Composition of Collected waste samples

**Table.13: Chemical analysis of legacy waste collected from Ugrankunnu dumpsite**

| TEST PARAMETERS | UNIT | RESULTS | LIMITS as per Schedule II of SWM Rule 2016 for Organic Compost (FCO 2009) |
|---|---|---|---|
| pH | - | 7.94 | 6.5-7.5 |
| Electrical Conductivity | mS/cm | 3.31 | 4.0 |
| Nitrogen(N) | % | 0.14 | 0.8 |
| Phosphorus(P) | % | 0.012 | 0.4 |
| Potassium(K) | % | 0.43 | 0.4 |
| Carbon | % | 5.0 | - |
| Carbon/ Nitrogen Ratio | % | 35.7 | <20 |
| Calorific Value | Kcal/kg | 844.02 | - |
| Biodegradable Factor | - | 0.54 | - |
| **HEAVY METALS-TEST METHOD: EPA 3050 (ICP OES)** | | | |
| Arsenic(As) | mg/Kg | <0.1 | 10 |
| Cadmium (Cd) | mg/Kg | <5 | 5 |
| Chromium(Cr) | mg/Kg | 32.9 | 50 |
| Copper(Cu) | mg/Kg | 95.8 | 300 |
| Lead (Pb) | mg/Kg | 85.8 | 100 |
| Nickel(Ni) | mg/Kg | 24 | 50 |
| Zinc(Zn) | mg/Kg | 107.8 | 1000 |
| Mercury(Hg) | mg/Kg | <0.1 | 0.15 |

| TEST PARAMETERS | UNIT | RESULTS | LIMITS as per Schedule II of SWM Rule 2016 for Organic Compost (FCO 2009) |
|---|---|---|---|
| pH | - | 7.94 | 6.5-7.5 |
| Electrical Conductivity | mS/cm | 3.31 | 4.0 |

| | | | |
|---|---|---|---|
| Nitrogen(N) | % | 0.14 | 0.8 |
| Phosphorus(P) | % | 0.012 | 0.4 |
| Potassium(K) | % | 0.43 | 0.4 |
| Carbon | % | 5.0 | - |
| Carbon/ Nitrogen Ratio | % | 35.7 | <20 |
| Calorific Value | Kcal/kg | 844.02 | - |
| Biodegradable Factor | - | 0.54 | - |
| **HEAVY METALS-TEST METHOD: EPA 3050 (ICP OES)** | | | |
| Arsenic(As) | mg/Kg | <0.1 | 10 |
| Cadmium (Cd) | mg/Kg | <5 | 5 |
| Chromium(Cr) | mg/Kg | 32.9 | 50 |
| Copper(Cu) | mg/Kg | 95.8 | 300 |
| Lead (Pb) | mg/Kg | 85.8 | 100 |
| Nickel(Ni) | mg/Kg | 24 | 50 |
| Zinc(Zn) | mg/Kg | 107.8 | 1000 |
| Mercury(Hg) | mg/Kg | <0.1 | 0.15 |

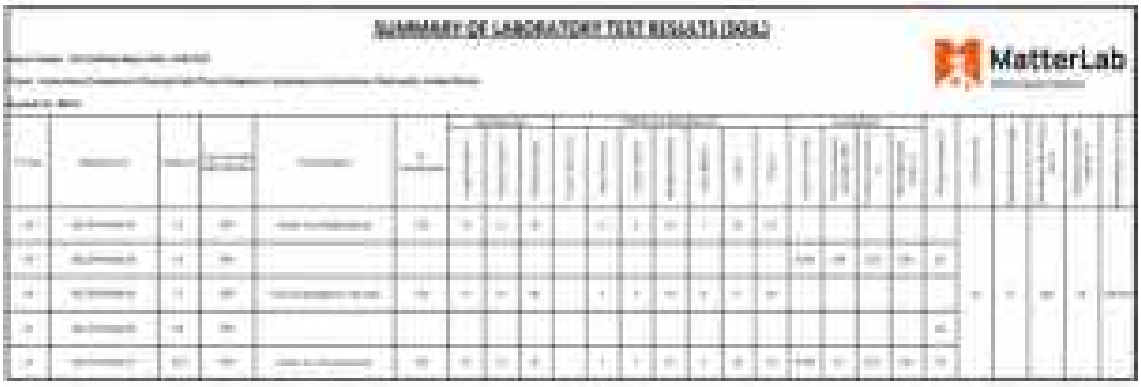
**Source: Matter Material Testing and Research Laboratory Pvt. Ltd*

It is found that all physical and chemical parameters including heavy metals are well within the FPO specified standards for Compost in the SWM Rule 2016.It is found that there is no specific Indian Standards for soil below the dumpsite or soil above waste therefore the FCO standard which is found suitable for land application without affecting the local Environment is selected. The FCO standards are taken for comparing admissibility of soil for usage /utilisation at the time of Sieving /segregation from the dumpsite

### 6.5.2. Soil

Sampling and analysis of soil collected below the solid waste dump at Ugrankunnu Kottarakkara was conducted through an NABL accredited laboratory namely, Matter Material Testing and Research Laboratory Pvt. Ltd, Kozhikode. Analysis results of soil collected from the dumpsite using borehole technique is given in table 14 and 15.

**Table.14: Analysis results of soil collected from Ugrankunnu dumpsite**



*Source: Matter Material Testing and Research Laboratory Pvt. Ltd*

**Table.15: Chemical analysis of soil collected from Ugrankunnu dumpsite**

| TEST PARAMETERS | UNIT | RESULTS | LIMITS as per Schedule II of SWM Rule 2016 for Organic Compost (FCO 2009) |
|---|---|---|---|
| pH | - | 4.80 | 6.5-7.5 |
| Electrical Conductivity | mS/cm | 0.55 | 4.0 |
| Nitrogen(N) | % | 0.21 | 0.8 |
| Phosphorus(P) | % | < 0.01 | 0.4 |
| Potassium(K) | % | 0.22 | 0.4 |
| Carbon | % | 1.37 | - |
| Carbon/ Nitrogen Ratio | % | 6.52 | <20 |
| Calorific Value | Kcal/kg | < 10.0 | - |
| Biodegradable Factor | - | < 0.1 | - |
| **HEAVY METALS-TEST METHOD: EPA 3050 (ICP OES)** | | | |
| Arsenic (As) | mg/Kg | < 0.01 | 10 |
| Cadmium (Cd) | mg/Kg | <0.005 | 5 |
| Chromium (Cr) | mg/Kg | 0.11 | 50 |
| Copper (Cu) | mg/Kg | 0.08 | 300 |
| Lead (Pb) | mg/Kg | 0.11 | 100 |
| Nickel (Ni) | mg/Kg | 0.07 | 50 |
| Zinc (Zn) | mg/Kg | 0.06 | 1000 |
| Mercury (Hg) | mg/Kg | < 0.01 | 0.15 |

*Source: Matter Material Testing and Research Laboratory Pvt. Ltd*

### 6.5.3. Leachate

The investigation done during the site visit, boring operation and sample collection of legacy waste and soil below the dump area reveals that there is no leachate generation inside the dump. Leachate was not observed within the dumpsite area during the time of baseline sampling and due to the absence of leachate sample, leachate characteristics study was not conducted

## 6.6 Risk Assessment

**Groundwater:** Pollutants from dumpsites can infiltrate into the underlying groundwater, if waste disposal practices have caused contamination of the soil. Once pollutants enter the groundwater, they can spread over a wide area, affecting drinking water sources and ecosystems. Remediation techniques often focus on preventing or minimizing further groundwater contamination.

Results of borewell sample indicates that all parameters are well within the limits specified as per IS 10500:2012. This indicates that there is no physical and chemical contamination of ground water from the existing dumpsite at Ugrankunnu, Kottarakkara, Kollam. Results of biological monitoring of borewell/ground water conducted at Ugrankunnu indicates that the coliform bacteria is slightly above the acceptable limit specified by IS 10500:2012 (Observed value = 30, Acceptable limit = 0).

Results of physical and chemical quality monitoring of three shallow wells/ground water conducted in and around Ugrankunnu dumpsite indicates that all parameters are well within the limits except pH and turbidity are slightly above the acceptable limit specified by IS 10500:2012 (Observed value of pH = 5-6, Acceptable limit of pH = 6.5-7.5, Observed value of turbidity = 1.8-4 NTU, Acceptable limit of turbidity = 1 NTU).

Results of biological monitoring of three shallow well/ground water conducted around Ugrankunnu dumpsite indicates that the coliform bacteria are slightly above the acceptable limit specified by IS 10500:2012 (Observed value = 30, Acceptable limit = 0) in one of the wells. The variations in these results are not influenced by the dumpsite. The coliform content presence can be dependent on may other factors, the primary factor is the nearness to septic tank or a faulty septic tank.

**Table.16: Risk Assesment -Groundwater**

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite – pH is acidic in nature |

| | |
|---|---|
| **Pathway** | Water, Soil |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | **Possible risks to Human health**<br>• diarrhoea<br>• Nausea and Vomiting<br>• Abdominal Pain<br>• Weakness<br>• Shortness of Breath<br>**Possible risks to Animals**<br>Animals when intake waters with pH acidic in nature it affect the health of the animals.<br>**Possible risks to flora**<br>It can decrease the availability of plant nutrients, such as phosphorus and molybdenum, and increases the availability of some elements to toxic levels, particularly aluminium and manganese. |

**Source:TSC Package A*

**Air**: Dumpsites may emit pollutants into the air through processes such as open burning of waste or the release of gases from decomposing organic materials. Airborne pollutants can include particulate matter, volatile organic compounds (VOCs), dioxins, and other hazardous substances. These pollutants can have adverse effects on air quality and human health. Measures to control and mitigate air pollution during dumpsite remediation include covering waste, implementing proper waste management practices viz., dust containment screens etc.

**Table.17: Risk Assessment -Groundwater**

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Within the limits |
| **Pathway** | Air |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | No anticipated Risks |

**Source:TSC Package A*

**Soil**: Dumpsites can contaminate the surrounding soil with a wide range of pollutants. Hazardous chemicals, heavy metals, and organic compounds can leach from the waste and accumulate in the soil, potentially posing risks to plants, animals, and humans.

**Table.18: Risk Assessment -Groundwater**

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Heavy metals etc. |
| **Pathway** | Soil |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | Possible risks to Human health |

| | |
|---|---|
| | Soils if contain substances such as heavy metals, which may be toxic to humans, can pass those substances on to humans through crop uptake, leading to unsafe foods.<br>Possible risks to Animals<br>When farm animals consume the plants grown from contaminated soil it affects the health of animals in later stage.<br>Possible risks to flora<br>Soil pollution may alter plant metabolism and reduce crop yields and cause trees and plants that may absorb soil contaminants to pass them up the food chain. |

**Source:TSC Package A*

**Bioaccumulation in Biota**: Pollutants from dumpsites can enter the food chain and bioaccumulate in plants and animals. Contaminated soil or water can be taken up by plants, and these plants may then be consumed by animals. As pollutants move up the food chain, their concentrations can increase, leading to potential health risks for humans and wildlife. Remediation efforts include restoring the ecological balance and minimizing the exposure of organisms to contaminated environments.

**Table.19 Risk Assessment - Bioaccumulation in Biota**

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Leachate and gas emission from Dumpsite |
| **Pathway** | Air, water and soil |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | **Possible risks to Human health, Animals and flora & fauna**<br>Accumulation of contaminants in plants and animals indirectly through food chain affects human health. |

**Source:TSC Package A*

## 6.7 Inferences of Baseline Conditions at Ugrankunnu Dumpsite

Sampling and analysis of physical, chemical and biological characteristics of legacy waste, soil, air, noise and water reveals that there is no much contamination in the above-mentioned environmental components due to dumping of waste at Ugrankunnu, Kottarakkara, Kollam. It can be inferred that the waste dump is having soil cover in between and covering of top with red soil helped for degradation of organic matter. The impermeable sub strata of laterite, rocky terrain may be another reason for not polluting the ground water and surrounding water environment.

# 7. Evaluation and Remediation Techniques

Remediation is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

1. Uplift of the environment- reduction in greenhouse gas emissions, soil pollution, ground water contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.

2. Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in nearby real state value and rental values.

3. Land - Dumpsite land becomes available for public use or for setting up SWM facility on the reclaimed land.

4. Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled, or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels.

For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- A total station survey for assessment of volumetric quantity of legacy waste above the ground level.
- Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- History of the site, Physical features of site, as –is/current situation and compositional analysis of waste.
- Baseline study of heavy metals in Legacy waste and Soil below,water, rainfall, soil type, surface hydrology, topography, wind direction etc. shall be studied before and after bioremediation.
- Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area

## 7.1. Quantity of Legacy Waste

Total station survey was carried out at the dumpsite for estimating quantity of legacy waste accumulated at the dumpsite. Report of total station survey conducted at the dumpsite is attached as Annexure.

The legacy waste at the Ugrankunnu dumpsite predominantly of a mix of inorganic material, stones, plastic material and including silt material. The total area of Ugrankunnu dumpsite is 1 acre 50 Cents. Based on the Total Station survey details from Kottarakkara municipality the total volume of legacy waste spread over 37.66 cents and 4.3 m height is 8245 cubic meters. With a density of the material considered to be 1.042 T/cu m the total quantity of waste dumped is estimated as 8591 T.

## 7.2 Evaluation of Technologies for Remediation of existing Dumpsite

From the quality assessment of the legacy waste, material consists of 92.69 % soil/earthen materials, 1.28 % glass waste and 6.03 % plastic waste.

The chemical analysis confirms that the scope for recovering any compost from these landfill materials is minimal since the legacy waste has degraded over the period of time

The Ground and Surface water test result are within the limits and has no contamination except in the downstream and upstream shallow wells for pH, turbidity and coliform non-compliance.

The Solid Waste Management rules 2016, Central Pollution Control Board (CPCB) and Swachh Bharat Mission guidelines recommend taking up bioremediation of legacy waste to recover land. The existing site can be reclaimed to set up any SWM facilities complying to Solid Waste Management rules 2016. Bioremediation is one of the key focus areas of Swachh Bharat Mission 2.0. The guidelines released in October 2021 expects that all the legacy historic waste dumpsites across the country are remediated and converted to green zones or as state-of-the-art Solid Waste Management facility.

There are various techniques/technologies for remediation of waste landfills. Based on the type /nature of the waste, geographical conditions, and required outcomes of the project from the project suitable project specific technique need to be selected.

i. Biomining
ii. Capping without land recovery
iii. Capping with partial land recovery (Combination of biomining and capping)

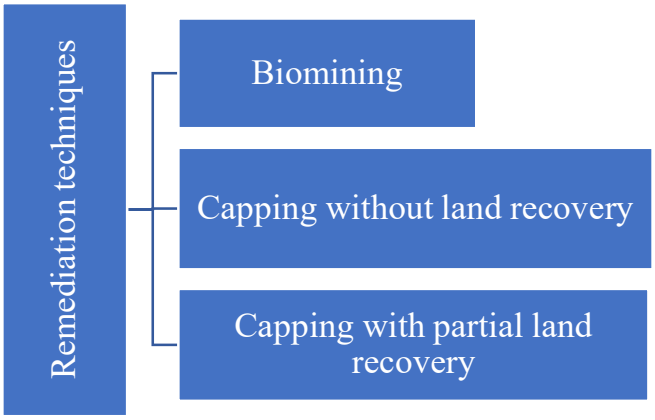



**Fig.15 Bioremediation Methods/Technologies**

i. **Biomining**

Biomining is a process in which solid wastes which have previously been landfilled are excavated and processed. The process is a sequence of processing machines laid out in a functional conveyor system and to excavate, sieve and sort the landfill material.

Biomining eliminates leachate and landfill gases by removing old waste from the top down, and turning the loosened waste into bio-treated aerobic windrows. Further process is to sieve the material to recover any bio enricher/soil//compost, RDF and other waste. The sieving machinery should consist of automated feeder system, conveyor belts to trommel. This allows for an almost total separation of waste, making it an efficient way of reusing or disposing of separated products. Ultimately the land is reclaimed.

Some of the advantages of biomining are highlighted below:

- increases the post-closure area for alternate use.
- near-zero emissions of methane and leachate.
- clearance of legacy waste at less cost than conventional capping
- reduce annual cost of management, leachate treatment and gas monitoring.
- recycle both organics and buried recyclables.
- It can achieve all this in lesser time
- Environmentally safe and green.

### ii. Capping without land recovery

Capping is the traditional method for isolating landfill wastes and contaminants. It is basically used to address large volumes of soil or waste with low levels of contamination. Caps can be of asphalt or concrete, or a layer of soil planted with grass.

Capping is a scientific process of profiling legacy waste and covering with barrier layof soil, high density polyethylene (HDPE) liner, gas collection system surface drainaa vegetative cover to minimize the percolation of rainwater into the legacy waste.

Features of capping without land recovery:

- The capped area becomes a green space and can be developed into parks/recreational areas
- Capped area will be equipped with environmental monitoring systems for posclosure maintenance to monitor pollution levels in groundwater and surface-watersources and air (especially methane emissions) at least 15 years.
- Capped area needs to be inspected periodically for settlement due to physical, chemical and biological transformation, leachate generation, erosion and naturally occurring invasion by deep-rooted vegetation. Recurring expenditure will be incurred for regular maintenance.
- On July 17, 2019, the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested bio-mining as environmentally safe and the most preferable approaches to dumpsite remediation
- SWM rules do not permit habitation over it for at least 15 years because of the danger posed by toxic gases release by the waste

Capping is a containment technology that form a barrier between a waste body or contamination source area and the ground surface, thereby minimising the exposure of humans and environmental receptors to the waste. The cap design will be such to restrict any infiltration of surface water and rainwater into the waste body accumulated and thereby reduce the potential for leaching of site contaminants. The landfill cap design generally will be an impervious clay liner, along with an efficient drainage system. Further this is covered by a layer of clean soil and plants, which ideally in is sloped to prevent rainwater and surface water from infiltrating into the legacy waste.

Recovery of landfill gas from capped dumpsite is an option for recovery of energy from the dump and for minimising emission of greenhouse gas not the environment. Landfill Capping is generally less expensive than other technologies and effectively reduce the infiltration into the landfill, controlling the leach, Minimise emissions of gas

The disadvantage of landfill capping is requirement of more space and may need periodic maintenance of drainage and inspection of covers: and the land cannot be reclaimed to be used for other purposes and also with is no recovery of recyclables from the waste.

iii. **Capping with partial land recovery**

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can linked to relevant buyers and the inert material will be capped to prevent further degradation of the environment. Capping is a containment technology that form a barrier between a waste body or contamination source area and the ground surface, thereby minimising the exposure of humans and environmental receptors to the waste. The cap design will be such to restrict any infiltration of surface water and rainwater into the waste body accumulated and thereby reduce the potential for leaching of site contaminants. The landfill cap design generally will be an impervious clay liner, along with an efficient drainage system. Further this is covered by a layer of clean soil and plants, which ideally in is sloped to prevent rainwater and surface water from infiltrating into the legacy waste.

Recovery of landfill gas from capped dumpsite is an option for recovery of energy from the dump and for minimising emission of greenhouse gas not the environment. Landfill Capping is generally less expensive than other technologies and effectively reduce the infiltration into the landfill, controlling the leach, Minimise emissions of gas

Features of capping without land recovery:

- The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.

- Ensures short -term sustainability and environmentally sound treatment of legacy waste. Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area

## 7.4 Comparison of various Remediation Technique

Various options for remediation of existing dumpsite at Ugrankunnu has been examined by considering its quantity, characteristics of waste, stage of degradation of organic waste, percentage of high calorific value material present in the dumpsite, potential for utilisation of land for other purposes and results of baseline environment and geotechnical survey conducted at the site, the following the strategy is suggested for remediating the site.

**Table 20: Suggested method for Remediating Dumpsite at Ugrankunnu**

| Sl No | Remediation Technique | Analysis/Justification | Suitability to Ugrankunnu |
|---|---|---|---|
| 1 | Biomining | • Viable option based on baseline environmental assessment, stage of degradation of organic waste, absence of toxic contamination in the dumpsite as well as in the surrounding environment<br>• Benefit of reclamation of land for setting up of SWM facilities<br>• Less expensive compared to other techniques. | Recommended |
| 2 | Capping | • It is an accepted method but considering the land constraints and requirement of land for SWM management the option is not viable<br>• The waste dumped at the site are partially capped periodically but scientific capping may not be suitable for the dump at Ugrankunnu. | Not Recommended |
| 3 | Combination of biomining and capping((Capping with land recovery) | • Suitable for landfill with large land area available<br>• Avoids the forward linkages for inerts | Not recommended |

*Source: TSC Package A*

# 8. TECHNICAL DESCRIPTION OF THE SELECTED OPTION

Evaluation of various techniques for remediating the existing dumpsite reveals that biomining is the best option for remediating the dumpsite at Ugrankunnu, Kottarakkara.

The objective is to recover/reclaim land from the existing site and use the same for setting up SWM facilities in the reclaimed land. This rules out other remediation techniques except Biomining. The legacy waste at the Ugrankunnu dumpsite is a mix of soil/earthen material, plastic, glass and inerts. The technique/process recommended for the bioremediation of legacy waste at Ugrankunnu is Biomining.

## 8.1 Planning for dumpsite remediation

The initial step of a dumpsite remediation project is preparing and planning the site for after having carried out the estimation of the material, processing method, various parameters such as geological features, the stability of the surrounding area, proximity of ground water, and determine the fractions of usable soil, recyclable material, combustible waste, and hazardous waste at the site Factors considered in planning and site preparation are as below

- Site Location (Maps/GIS)
- Geology
- Surface and Ground Water
- Quality of Ground Water
- Land environment
- Landscape
- Depth and Volume of Waste
- Type of Waste
- Type of Waste disposal

### 8.2 Bio mining Process/Step

Process of Bioremediation commences after the site preparation. This cycle commences with the excavation of materials and ends with the disposal of recovered outputs.

The process involves




**Fig.16: Flowchart or process of biomining**

There are two options that can be considered for stabilising the waste after excavation;

- ***Option 1***: Windrow formation
- ***Option 2***: Coning method wherein legacy waste is made as a heap continuously so as to expose to air and is the recommended option.

## 8.3 Proposed Design of Bioremediation (Biomining)

It is proposed to carry out the bioremediation works over a time frame of about 5 months. The basis of design of this bioremediation works are the physical analysis, chemical analysis reports, field inspections, topographical conditions, and knowledge and understanding of the process. The proposed steps for executing biomining process is explained in below Fig 17:

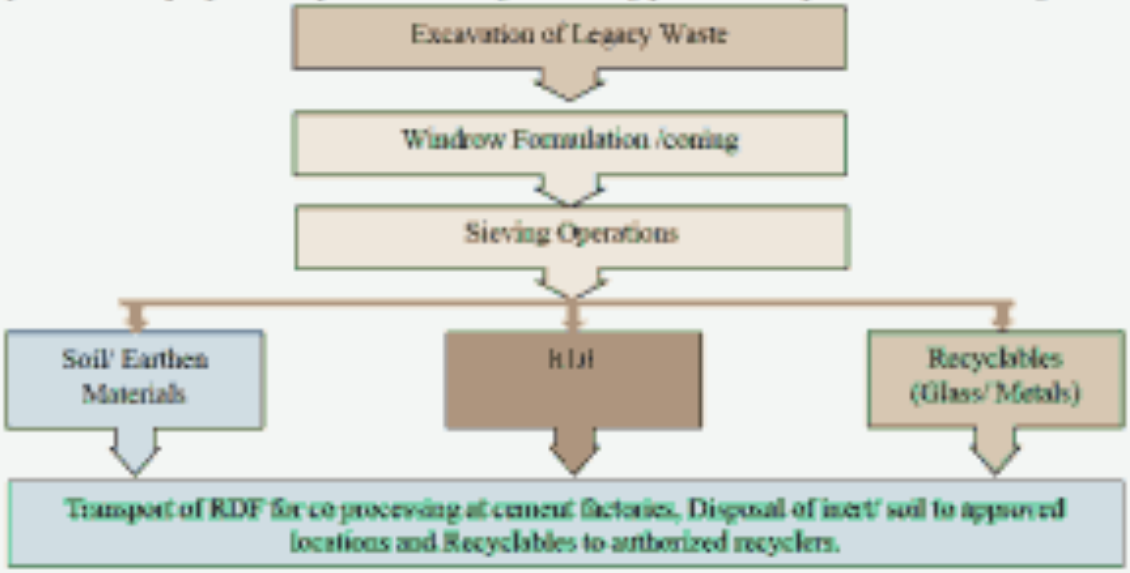



**Fig.17: Proposed steps for performing biomining process**

## 8.4 Project Design Basis

Based on the above the Project Design basis can be summarised as below table 21

**Table 21: Project design basis of dumpsite remediation at Ugrankunnu**

| Sl No | Project description | Details | Units | Remarks |
|---|---|---|---|---|
| 1 | Site Location | Ugrankunnu | | |
| 2 | Total Land Area | 6070 | Sq. m | Dump site is only 37.66 Cents out of 1 acre 50 cents total land |
| 3 | Disposal Site Used till | 2018 | Year | |
| 4 | Legacy Waste Disposed over | 1523.7 | Sq. m | |
| 5 | Legacy Waste Volume | 8245 | cu m | |
| 6 | Quantity of Legacy waste | 8591 | Tonne | Density @1.042 T/cu m |
| 7 | Quantity of soil | 7963 | Tonne | Density @1.042 T/cu m<br>Soil Earthen Material-92.69 % (7642.3 cu m) |
| 8 | Quantity of waste (plastic and glass) | 627.98 | Tonne | Density @1.042 T/cu m<br>Plastic – 6.03 % (497.17 cu m)<br>Glass-1.28 % (105.5 cu m) |
| 9 | Excavation Duration | 120 | Days | |
| 10 | Transportation and Disposal | 130 | Days | |

**Source:TSC Package A*

The project duration is 5 months. It is expected that Mobilisation, machinery installation period is concurrent and is required to set up a 100 to 120 TPD production output sieving and sorting plant and machinery infrastructure. Mobilisation period of one month and operational period of 4 months at site and transportation of material is concurrent. The design considers 3 months of sieving operations/Baling with completion of mobilisation and setting up of plant within 30

days of commencement of Contract. Based on this, an average of 100 to 120 tonnes per day of excavation is to be carried out.

## 8.5 Basis of Plant & Machinery Estimation

The details of vehicle, trips and machinery required for remediating dumpsite at Ugrankunnu is given in following tables 22 and 23

**Table 22: Details of vehicle and trips required for remediating Dumpsite at Ugrankunnu**

| Sl. No | Description | Soil/ Earthen Materials | RDF | Recyclables (Glass) | Inerts |
|---|---|---|---|---|---|
| 1 | Quantity (Tonne) | 7803 | 518 | 109 | 160 Estimated about 2% in Earthen Material as Inerts |
| 2 | Volume of Tipper Truck (cu m) | 16 | 10 | 10 | 10 |
| 3 | Quantity in a Truck (Tonne) | 15 | 10 | 10 | 1 |
| 4 | No of Trips Proposed per day (No) | 4 | 1 | 1 | 1 |
| 5 | Distance to transport RDF to Cement Plants in neighbouring states for Co-incineration -Km | | 390 | | |
| 6 | Distance to dispose Soil Earthen Material for median formation in ongoing NH/outer ring road -Km | 35 | | | |
| 7 | Distance to transfer recycling glass in neighbouring states -Km | | | 150 | |
| 8 | Estimated no of trips per day (No) | 4 | 1 | 1 | 1 |
| 9 | Estimated No of Trucks (No) | 4 | 1 | 1 | 1 |
| 10 | Duration for completion of task (days) | 110 | 51 | 10 | 17 |

*Source:TSC Package A*

**Table 23: Details of machinery for remediating Dumpsite at Ugrankunnu**

| | Activity | Quantity | Remarks |
|---|---|---|---|
| I | **Excavation** | | |
| i | Total Quantity (Tonne) | 8591 | |
| ii | Estimated quantity of excavation per day (Tonne) | 100 | Considered for 8 hrs working over 90 days |

| | Activity | Quantity | Remarks |
|---|---|---|---|
| iii | Excavator required for excavation of waste heap | 2 no | 10 Cu m capacity |
| 2 | **Transportation of materials within the site** | | |
| i | Required no of Tipper Trucks per day | 2 | @10 cu m capacity truck for 8 hrs |
| 3 | **Windrow/Stabilisation process** | | |
| i | Required no of front end loader for heap elongation / Windrow of the Legacy waste transported/ tipped from tippers and waste turning | 2 no. | 0.26 cu m capacity<br>(taken as 8 to 10 cu m/hr minimum) |
| 4 | **Sieving and Baling process** | | |
| i | No of sieves required for Legacy Waste sieving | 1 no. | 100 to 120 TPD Sieving Machine with dual trommel with sieve sizes of 30mm and 6 mm with Feeder, trammel, accept and reject conveyors |
| ii | No of baling machine required | 1no. | Baling Machine to process RDF material into blocks by hydraulic pressing 50 T capacity |
| iii | Front End loader with Backhoe for loading of materials to sieve | 2 no. | Taking 10 cu m/hr to be sieved |

*Source: TSC Package A*

## 8.6 Summary of Plant & Machinery and Manpower

### 8.6.1 Plant &Machinery

The Project estimates requirement of 2 no of front-end loader with backhoe along with 6 tipper trucks, 1 excavator for site activities and sieving /baling machine as detailed below. Generator for temporary power supply and operations are also required. **It may be noted that the details of plant, machinery, manpower, electrical power, fuel etc shown is only indicative and the contractor is required to propose and arrange for all necessary requirements to complete the works in the stipulated time and standards.**

**Table 24: Details of plants and machinery for remediating dumpsite at Ugrankunnu**

| Sl No | Vehicle Type | Quantity (Nos) |
|---|---|---|
| 1 | Backhoe Front end loader<br>0.24 cu m Capacity | 2 |
| 2 | Excavators (with 8-10 cu m/hr) | 2 |
| 3 | Trucks for internal Movement 10 cu m | 2 |
| 4 | Trucks for Earth/RDF etc 16 cu m capacity | 4 |
| 5 | Trucks for RDF 10 cu m capacity | 1 |

| Sl No | Vehicle Type | Quantity (Nos) |
|---|---|---|
| 6 | Trucks for Inert/Recyclable/Glass 10 cu m capacity | 1 |
| 7 | Sieving Machine 100 to 120 TPD with dual trommel with sieve sizes of 30mm and 6 mm Feeder, trommel, accept and reject conveyors | 1 |
| 8 | Baling Machine 50 T | 1 |

** The details of Plant and Machinery shown is only indicative and the contractor is required to propose own design and capacity to complete the works in the stipulated time and standards.*

### 8.6.2 Manpower Requirement

Manpower requirement is expected to be about 12 labourers, 2 Supervisors, 2 technicians and 1 Health and Safety Officer other than the Plant and Machinery operators.

**Table 25: Details of manpower required for remediating dumpsite at Ugrankunnu**

| No | Description | Quantity Nos |
|---|---|---|
| 1 | Supervisor | 2 |
| 2 | Technicians/ Support Staff | 2 |
| 3 | Health and Safety Officer | 1 |
| 4 | Labour | 12 |
| 5 | Security Staff | 3 |
| | **Total** | **20** |

*Note: Environmental and Social Safeguard experts are considered to be outsourced at the time of execution of the project by the contractor. The details of manpower shown is only indicative and the contractor is required to propose necessary manpower to complete the works in the stipulated time and standards.*

### 8.6.3 Electrical Power

**Table 26: Electrical power details**

| Machineries | Required Electrical Load (KW) | Working Hr. | Total Units (KW-Hr) |
|---|---|---|---|
| Baling Machine | 5 | 4 | 20 |
| Ballistic Separator | 15 | 6 | 90 |
| Magnetic Separator | 5 | 6 | 30 |
| Total | 25 | | 140 |

** The details of power requirement shown is only indicative and the contractor is required to propose and arrange necessary power supply to complete the works in the stipulated time and standards.*

### 8.6.4 Fuel diesel for vehicle

**Table 27: Fuel /diesel for vehicle**

| Description | Liters per Day |
|---|---|
| Fuel - Diesel Mobile Trommel (12 liters/hour) | 96 |

**The details of fuel/ diesel requirement shown is only indicative and the contractor is required to propose and arrange necessary fuel/diesel supply to complete the works in the stipulated time and standards.*

### 8.6.5 Water Requirement

**Table 28: Water Requirement**

| Description | Liters per Day |
|---|---|
| Water - Liters per day for domestic purpose | 250 |
| (Source – Municipality water Supply) | |

*Source:TSC Package A*

## 8.7 Leachate Management

Leachate generation is predominantly due to rainwater getting mixed with the solid waste when the material is not covered. The Ugrankunnu dumpsite has a temporary capping with soil which was carried out by the ULB. The ground and surface water test carried out in the open shallow wells nearby and bore well at site do not indicate contamination due to leachate. Further chosen window of six months for the project from the month of October would have relatively less rainfall and especially the three active months of January to March, 2024 would be the peak dry season in the State.

However, when legacy waste heaps are opened up, some leachate may likely tickle out. This is not produced by the formation of windrows or cones, which in fact help to dry out the waste through aerated decomposition. Since the material is older, the only possibility of moisture addition is rainfall unlike in fresh waste where the material itself contains 20-30% moisture.

Channels must be created to lead the oozing leachate into a lined depression or pond for treatment as required

## 8.8 Fire Management

Though the existing site is temporarily capped with a layer of soil and most unlikely does not consist of fires and flames. However, there is a possibility of fire incident when any high calorific material like plastic is being taken out, baled and stacked at the site. It is important that a fire risk associated with material handling need be considered at the time of remediation activities are undertaken. It is required to conduct risk assessment and prepare on-site emergency plan prior to commencement of remediation work. It is also suggested that the contractor to liaison with Fire and Rescue Services and deploy a fire tender at site as stand by during the works. Also, the following should be considered under fire safety:

a. Fire Fighting System including fire hydrant, pressure pumps, 5000 Ltr (min) water storage, adequate hose reel and fire extinguishers to be provided at site.

b. Alternate source of power (DG)
c. Manual Fire Alarm System with evacuation plan
d. Regular check, maintenance of equipments for firefighting (before initiating work and then at interval of 1 months thereof)
e. Training to all men. (Before initiating work and then at interval of 3 months thereof)
f. Maintaining fire line while storage of material (RDF). RDF to not exceed 10% of total estimated waste at site at any given time.
g. any other requirement in consultation with local Fire & Rescue Services office.

## 8.9 Transportation /Traffic Management

Considering the limitation of access road which is only 3 m wide, and due to the surrounding inhabitants and functioning of an educational institution within 500 m, it is critical that the site activities and transportation are to be carried out with minimal disruptions. Necessary precautions should be taken at the time of transportation of materials within and outside the site. Proper transportation/traffic plan is to be in place where movement of truck has to be restricted during the peak hours such as 7.30 am to 9.30 am and further from 2 pm to 3.30 pm. Further details on transportation are available are in Sec 3.9 of ESIA report. (Vol II- Annexure)

## 8.10 Temporary Site Facilities

There are no facilities currently at the Ugrankunnu dumpsite. It is necessary to build/ install temporary infrastructure for execution of this project such as electrical generators and associated electric panels, site office, rest rooms and area for storing inert waste till transportation.

## 8.11 Space Constraints

The total land area of Ugrankunnu is 1 acre 50 cents and the dumpsite occupy an area of 37.66 cents (i.e. spread over an area of 1525 Sq. m). The rest of the plot occupies MCF, RRF, Rest Rooms, Toilet and Crematorium due to which further open space is limited.

The remediation works require a working area for a minimum of 100 to 120 TPD of waste for windrow formations, sieving, sorting and baling operations. Temporary site facilities including machinery parking /repair are also required. This space constraints necessitates additional adjacent land of area about 1500 – 2000 sq.m. This much area is required to be leased even

with coning or windrow method of stabilisation. The map showing plot availability in the area near to Ugrankunnu dumpsite are shown below. The map showing plot availability in the area near to Ugrankunnu dumpsite are shown below.in Fig 18




**Fig.18: Proposed steps for performing biomining process**

Proposed Site Management Plan for Bio mining activity at Ugrankunnu dumpsite is given in Fig.19

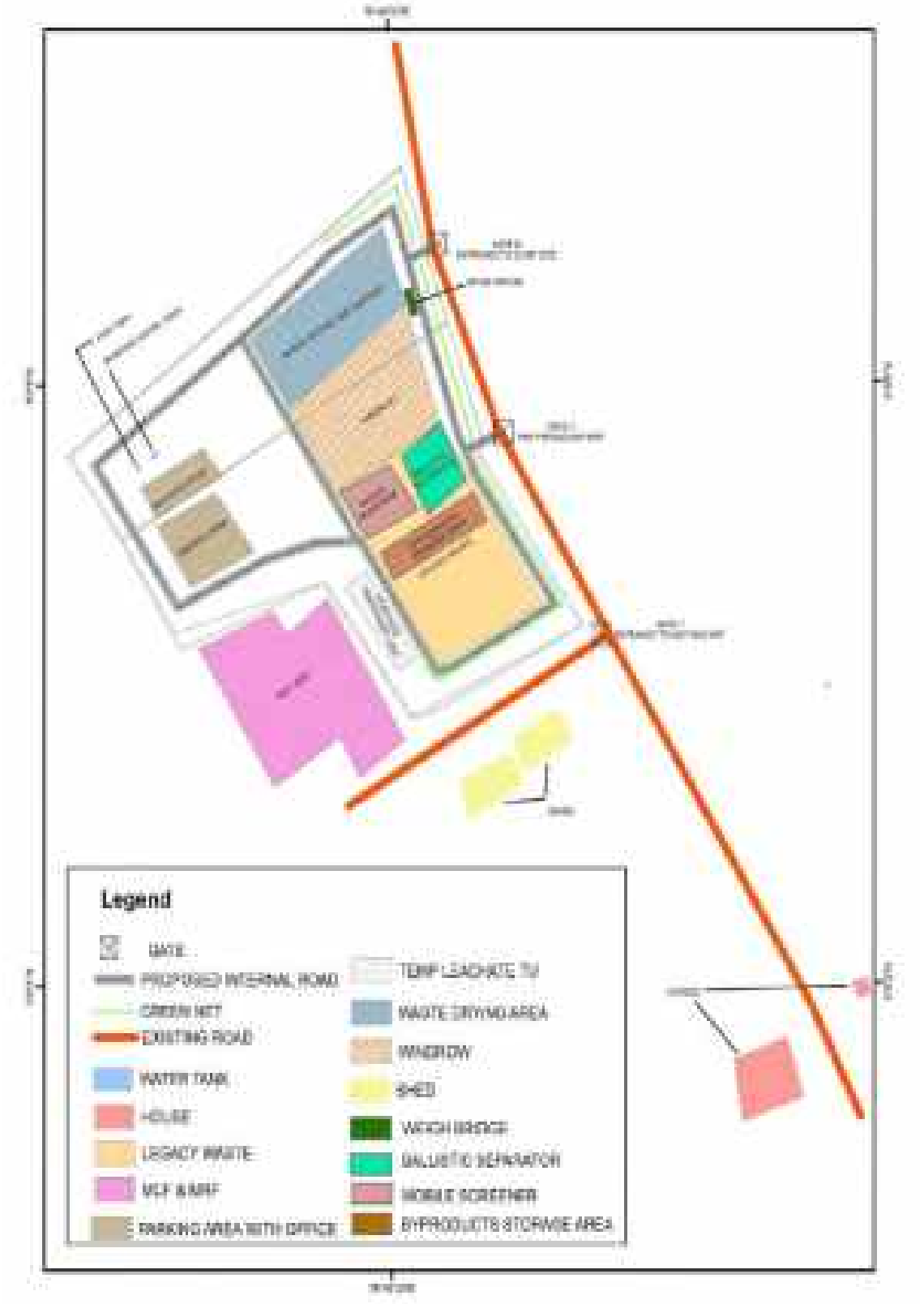



**Fig 19: Proposed Site Management Plan**

# 9. SCOPE OF DISPOSAL INCLUDING LOCATION OF DISPOSAL FOR RDF, BIO SOILS, C & D WASTE, AND OTHERS AS PER LOCAL DEMANDS -FORWARD LINKAGES

It is expected that 8591 Tonnes of legacy waste is to be disposed. The components to be disposed by bio mining process is listed in below table 29

**Table 29: Details of Legacy waste components for disposal**

| Description | Soil/ Earthen Materials | RDF | Recyclables (Glass) | Inerts /Rejects (Estimated about 2% in Earthen Material as Inerts) |
|---|---|---|---|---|
| Quantity (Tonne) | 7803 | 518 | 109 | 160 |

**RDF**: In the absence of cement industries in the State of Kerala to consume the RDF generated, it would necessitate the transportation of the generated RDF to factories in distant locations in neighbouring States and this would enhance the cost of the bio-remediation.

The possible forward linkages identified are M/s Dalmia Bharath Limited Cements, Ultratech Cements and Chettinad Cement Corporation which are situated at Tiruchirappalli, Tamilnadu which is approximately 390 kms from dumpsite at Ugrankunnu.



**Fig.20: Possible forward linkages for RDF disposal (nearby cement plants for co-incineration)**

**Recyclables:** Typically, these would be predominantly glass and iron, which would be sent to recyclers and traders of recyclables within the state or outside the state.

**Soil Enrichers/ Earthen Materials:** This is essentially fine soil with size below 8 mm having a higher organic content, which will be used for use in the agricultural sector. Primarily, this will be used in the Government Social Forestry, Nurseries and similar projects

Recommended utilisation are;

- For filling of land for playground, formation of medians in the highways/ ring roads/ Vizhinjam port and similar construction sites within the state.
- A part of earthen material approximately 20% can be used for filling the low lying areas within the site
- Another feasible option is to use as daily cover in sanitary landfill facilities.
- Stabilised organic manure recovered from the dumpsite after processing in Windrows Sieving ,Value Addition and Packing is a viable option for utilisation in the nearby areas for agricultural purposes
- Remaining 80% soils ,gravel and stones recovered from the dumpsite can be utilised for filling of land in nearby areas other than paddy fields

The standards specified in the SWM Rule 2016 for organic compost has been compared for ascertaining use of bio soil for agriculture/filling of land. The quality analysis of waste as well as bottom soil reveals that most of the toxic parameters including heavy metals are well within the specified limits. The standard specified in the SWM Rule 2016 is followed. Dumpsite is having solid waste and the resources recovered, like bio earth, which can be used as it contains compost and organic matter in stabilised form. It is also found that there is no standard specified for heavy metal in soil in the point of utilisation of land for agricultural purposes

# 10. PROJECT COST

The Project cost estimation for bioremediation of legacy waste at Ugrankunnu is based on the Project Design basis mentioned above paragraphs.

The Capital Cost include site preparation, execution of biomining process, recovery of materials, transportation of material and temporary site facilities/mobilisation cost for the Project. The details of the tentative capital costs with rates are provided below.

Operation cost for the project include the costs to be incurred every month. These costs include vehicles, fuel expenses, Manpower cost and other running costs.

## 10.1 Breakdown of Project Cost

Important components of implementation of bioremediation process of Ugrankunnu dumpsite are briefed below;

1. Site Preparation
    a) Leasing of land for site operations
    b) Permits and licences
    c) Levelling /Clearing of existing vegetation
2. Mobilisation
    a) Setting up Temporary facilities
    b) Setting up plant and Machinery
    c) Fire Management
3. Works

    Excavation, Sieving, Sorting, /windrow, baling, disposal and levelling as required at 100-120 TPD per day
4. Post works levelling of site
5. Environmental Monitoring and handing over the site

## 10.2 Project Cost Estimation

The Project cost estimation for bioremediation of legacy waste at Ugrankunnu is as given below table 30.

**Table 30: Estimated project cost for remediating dumpsite at Ugrankunnu**

| Items | | Quantity | Rate (Rs) | Months | Duration in days | Amount (Rs) | Remarks |
|---|---|---|---|---|---|---|---|
| **Site Preparation** | | | | | | | |
| i. | Land Lease or Purchase | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | |
| ii. | Clearing of site | [redacted] | | | [redacted] | [redacted] | Include Dumpsite and lease land (2 no JCB and Tipper) |
| **Mobilisation** | | LS | | | 30 | 0 | |
| **Approvals and Licences including Environmental Monitoring** | | LS | | | 30 | [redacted] | |
| **Machinery installation** | | | | | | | |
| i | Sieving Machine /Conveyors | | | | 15 | 0 | |
| ii | Baling Machine | | | | 15 | 0 | |
| iii | Generators & Electric Panel | | | | 15 | 0 | |
| **Works** | | | | | | | |
| **I. *Manpower*** | | | | | | | |
| i. Supervisors | | [redacted] | [redacted] | | | [redacted] | [redacted] |
| ii. Technicians | | [redacted] | [redacted] | | | [redacted] | [redacted] |
| iii. Labour | | [redacted] | [redacted] | | | [redacted] | [redacted] |
| iv. Health &Safety Officer | | [redacted] | [redacted] | | [redacted] | [redacted] | |
| v. Security Staff | | [redacted] | [redacted] | | | [redacted] | [redacted] |
| **II. *Plant &Machinery*** | | | | | | | |
| i.Excavator for excavation of Legacy waste | | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | Capacity 10 to 15 cum/hr |
| ii.Front end loaded with backhoe for Windrow | | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | Capacity 10 to 15 cum/hr |

| Items | Quantity | Rate (Rs) | Months | Duration in days | Amount (Rs) | Remarks |
|---|---|---|---|---|---|---|
| iii.Front end loader with backhoe for loading to sieve | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | Capacity 10 to 15 cum/hr |
| iv.Tipper Truck for Internal use | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | Capacity 10 cum |
| v.Truck for transporting of Recyclables | [redacted] | [redacted] | | [redacted] | [redacted] | Capacity 10 cum 150km [redacted] |
| vi.Truck for transporting of RDF | [redacted] | [redacted] | | [redacted] | [redacted] | Capacity 10 cum 390 km [redacted] |
| vii.Tipper Truck for transporting earthen material | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | Capacity 16 cum 35 km [redacted] |
| viii.Sieving Machine | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | Capacity 100 to 120 TPD |
| ix.Baling Machine | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | Capacity 50 TPD |
| x.Generators & Electric Panel | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 250 kva |
| xi.For generator fuel (Diesel) | [redacted] | [redacted] | | [redacted] | [redacted] | Generator Fuel [redacted] |
| xii.Fire Safety Equipment | | LS | [redacted] | [redacted] | [redacted] | |
| | | | | | | |
| **Total Cost** | | | | | [redacted] | |
| **Post Contract Activities** | | | | | | |
| Environmental and Social Monitoring | | | | | [redacted] | Included in ESMP |
| | | | | | | |
| **Contractor's Overheads and Profit** *(15% of Total Cost)* | | | | | [redacted] | |
| **GST** *(18 % of Total Cost)* | | | | | [redacted] | |
| **Total** | | | | | [redacted] | |
| **G.Total Considering Average Cost index for Kerala based on DSR 2018(1.35)** | | | | | [redacted] | |
| **Average Cost index for Kerala based on DSR 2018 is 1.35 at present. Considering the same, the Grand Total Cost per cum** | | | | | [redacted] | Total 8245 cum |
| | | | | | **Rounded to** [redacted] | |

Note. Rental/Hire charges considered are based on monthly rental rates. Estimated quantity of waste and composition is based on topographic survey and lab analysis and may vary.

*Source:TSC Package A*

**Table 31: Funding for the project**

| Item | External (70%) Rs. | State Govt.(30%) Rs. | Total cost Rs |
|---|---|---|---|
| Bioremediation | [redacted] | [redacted] | [redacted] |

*Source:TSC Package*

# 11. PROJECT IMPLEMENTATION PLAN

## 11.1 Timeline

Proposed timeline for the activity is given below.

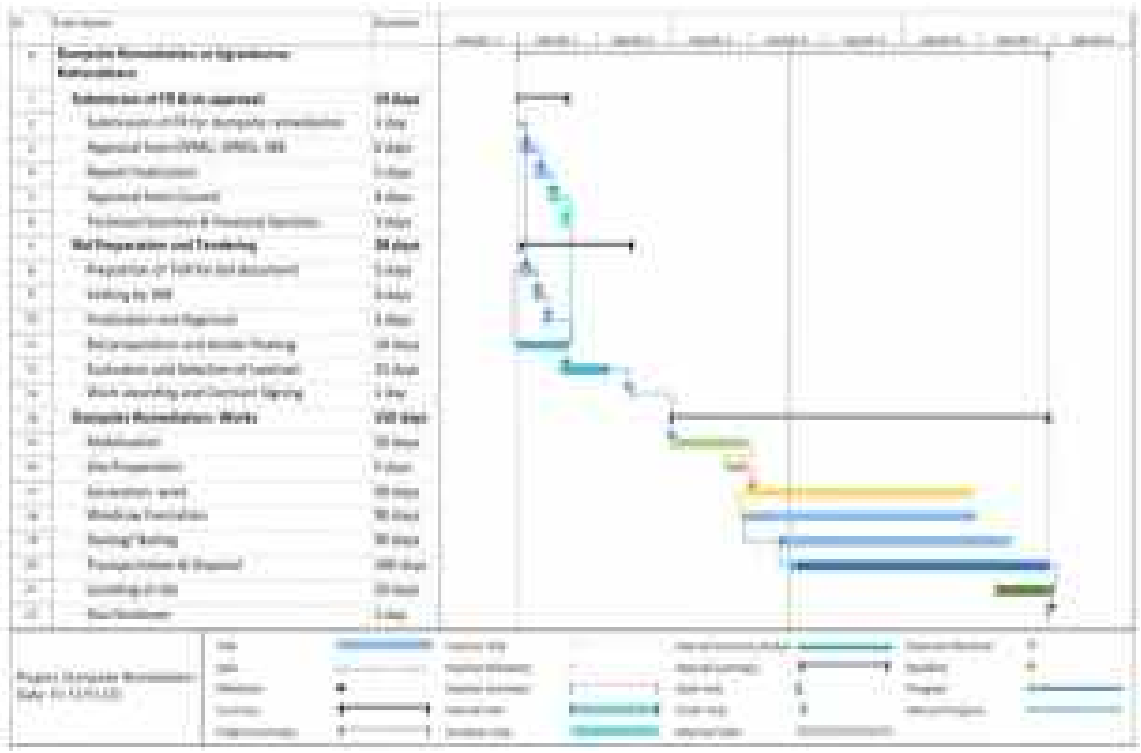


**Fig.21: Proposed timeline for Ugrankunnu dumpsite biomining**

The project duration is estimated as 6 months and all works of bio-remediation is to be completed before 31/03/2024.

## 11.2 Contract Model

For the timely and effective reclamation of the legacy dumpsites, a competent Agency should have the capability to undertake the physical process of **segregation and processing**, as well as the forward linkages for the **safe disposal / utilisation** of the segregated fractions (aggregates) generated from the legacy waste.

The project considered as a fast track critical project, its implementation will have to be with a clear time bound plan and action, supervision and control. It is recommended to tender out this project to vendors as an open tender who are technically qualified, capable to source all

required plant and machinery with proper supervision. The tendering shall be on rated criteria with 30% weightage to technical offer and 70% to financial offer.

The Contract shall also explicitly state the requirement of disposal to approved locations and shall have valid receipt /acceptance documentation for each trip. The success of the project would be based on the ability of the selected agency to dispose / utilise all the fractions effectively. Hence, it is recommended that the bid document should clearly insist on the time bound disposal of these fractions generated from the legacy waste. The qualifying criteria should unequivocally stipulate that the bidder should showcase their proven tie-ups with established third parties for the forward linkages for the time-bound disposal of all fractions as per the existing regulatory requirements.

As per the provisions of the SWM Rules 2016 and the CPCB Guidelines, the entire bio-remediation process has to be carried out under the close monitoring of the respective State Pollution Control Board (SPCB). Additionally, there are few regulatory approvals to be obtained, which will ensure that the entire bio-remediation process, including the safe disposal / utilisation of the material produced is carried out under the close monitoring of the Regulatory Agencies.

Bid document should stipulate that the entire work should be undertaken following the regulatory parameters applicable under law and that the bidder should have the necessary licenses or should obtain the necessary licenses as prescribed by law.

An indicative list of approvals/sanctions/licenses to be obtained are as follows:

- Authorization from the State PCB under Solid Waste Management Rules 2016.
- Consent to Establish under Air and Water Act from State PCB.
- Consent to Operate under Air and Water Act from State PCB.
- Registration with the local Urban and Local Body for Professional Tax.
- License for Petrol and Diesel Storage (if applicable)
- Legal Meteorology Stamping for Weigh Bridge and weighing scales.
- LPG and Oxygen usage NOC from Urban and Local Body (if applicable)
- Electrical Energization for power supply.
- Authorization from Electrical Inspectorate for operation of DG set.
- License for extraction of ground water from bore wells for meeting
- domestic/process needs.

- Electrical O&M personnel along with their wireman permits and supervisory certificates.
- PSARA License, Gunman License from the Security Company/Agency

The quantity of legacy waste to be remediated is less in volume and therefore there is a possibility that large scale companies may not participating in the tender. It is understood from market sounding that minimum of 1,00,000 Tonne of legacy is the minimum for such companies to participate. It is recommended that the tender qualification criteria shall cater to medium companies to participate as well.

Alternatively, if the project is considered cluster wise by adding few more ULBs having dumpsite together, the large-scale companies can be attracted to participate in the tender.

# 12. PROJECT BENEFITS

Following are the few benefits of the project;

*Reclamation of Land*: An area of 37.66 cents will be reclaimed and can be utilised by Municipality for setting up of other projects related to Waste Management A contamination assessment is to be carried out before any public use project is taken up at the location.

*Environmental Protection*: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By cleaning up contaminated sites, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity. The project shall arrest GHG emissions from the legacy dumpsite.

*Health Improvement*: Remediation projects reduce these risks, leading to improved public health outcomes and a reduction in waterborne and airborne diseases.

*Enhanced Water Quality*: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to the safe drinking water.

*Aesthetic and Social Benefits*: Remediation of legacy waste dumpsite can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents. Uncontrolled waste dumping will be stopped.

*Operational & Life cycle Aspects:* Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through bio-mining process.

*Employment:* During remediation & post- remediation period, requirement of un-skilled labor can be fulfilled by sourcing from local areas

# 13. CONCLUSION

As the **Solid Waste Management Rules, 2016** mandate bio-mining of legacy waste instead of 'capping', this is the essential way forward for the reclamation of the existing legacy dumpsites in the State of Kerala.

Evaluation of various techniques for remediating the existing dumpsite reveals that biomining is the best option for remediating the dumpsite at Ugrankunnu, Kottarakkara. The objective is to recover/reclaim land from the existing site and use the same for setting up SWM facilities in the reclaimed land.

The risk assessment carried out during the detailed investigation on environmental and geotechnical aspect do not indicate any risk or mitigation requirement. However, during execution close Environmental monitoring is mandatory to ensure compliance to regulations of Pollution Control Board. It is important that a risk assessment and an onsite emergency plan is ready as a part of Fire Management prior to commencement of dumpsite bio remediation and bio mining. All precaution with regard to leachate management shall also be ensured prior to commencement of any work. It is also important to ensure compliance to all required environmental and social safeguard during the execution of work as well as after completion of work.

The proposal is to remediate the dumpsite in compliance with the Municipal Solid Waste Management Rules 2016 and other National and State Guidelines for management of Solid Waste by sustainably removing the accumulated legacy waste and to use site for other activities.

Sampling and analysis of physical and chemical characteristics of legacy waste, soil, air, noise and water reveals that these environmental components are not much contaminated due to dumping of waste. It can be inferred that the waste dump with soil cover in between and red soil top covering helped the degradation of organic matter. The impermeable sub strata of laterite, rocky terrain may be another reason for not polluting the ground water and surrounding water bodies.

The total volume of legacy waste is estimated to be 8245 cubic meters spread over 37.66 cents and 4.3 m height. With a density, considered to be 1.042 Tonnes/cum, the total quantity of waste dumped is estimated as 8591 Tonnes.

It is estimated that out of 8591 Tonnes of legacy waste, approximately there are 7803 Tonnes of soil/earthen materials, 518 Tonnes of materials for RDF/plastics, 109 Tonnes of Recyclables/Glass along with an expected 2% Inert, which is approximately 160 Tonnes.
Evaluation of various techniques for remediating the existing dumpsite reveals that biomining is the best option for remediating the dumpsite at Ugrankunnu. The remediated land can be utilised for establishing other solid waste management activities of Kottarakkara Municipality.

The bioremediation works has been designed on the basis of physical analysis, chemical analysis reports, field inspections, topographical conditions.

As Kerala does not have facilities to consume the RDF generated, it has to be transported for co processing at cement factories in neighbouring States and this would enhance the cost of the bio-remediation. The possible forward linkages are identified in the nearby state, Tamil Nādu and is approximately 390 km from dumpsite at Ugrankunnu. This implies that the cost of transportation of the RDF will be high. Recyclables would be predominantly glass and iron, which would be sent to approved recyclers and traders of recyclables. However, there are possibilities for utilisation of recyclables/RDF in the neighbouring state and is recommended to be the responsibility of the successful bidder.
Soil and stones can be used for filling of land for playground, formation of medians in the ongoing highways, ring road projects or Vizhinjam port, and similar construction sites. A part of soil/stones can also be disposed in low lying areas within the site. It is advisable to avoid use of this soil for agriculture/ fruit bearing tree plantations. Another feasible option is to use as daily cover in sanitary landfill facilities.
The project duration is proposed to be 5 months. It is expected that the time for mobilisation, and installation of machinery would be concurrent. It is required to set up a 100 to 120 TPD production output sieving/ sorting plant and machinery infrastructure. The design considers 3 months of sieving operations/baling with completion of mobilisation and setting up of plant within 30 days of commencement of contract. Based on that, the excavation capacity is to be on an average of 100-120 tonnes per day.

Total Project cost including all machineries required for processing, transporting is estimated to be [redacted] which accounts to be about [redacted] (including GST, EMP and SMP cost and cost index).

# ANNEXURES

| Annexures | Description |
|---|---|
| ANNEXURE A | GEO TECHNICAL AND WASTE ANALYSIS REPORT |
| ANNEXURE B | ENVIRONMENTAL TEST REPORT |
| ANNEXURE C | SITE VISIT PHOTOS |
| ANNEXURE D | SITE MANAGEMENT PLAN |
| ANNEXURE E | CONTOUR MAP |
| ANNEXURE F | PROPOSED OPERATIONAL PLAN |
| ANNEXURE G | LSGD GUIDELINES FOR REMEDIATION OF LEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION |

MatterLab
Where Quality Matters

Report Number: **ML/GT/2426/220/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE A OF KSWMP AT UGRANKUNNU, KOTTARAKKARA, KOLLAM DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | KSWMP Technical Support Consultants |
| Address | : | Kalayil Residency, TC30/1320, Haritha Giri Road, Kanjirampara P.O, Kerala, India |
| Contact Person | : | Mr. Dileep Kumar M |
| Project No | : | GT-195 |
| Project Name | : | Geotechnical examination of dumpsite under package A of KSWMP at Ugrankunnu, Kottarakkara, Kollam district. |
| Owner | : | - |
| Project Location | : | Kottarakkara, Kollam |
| Tel / Fax No | : | 9895523767 |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 05-07-2023 | 1st Submission | Dr. Gautham Adapa |  |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Dr. Jimmy Thomas | Geotechnical Expert, Consultant, MatterLab |  |
| Approved by: | Freddy Soman | General Manager, MatterLab |  |



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2 SCOPE OF WORK ..... 4

3 GEOTECHNICAL INVESTIGATIONS ..... 4

4 DUMP WASTE SAMPLING FROM SITE ..... 6

5 LABORATORY ANALYSIS ..... 6

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## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results

Soil

Waste

i) Physical

ii) Chemical

# 1 INTRODUCTION

Matter Material Testing and Research Laboratory Pvt. Ltd has been set-up as a result of increased demand locally from various industries for a multidisciplinary testing, materials consultancy & investigation facility in alignment with global standards and technology advancements. MatterLab is an independent professional and technical services provider to all who are concerned with quality and performance of materials & products.

Kerala State Waste Management Project (KSWMP) has entrusted the work of investigation work for the preliminary investigative works for the remediation of dumpsite in Kotattukara, Kollam district to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was bored using a rotary drill. Waste samples were collected from the dumpsite and chemical test analysis was done on the samples. The initial site visit was done on 26th April 2023. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 12th May 2023 and was completed on 25th May 2023. Collection of waste samples and transporting the samples to the laboratory was done during this time. Standard Penetration test (SPT) was conducted within the borehole as required. Soil samples were collected and relevant laboratory tests were carried out on it. This report presents results of the geotechnical investigation, chemical analysis and physical analysis of waste collected at the dumpsite.



**Figure 1 :** Location of the borehole drilled at the dumpsite.

## 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil and waste samples and conducting relevant laboratory tests on the collected samples.
- Preparation of report with laboratory test results.

## 3 GEOTECHNICAL INVESTIGATIONS

### 3.1 Rotary drilling

Rotary drilling technique was adopted for advancing and clearing out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste in the landfill.

### 3.2 Drilling equipment

Mechanical rigs of rotary drilling machine were used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The borehole of 150mm diameter was formed using a drag bit (Soil Cutter) in soil. The drag bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by drilling mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

### 3.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as disturbed samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log the commencement and completion date, location of borehole, elevation of top and bottom of boring, ground water table, boundaries of each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelogs are attached as **Appendix-I.**

## 4 DUMP WASTE SAMPLING FROM SITE

Matterlab has deputed a team from our chemistry operations during the third week of May 2023, in order to collect the already dumped waste material over the ground using appropriate sampling gears.

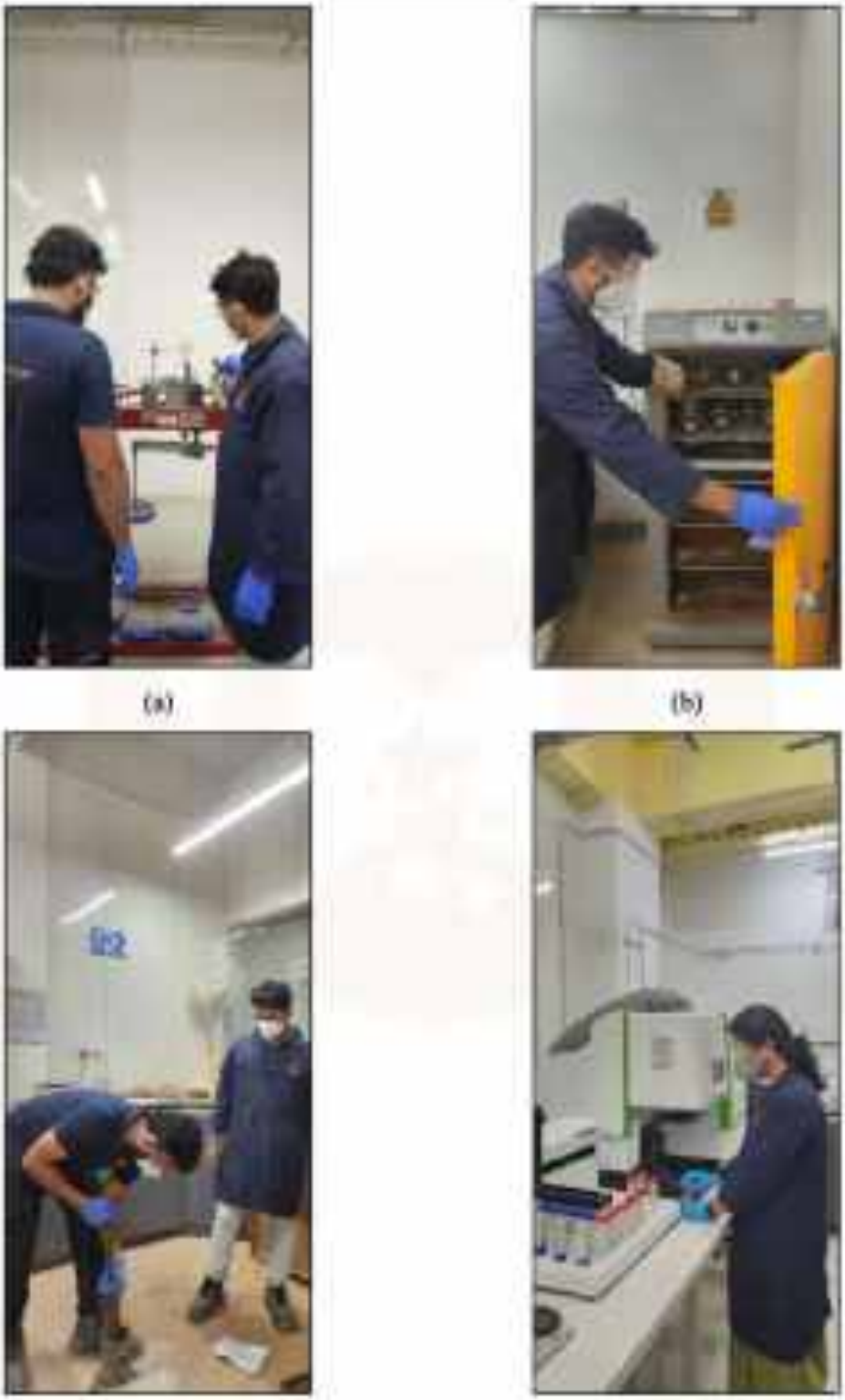
A bulk waste sample was collected from various locations of this dumpsite in the presence of KSWMP representatives and this bulk sample collected was sealed in polythene bags and dispatched to Matter laboratory at Kozhikode for further laboratory physical and chemical analysis.



**Figure 2** : Gear for sample collection from dumpsite

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant Standard Codes. A summary of laboratory tests carried out is shown below in **Table 2** and the complete results of laboratory testing are presented in **Annexure II**.



(a) (b)

(c) (d)

**Figure 3 :** Performing different laboratory tests

**Table 2: Details of various laboratory tests and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| GEOTECHNICAL INVESTIGATION | | | |
| 1 | Soil | Natural Moisture Content | IS: 2720(Part-2)-1973 |
| 2 | | Specific Gravity | IS: 2720(Part-3)-1980 |
| 3 | | Grain-Size Analysis | IS: 2720(Part-4)-1985 |
| 4 | | Atterberg's Limit | IS: 2720(Part-5)-1976 |
| 5 | | Bulk density and Dry density | BS:1377(part 2)-1990 |
| 6 | | Unconfined compressive strength | IS:2720(part-10)-1991 |
| 7 | | Direct shear | IS:2720(part-13)-1986 |
| 8 | | Consolidation | IS:2720(part-15)-1986 |
| 9 | | MDD/OMC (Light Compaction) | IS:2720(part-7)-1980 |
| 10 | | Permeability | IS:2720(part-17)-1986 |
| WASTE INVESTIGATION | | | |
| a. Physical Analysis | | | |
| 11 | Waste | Density | CPHEEO Manual |
| 12 | | Bulk Density | |
| 13 | | Moisture Content | |
| 14 | | Size of waste constituents | CPHEEO Manual |
| 15 | | Calorific value | |
| b. Chemical analysis | | | |
| 16 | Waste | Heavy metals | EPA 3050 (ICP OES) |
| 17 | | pH | IS 9234:20 |
| 18 | | Nitrogen | |
| 19 | | Potassium (N-P-K) | |
| 20 | | C/N Ratio | |
| 21 | | Total Carbon | |

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 22 | | Bio-chemical-Biodegradable factor | CPHEEO Manual |

## 6 SUMMARY

The geotechnical investigation of the original ground below the waste and the physical and chemical analysis of the waste collected at the dumpsite at Ugranukunnu, Kottarakkara, Kollam was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a single borehole was bored using a rotary drilling method. The maximum depth of investigation was 10.5 m (4.2 m in waste and 6.3 m in the ground).

The representative samples collected during the site investigation were transported to the lab. Whereas collection of undisturbed soil samples at the site was not possible as the ground comprises of hard lateritic soil/laterite and collection of undisturbed samples within these kind of formations is very difficult. The tests mentioned in the above table were performed on the representative samples in the laboratory following the respective codes to obtain the necessary parameters. The laboratory results on soil samples and waste samples are appended in **Appendix II**.

The ground encountered after drilling through the waste was a sandy clay of high plasticity (CH) with a liquid limit in the range of 70 and a plastic limit of 30. Consolidated drained direct shear tests were performed on the soil samples to determine the shear parameters of the soil and the average cohesion is of 33kPa and angle of friction with a value of 25°. The permeability of the soil layer below is at an average value of 2.465E-03 cm/sec. The maximum dry density achieved by light compaction method on the soil samples was 1.6gm/cc with an optimum moisture content of 20%.

The physical analysis done on the waste samples collected at the site has shown that the density of waste is 1042 kg/m$^3$, percentage of total waste to be 7.4% with a moisture content of 23%.

The chemical analysis for the collected solid waste samples was performed as per IS 9234:2021 and as per CPHEEO manual. The heavy metals are analysed as per EPA 3050 ICP OES technique. The parameters analysed are pH, Electrical Conductivity, Nitrogen, Phosphorus, Potassium, and Carbon, C/N ratio, Calorific Value, biodegradable factor and

heavy metals. The C/N ratio above 30 indicates that organic manure of solid waste is rich in nutrients.

# APPENDIX-I

# BORELOGS

MatterLab
Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | |
|---|---|---|---|
| PROJECT | : Geotechnical Investigation of the Municipal Solid Waste Dumpsite at Eranhikkara in Kozhikkodan | SHEET NO. | : 1 of 1 |
| CLIENT | : Kerala Solid Waste Management Project Technical Support Consultants | BORE DIAMETER (mm) | : 150 |
| Proposed Structure | : Dump site | BORING TYPE | : Rotary |
| LOCATION | : Kozhikkodan Municipality, Kollam | TERMINATION DEPTH (m) | : 14.5 |
| BOREHOLE NO. | : BH-01 | WATER LEVEL | : |

| DEPTH in m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM | | | SPT 'N' VALUE | DRIVEN FIELD VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 5Cl | 5Cl | 5Cl | | 0 10 20 30 40 50 | |
| 4.2 | | Waste deposit | 4.2 | | | | | | | | |
| | | Sandy clay with traces of gravel | 4.8 | 4.2 | SPT-1 | 9 | 27 | 28 | >55 | | Refusal to drive |
| | | | | 5.0 | SPT-2 | 16 | 29 | 29 | >58 | | Refusal to drive |
| | | | | 6.5 | UDS | | | | | | No recovery |
| 9.0 | | Clay with sand and traces of gravel | | 7.95 | SPT-3 | 16 | 29 | 31 | 60 | | Refusal to drive |
| | | Sandy clay with traces of gravel | 5.5 | 9.0 | SPT-4 | 20 | 33 | 29 | 62 | | |
| 14.5 | | | | 14.5 | SPT-5 | 9 | 20 | 26 | 46 | | |
| | | Bore hole terminated at the depth of 14.5 m from top of waste (4.2 m below original ground level) | | | | | | | | | |

Abbreviations:
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
NR- Core Recovery, RQD- Rock Quality Designation

Seal:
Site Supervision

# APPENDIX-II

# LABORATORY TEST RESULTS

# SOIL

# SUMMARY OF LABORATORY TEST RESULTS (SOIL)

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[redacted]

[redacted]

[redacted]

| N Value | MatterLab ref. | Depth (m) | Type of sample (SPT/UDS/BLK) | Soil description | BS Classification | Atterberg Limit | | | Particle Size Distribution,% | | | | | | | Consolidation | | | | Water content,% | Porosity, n% | Specific Gravity, Gs | Maximum dry density, g/cc | Optimum moisture content, % | Permeability at 2°c, cm/s |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit,% | Plastic Limit,% | Plasticity Index | Cobble Size,% | Fine Gravel,% | Coarse Sand,% | Medium Sand,% | Fine Sand,% | Silt,% | Clay,% | Initial Void Ratio | Pre-consolidation pressure, kPa | Compression Index, Cc | Recompression Index, Cr | | | | | | |
| >50 | [redacted] | 4.5 | SPT | Sandy clay of high plasticity | CH | 79 | 31 | 45 | | 11 | 6 | 14 | 7 | 34 | 34 | | | | | | | | | | |
| >50 | [redacted] | 9.0 | SPT | | | | | | | | | | | | | 0.870 | 124 | 0.31 | 0.03 | 39 | | | | | |
| >50 | [redacted] | 7.5 | SPT | Clay of high plasticity with sand | CH | 78 | 31 | 46 | | 1 | 7 | 14 | 6 | 37 | 34 | | | | | | 33 | 37 | 1.46 | 25 | 2.80E+04 |
| 41 | [redacted] | 4.5 | SPT | | | | | | | | | | | | | | | | | 39 | | | | | |
| 50 | [redacted] | 13.5 | SPT | Sandy clay of high plasticity | CH | 74 | 31 | 43 | | 5 | 7 | 21 | 9 | 58 | 30 | 0.882 | 95 | 0.34 | 0.03 | 39 | | | | | |

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Kozhikode, Kerala, 673029

## Water Content of Soil Test Report

Report No: ML23/W-01664/2
Issue No.: 1
Report Date: 15/06/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kaleyil Residency,TC30/1320,Haritha Giri Road, Kanjhirampara,P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9995823767 |

ULR-TC709743253000043274F

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 10.50m |
| Work Order ID: | ML23/W-01664 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01664/S7 | Source*: | BH 01, Depth 10.50m |
| Date Sampled: | 09/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 0.200 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 30/05/2023 - 31/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 10.50m |
| Tested By: | DK | Client Sample Desc.*: | Soil, BH 01, Depth 10.50m |
| Test Location: | MatterLab - Kozhikode | | |

### Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 30 | - |

For and on behalf of Matter Lab

### Comments

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Kozhikode, Kerala, 673029.

## Water Content of Soil Test Report

Report No: ML23W-01884
Issue No : 1
Report Date: 31/05/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kaliyil Residency,TC30/1320,Harithe Giri Road, Kanjirampara,P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9895923767 |

ULR-TC707432308000532F

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 9.00m |
| Work Order ID: | ML23W-01884 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-01884/08 | Source*: | BH 01, Depth 9.00m |
| Date Sampled: | 06/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 0.300 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 30/05/2023 - 31/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 9.00m |
| Tested By: | DK | Client Sample Desc.*: | Soil, BH 01, Depth 9.00m |
| Test Location: | MatterLab - Kozhikode | | |

### Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 30 | - |

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## Water Content of Soil Test Report

Report No: ML/SW/01664/A
Issue No: 1
Report Date: 12/06/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kalapi Residency TC30/1320,Haritha Giri Road, Kanjirampara P.O Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9895023767 |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 5.00m |
| Work Order ID: | ML/SW-01664 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML/SW-01664/04 | Source*: | BH 01, Depth 5.00m |
| Date Sampled: | 06/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 – 1981 | Sample Size(kg): | 0.200 Approx. |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 30/05/2023 – 31/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 5.00m |
| Tested By: | DK | Client Sample Desc.*: | Soil, BH 01, Depth 5.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 28 | - |

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# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23W-01864/3
Issue No.: 1
Report Date: 15/06/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kalayil Residency,TC30/1320,Haritha Girl Road, Kanjirampara,P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9895923787 |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 4.20m |
| Work Order ID: | ML23W-01864 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-01864/03 | Source*: | BH 01, Depth 4.20m |
| Date Sampled: | 06/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 0.200 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 06/06/2023 - 10/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 4.20m |
| Tested By: | JJ/VY | Client Sample Desc*.: | Soil, BH 01, Depth 4.20m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3: Mechanical Method | Liquid Limit,% | 76 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 31 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 45 | - |

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# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23R-01664/SS
Issue No: 1
Report Date: 15/06/2023

| | |
|---|---|
| **Client:** | Kerala Solid Waste Management Project Technical Support Consultants |
| **Address:** | Kalayil Residency,TC30/1320,Haritha Giri Road, Kanjirampara,P.O,Kerala,India |
| **Contact:** | Mr. Dileep Kumar M |
| **Project No:** | - |
| **Project Name:** | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugranaumnu in Kottarakkara Municipality, Kollam District |
| **Consultant:** | - |
| **Owner:** | - |
| **Contractor:** | - |
| **Project Location:** | Kottarakkara Municipality, Kollam |
| **Tel / Email:** | 9895623787 |

IR-TG70781230800043278F

## Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 22/05/2023 | **Client Sample Ref.*:** | Soil, BH 01, Depth 7.50m |
| **Work Order ID:** | ML23WV-01664 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23WV-01664/SS | **Source*:** | BH 01, Depth 7.50m |
| **Date Sampled:** | 09/05/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2131 - 1981 | **Sample Size(kg):** | 0.200 Approx |
| **Sample Location*:** | Kottarakkara Municipality, Kollam | **Date Tested :** | 08/06/2023 - 10/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil, BH 01, Depth 7.50m |
| **Tested By:** | JJVY | **Client Sample Desc*.:** | Soil, BH 01, Depth 7.50m |
| **Condition of Soil:** | Natural | **Period of Soaking:** | 24 Hrs |
| **Test Location:** | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-CL3: Mechanical Method | Liquid Limit,% | 75 | - |
| IS:2720(Part 5)-1985-CL7 | Plastic Limit,% | 31 | - |
| IS:2720(Part 5)-1985-CL8 | Plasticity Index | 44 | - |

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# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-016647
Issue No : 1
Report Date:15/06/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kaleyil Residency,TC30/1320,Haritha Giri Road, Kanjirampara,P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakkara Municipality, Kollam District |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9886823787 |

UL-TC107423000004529F

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 10.50m |
| Work Order ID: | ML23WW-01904 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23WW-01904/S7 | Source*: | BH 01, Depth 10.50m |
| Date Sampled: | 09/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 0.200 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 09/06/2023 - 10/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 10.50m |
| Tested By: | JJ/VY | Client Sample Desc*.: | Soil, BH 01, Depth 10.50m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-CL3: Mechanical Method | Liquid Limit,% | 74 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 31 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 43 | - |

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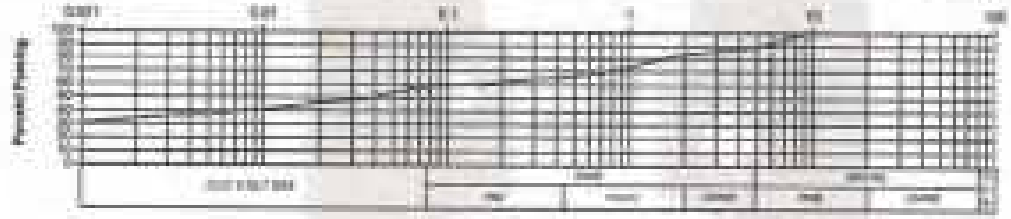
# Hydrometer Analysis Test Report

| | | | |
|---|---|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants | Consultant: | - |
| Address: | Kalayil Residency TC39/1320,Haritha Giri Road, Kanjirampara,P.O,Kerala,India | Owner: | - |
| Contact: | Mr. Dileep Kumar M | Contractor: | - |
| Project No: | - | Project Location: | Kottarakkara Municipality, Kollam |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakkara Municipality, Kollam District. | Tel / Email: | 9846522197 |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*): | Soil, BH 01, Depth 4.20m |
| Work Order ID: | ML23/W-01864 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01864/03 | Source*): | BH 01, Depth 4.20m |
| Date Sampled: | 09/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2131 - 1981 | Sample Size(kg): | 0.250 Approx |
| Sample Location*): | Kottarakkara Municipality, Kollam | Date Tested : | 23/05/2023 - 29/05/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 4.20m |
| Tested By: | SH | Client Sample Desc.*): | Soil, BH 01, Depth 4.20m |
| Test Location: | MatterLab - Kozhikode | | |

Particle Size Distribution — Method: IS: 2720 (Part 4)-1985, Cl.9.2




Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 99 |
| 2.000 | 80 |
| 0.850 | 71 |
| 0.425 | 58 |
| 0.425 | 49 |
| 0.300 | 84 |
| 0.150 | 60 |
| 0.075 | 58 |
| 0.036 | 49 |
| 0.026 | 47 |
| 0.019 | 45 |
| 0.014 | 43 |
| 0.010 | 41 |
| 0.007 | 39 |
| 0.005 | 37 |
| 0.003 | 35 |
| 0.002 | 34 |
| 0.001 | 32 |

| | |
|---|---|
| Gravel,% | 17 |
| Sand,% | 21 |
| Silt,% | 24 |
| Clay,% | 34 |

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Comments
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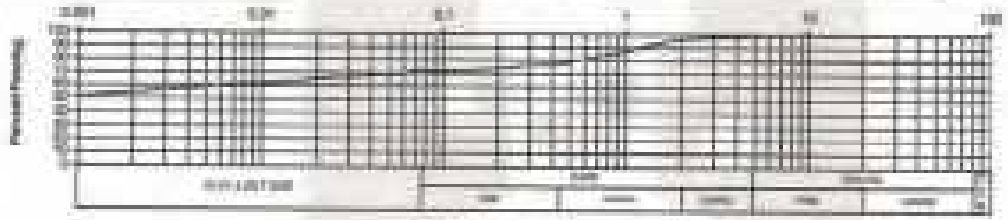
# Hydrometer Analysis Test Report

| | | | |
|---|---|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants | Consultant: | - |
| Address: | Kalayil Residency, TC/3/1330, Haritha Giri Road, Pandrampara, P.O, Kerala, India | Owner: | - |
| Contact: | Mr. Dileep Kumar M | Contractor: | - |
| Project No: | - | Project Location: | Kottarakkara Municipality, Kollam |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Uplakkunnu in Kottarakkara Municipality, Kollam District. | Tel / Email: | 9995822757 |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 23/05/2023 | Client Sample Ref.*: | Bh1, Bh1 01, Depth 7.50m |
| Work Order ID: | ML23/W-01664 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01664/02 | Source*: | Bh1 01, Depth 7.50m |
| Date Sampled: | 26/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Quantity: | 0.500 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 29/05/2023 - 27/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, Bh1 01, Depth 7.50m |
| Tested By: | RH | Client Sample Desc.*: | Soil, Bh1 01, Depth 7.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4) 1985, Cl.9.5




Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 4.750 | 100 |
| 2.000 | 98 |
| 0.850 | 88 |
| 0.600 | 81 |
| 0.425 | 77 |
| 0.300 | 75 |
| 0.150 | 72 |
| 0.075 | 71 |
| 0.048 | 68 |
| 0.029 | 60 |
| 0.018 | 54 |
| 0.013 | 52 |
| 0.006 | 50 |
| 0.003 | 39 |
| 0.003 | 36 |
| 0.002 | 34 |
| 0.001 | 31 |

| | |
|---|---|
| Gravel, % | 4 |
| Sand, % | 25 |
| Silt, % | 17 |
| Clay, % | 54 |

RAMESH T.V.

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**Comments**

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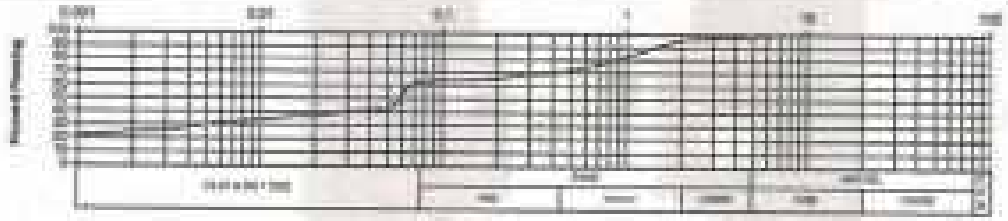
# Hydrometer Analysis Test Report

| | | | |
|---|---|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants | Consultant: | - |
| Address: | Kalayil Residency TC/30/1330,Harsha Giri Road, Kanjhampara P.O,Kerala,India | Director: | - |
| Contact: | Mr. Dileep Kumar M | Coordinator: | - |
| Project No: | - | Project Location: | Kottarakkara Municipality, Kollam |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Upasikunnu in Kottarakkara Municipality, Kollam District | Tel / Email: | |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 02/05/2025 | Client Sample Ref.*: | Soil, BH 01, Depth 9.00m |
| Work Order ID: | ML25/IN-01684 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML25/IN-01684/08 | Source*: | BH 01, Depth 9.00m |
| Date Sampled: | 05/05/2025 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Nature(g): | 0.200 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested*: | 20/05/2025 - 21/05/2025 |
| Sample Cont. Nos: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 9.00m |
| Tested By: | SH | Client Sample Desc.*: | Soil, BH 01, Depth 9.00m |
| Test Location: | Mother Lab - Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4)-1985, Cl. 9.3



Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 98 |
| 2.000 | 86 |
| 0.850 | 78 |
| 0.600 | 74 |
| 0.425 | 70 |
| 0.300 | 66 |
| 0.150 | 64 |
| 0.075 | 63 |
| 0.043 | 42 |
| 0.031 | 41 |
| 0.027 | 39 |
| 0.019 | 37 |
| 0.014 | 35 |
| 0.010 | 34 |
| 0.007 | 31 |
| 0.005 | 30 |
| 0.004 | 28 |
| 0.003 | 26 |
| 0.001 | 22 |

| | |
|---|---|
| Gravel,% | 2 |
| Sand,% | 36 |
| Silt,% | 38 |
| Clay,% | 24 |

For and on behalf of MatterLab

**Comments:**

Information provided by client

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## SHEAR STRENGTH TEST REPORT

Report No: ML23/K-01668/ST
Issue No: 1
Report Date: 18/08/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kaliyil Residency,TC/30/1300,Haritha Giri Road, Kanjirampara,P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9809020767 |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 4.2m – 10.5m |
| Work Order ID: | ML23/W-01668 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01668/03 to ST | Source:* | BH 01, Depth 4.20m – 10.5m |
| Date Sampled: | 05/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | 0.200 Approx. |
| Sample Location:* | Kottarakkara Municipality, Kollam | Date Tested: | 09/06/2023 - 10/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Lab Sample Desc.: | Soil, BH 01, Depth 4.2m – 10.5m |
| Tested By: | DK | Client Sample Desc.: | Soil, BH 01, Depth 4.2m – 10.5m |

### Test Results

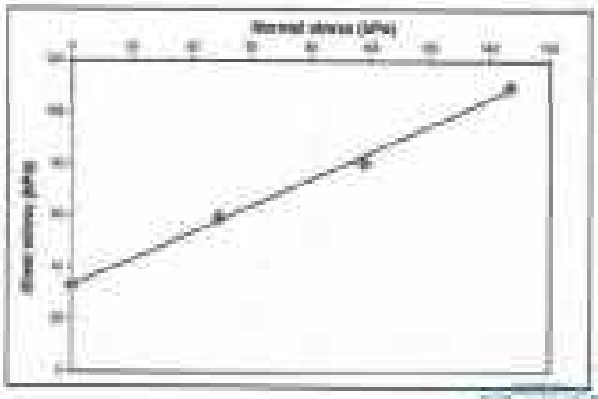
Method: IS 2720 (Part 13)-1986

| | | |
|---|---|---|
| Area of specimen (cm²) | : | 36 |
| Height of specimen (mm) | : | 25 |
| Rate of strain (mm/min) | : | 1.25 |
| Test Condition | : | Unconsolidated Drained |
| Bulk Density (Mg/m³) | : | 1.50 |
| Moisture content (%) | : | 23 |
| Dry Density (Mg/m³) | : | 1.50 |

| Load Increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Stress (mm) |
|---|---|---|---|
| 1 | 49 | 89.4 | 4.8 |
| 2 | 98 | 93.8 | 4.4 |
| 3 | 147 | 110.1 | 5.8 |

Cohesion Intercept (C') kPa 33

Angle of Internal friction (ϕ') 27°




For and on behalf of MatterLab

**Comments**

*Information provided by client

Material tested was passing 4.75 mm test sieve, recompacted at maximum achievable density and moisture content.



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# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/R-01994/18
Issue No : 1
Report Date:18/06/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kalayil Residency,TC30/1310,Haritha Giri Road, Kanjirampara P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Upparikunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9809233787 |

ULR-TC1070[illegible]

**Sample Details**

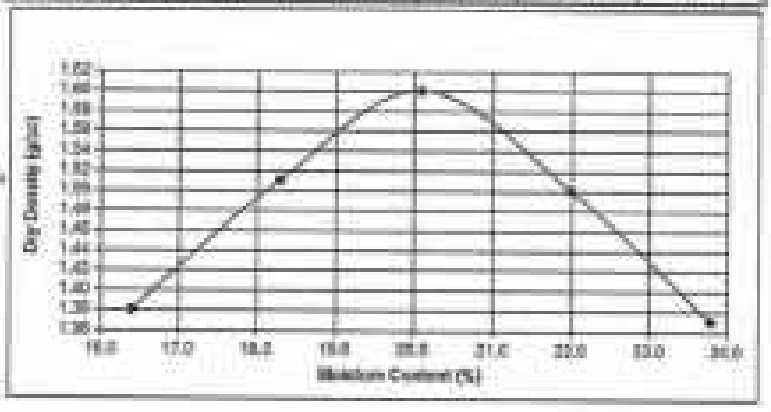
| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 4.2m - 10.5m |
| Work Order ID: | ML23/W-01994 | Sample Submitted By.*: | Geotechnical Division |
| Sample ID: | ML23/W-01994/03 to 07 | Source*: | BH 01, Depth 4.2m - 10.5m |
| Date Sampled: | 05/05/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 31/05/2023 - 01/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 4.2m - 10.5m |
| Tested By: | DK | Client Sample Desc.: | Soil, BH 01, Depth 4.2m - 10.5m |
| Test Location: | Matterlab - Kozhikode | | |

**Test Results**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ (cm³) | 1000 | | | | |
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4083 | | | | |
| Mass of mould + compacted sample | | W (g) | 5970 | 5949 | 5979 | 5969 | 5760 |
| Mass of sample | | | 1887 | 1866 | 1896 | 1886 | 1677 |
| Wet density | $(W-W_m)/V_m$ | $\rho_w$ (Mg/m³) | 1.87 | 1.79 | 1.82 | 1.83 | 1.70 |
| Mass of wet sample | | $W_{ws}$ (g) | 390.1 | 412.7 | 396.1 | 414.6 | 421.5 |
| Mass of dry sample | | $W_{ds}$ (g) | 335.1 | 348.7 | 329.8 | 339.8 | 340.5 |
| Moisture content | $(W_{ws}-W_{ds})/W_{ds}\times100$ | m (%) | 16.4 | 18.3 | 20.1 | 22.0 | 23.8 |
| Dry density | $\rho_w/(1+m/100)$ | $\rho_d$ (Mg/m³) | 1.28 | 1.51 | 1.69 | 1.50 | 1.37 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc | 1.80 |
| Optimum moisture content, % | 20 |
| Material retained on 20mm,% | 0 |
| Sample used | Single |
| Size of mould | 1000cm³ |
| Weight of rammer | 2.6 kg |




For and on behalf of MatterLab

Comments:
*Information provided by client

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# Permeability of Soil Test Report

Report No: ML23R-01664/R0
Issue No : 1
Report Date: 15/06/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kaleyil Residency,TC39/1320,Haritha GH Road, Kanjirampara P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ulpankunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 8606823757 |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 4.2m - 10.5m |
| Work Order ID: | ML23W-01664 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-01664/83 to 87 | Source*: | BH 01, Depth 4.2m - 10.5m |
| Date Sampled: | 06/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 0.200 Approx. |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 09/06/2023 - 07/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 4.2m - 10.5m |
| Tested By: | DK | Client Sample Desc.*: | Soil, BH 01, Depth 4.2m - 10.5m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 2.9E-03 | - |

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**Comments**

*Information provided by client

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# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | |
|---|---|
| Date Received | 22/06/2023 |
| Date Reported | 15/09/2023 |

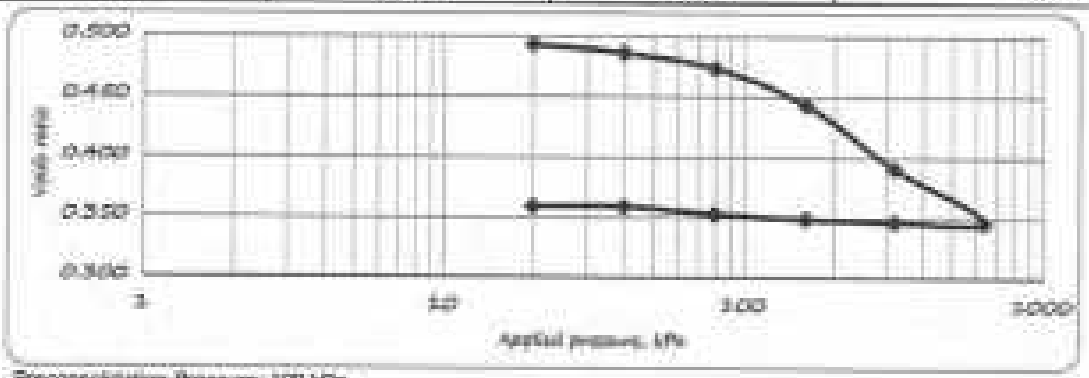
| | |
|---|---|
| Report No. | ML23/R-01664/23 |
| Client Ref. | Soil, BH 01, Depth 5.00m |

| | |
|---|---|
| Client | Kerala Solid Waste Management Project Technical Support Consultants |
| Adress | Kaleyil Residency,TC/3971/2/2,Haritha Giri Road, Kanjirampara,P.O,Kerala,India |
| Contact | Mr. Dileep Kumar M |
| Project Number | - |
| Project Name | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakkara Municipality, Kollam District. |
| Consultant | - |
| Owner | - |

| | | | |
|---|---|---|---|
| Source* | BH 01, Depth 5.00m | Client Sample Ref. | Soil, BH 01, Depth 5.00m |
| Sampled by | Geotechnical Division | Date Tested | 01/09/2023 - 10/09/2023 |
| Test Method | IS : 2720 ( Part 15 ) - 1986 | Test Location | MatterLab Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | ML23/R-01664/S4 | Initial diameter (mm) | 60 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Kottarakkara Municipality, Kollam |
| Initial voids ratio | 0.494 | Dry Density (Mg/m$^3$) | 1.633 |
| Moisture content (%) | 25.2 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 20 | 0.490 | 941.28 | 0.050 |
| 40 | 0.482 | 199.41 | 0.225 |
| 80 | 0.473 | 188.70 | 0.214 |
| 160 | 0.443 | 143.53 | 0.265 |
| 320 | 0.391 | 105.48 | 0.227 |
| 640 | 0.346 | 49.56 | 0.101 |




Preconsolidation Pressure: 100 kPa
Compression Index, $C_c$: 0.18
Recompression Index, $C_r$: 0.01

Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 2 of 3 & 3 of 3)
*Information provided by client

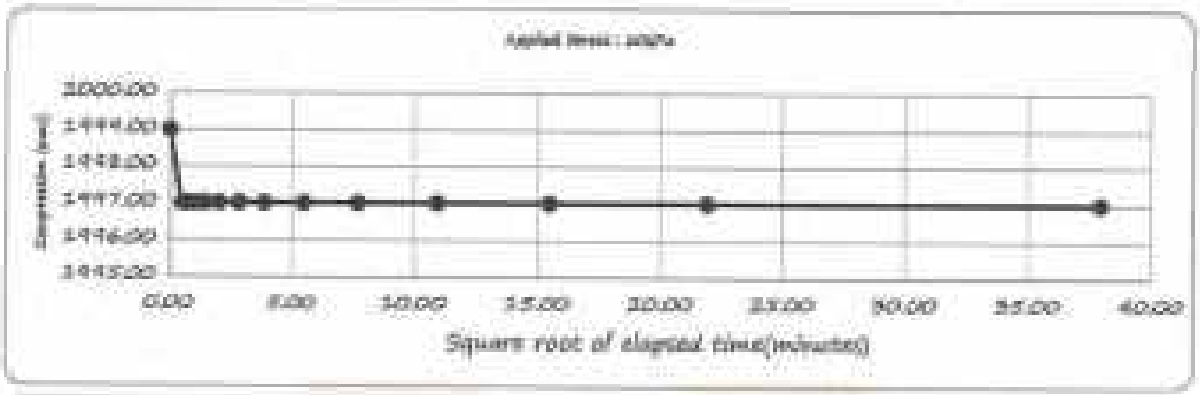


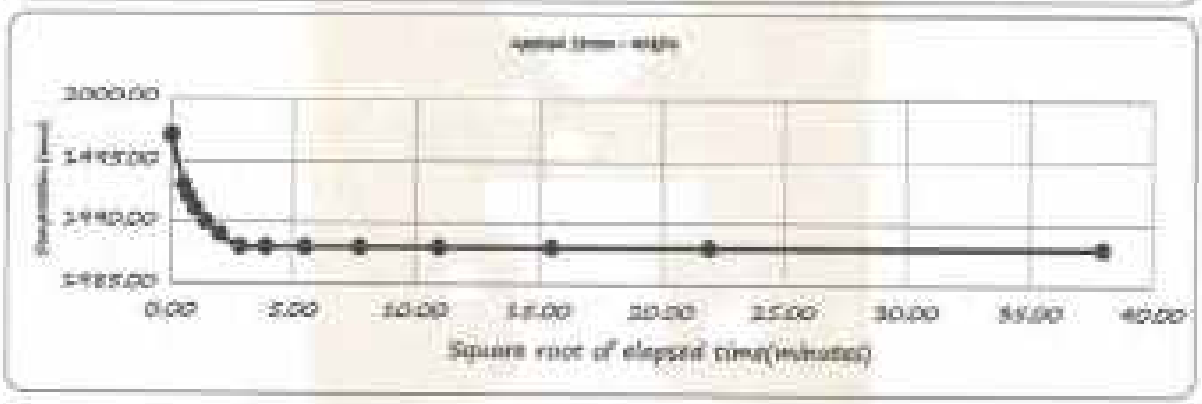
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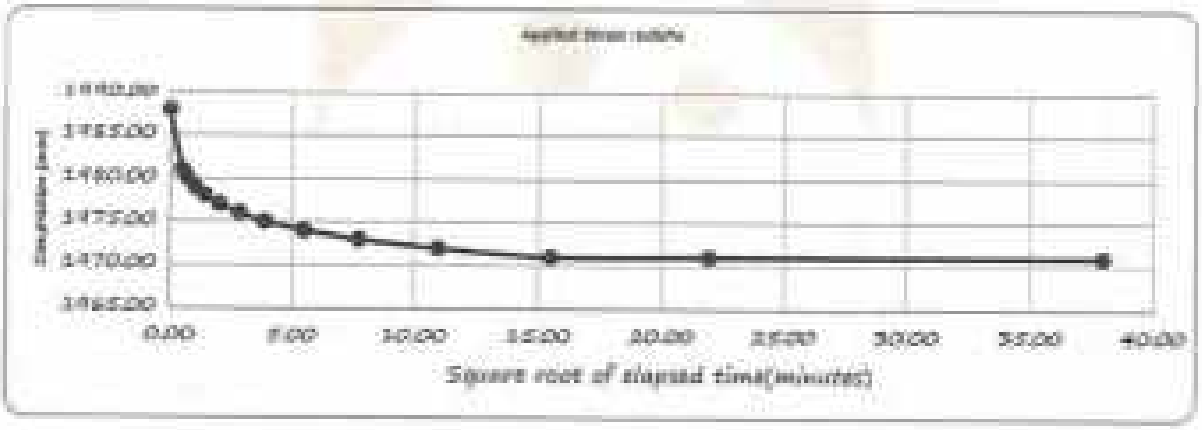
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**Compression Vs square root of time curves**



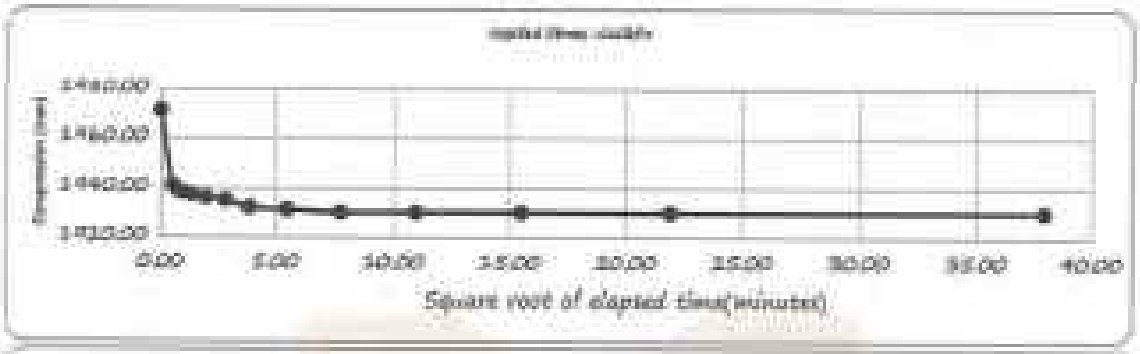


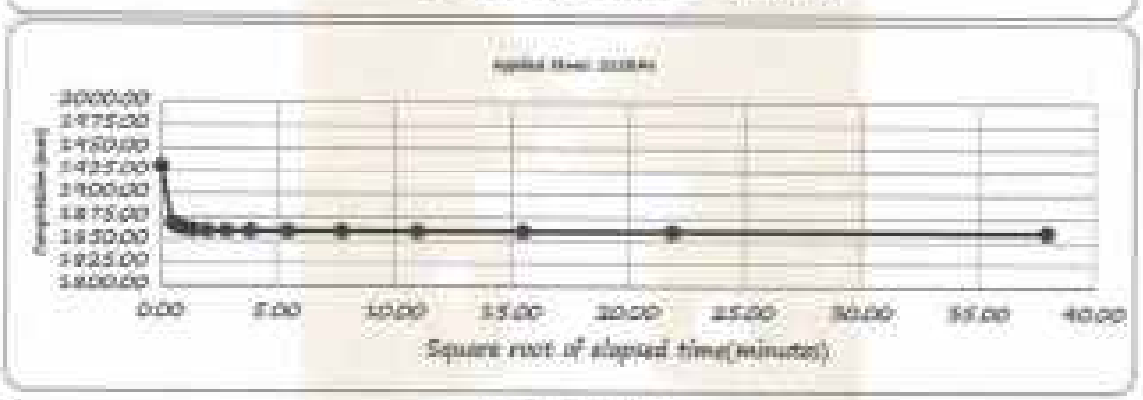

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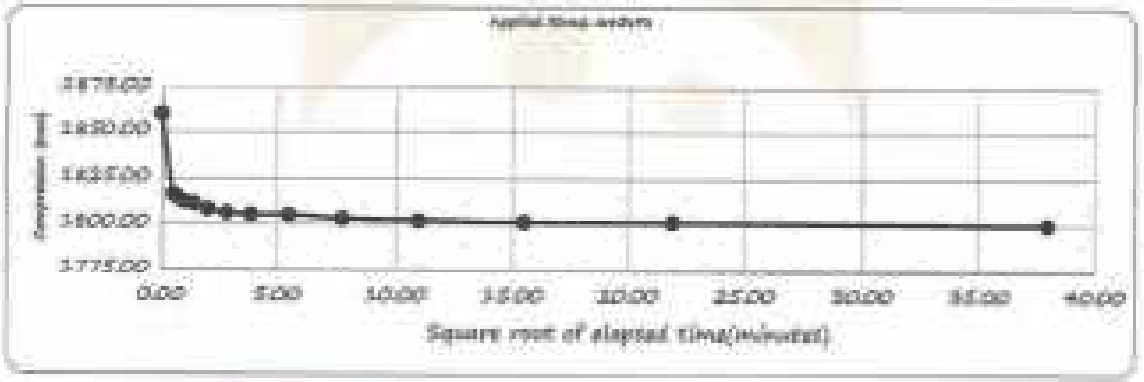
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Compression Vs square root of time curves




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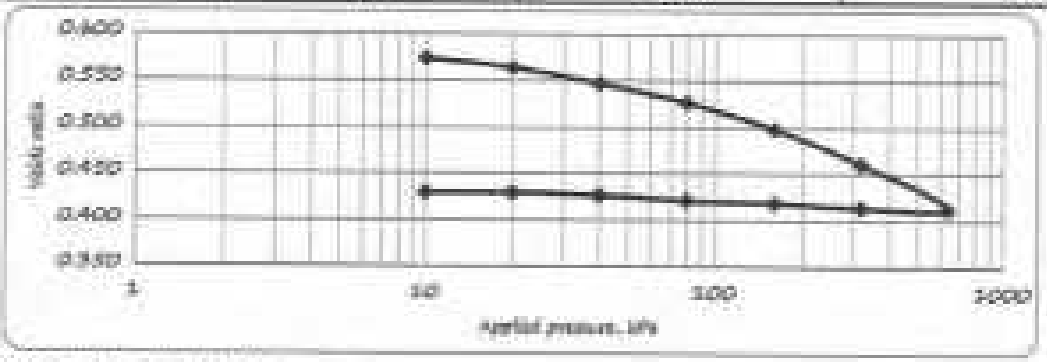
# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | | | |
|---|---|---|---|
| Date Received | 22/05/2023 | Report No. | MLZ3/R-0166/Q1 |
| Date Reported | 15/06/2023 | Client Ref. | Soil, BH 01, Depth 9.00m |

| | | | |
|---|---|---|---|
| Client | Kerala Solid Waste Management Project Technical Support Consultants | | |
| Adress | Kalayil Residency,TC30/1320,Haritha Giri Road, Kanjhirampara P.O,Kerala,India | | |
| Contact | Mr. Dileep Kumar M | | |
| Project Number | - | | |
| Project Name | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugramoonu in Kottarakkara Municipality, Kollam District. | | |
| Consultant | - | | |
| Owner | - | | |
| Source* | BH 01, Depth 9.00m | Client Sample Ref*. | Soil, BH 01, Depth 9.00m |
| Sampled by | Geotechnical Division | Date Tested | 01/06/2023 - 10/06/2023 |
| Test Method | IS : 2720 ( Part 15 ) - 1986 | Test Location | MatterLab - Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | ML23/W-0166A/06 | Initial diameter (mm) | 60 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Kottarakkara Municipality, Kollam |
| Initial voids ratio | 0.580 | Dry Density (Mg/m$^3$) | 1.519 |
| Moisture content (%) | 30.4 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 10 | 0.573 | 337.99 | 0.450 |
| 20 | 0.563 | 661.56 | 0.653 |
| 40 | 0.546 | 167.48 | 0.531 |
| 80 | 0.529 | 142.43 | 0.332 |
| 160 | 0.498 | 77.62 | 0.227 |
| 320 | 0.460 | 47.55 | 0.156 |
| 640 | 0.412 | 35.73 | 0.103 |




Preconsolidation Pressure: 92 kPa
Compression Index, $C_c$: 0.14
Recompression Index, $C_r$: 0.01

Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 2 of 4 & 3 of 4)
*Information provided by client

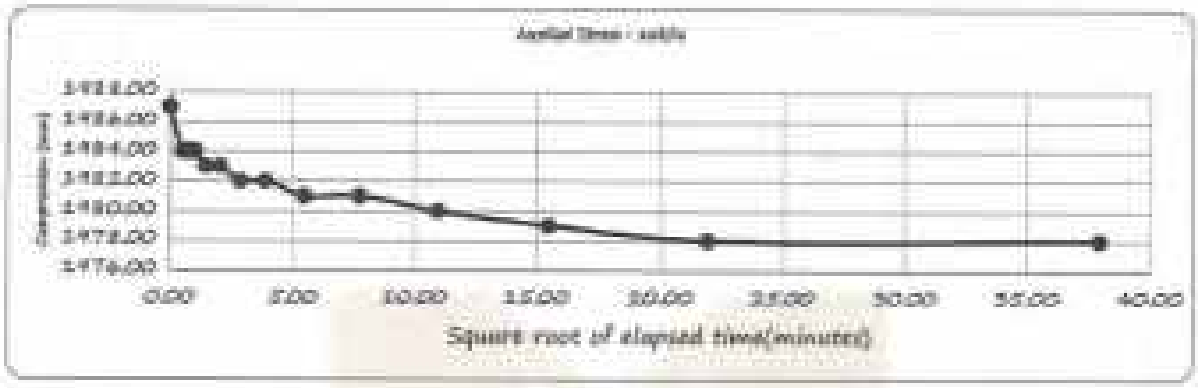


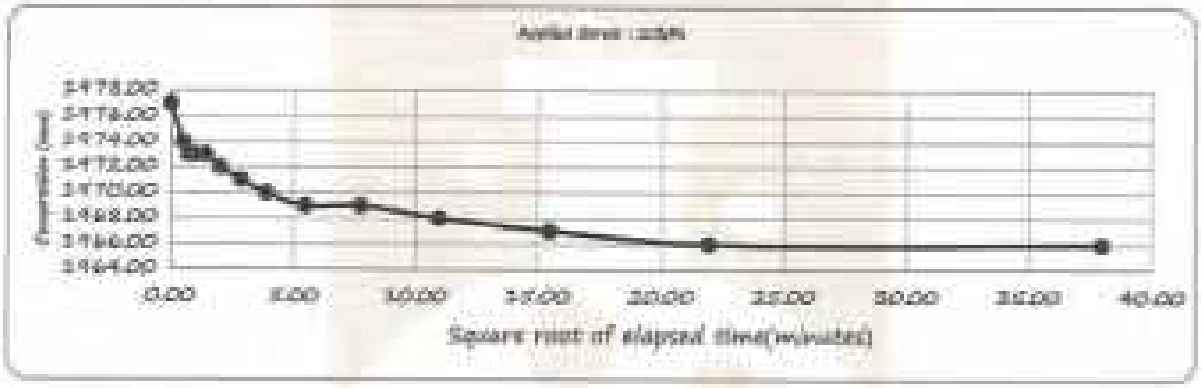
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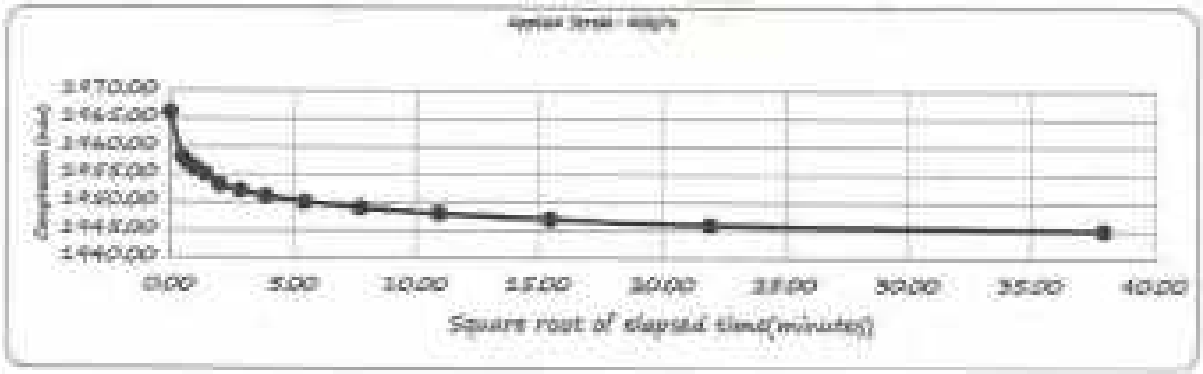
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Compression Vs square root of time curves



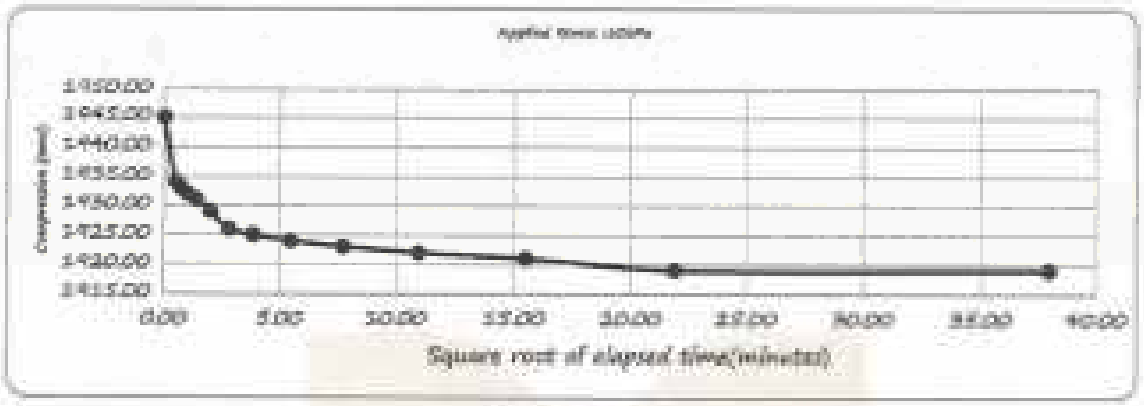


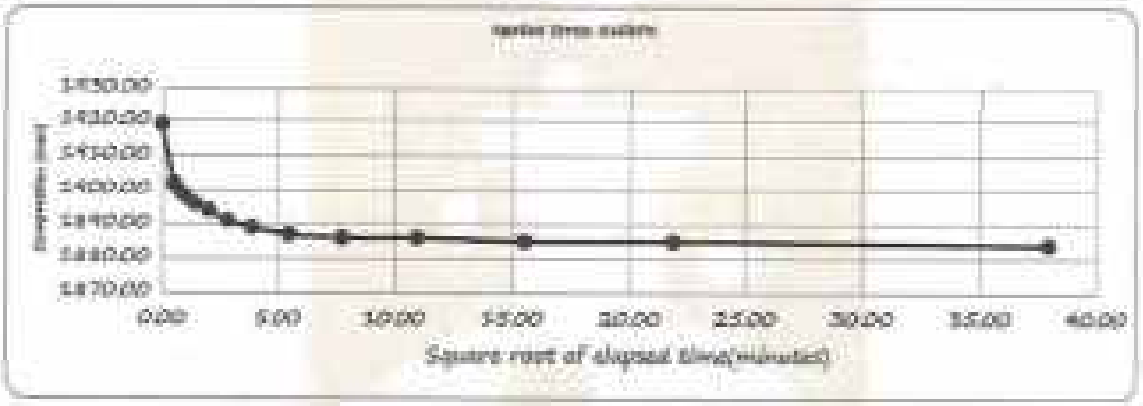

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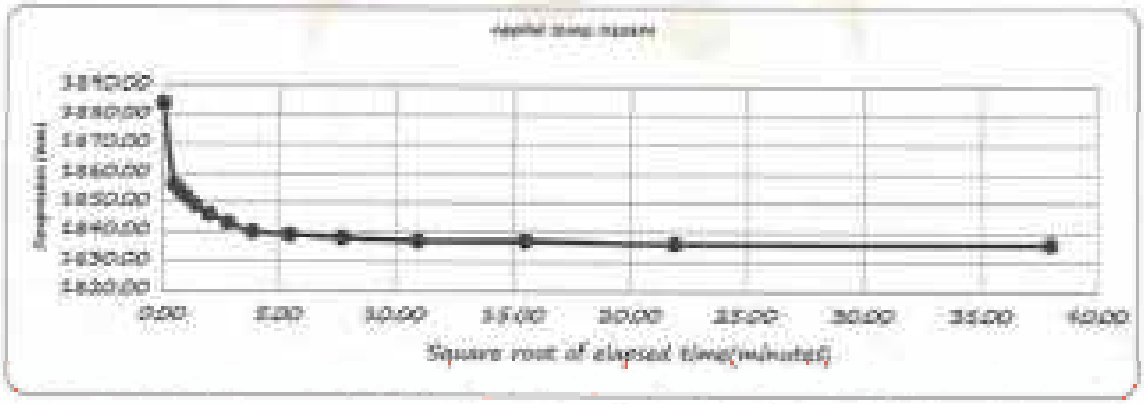
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**Compression Vs square root of time curves**



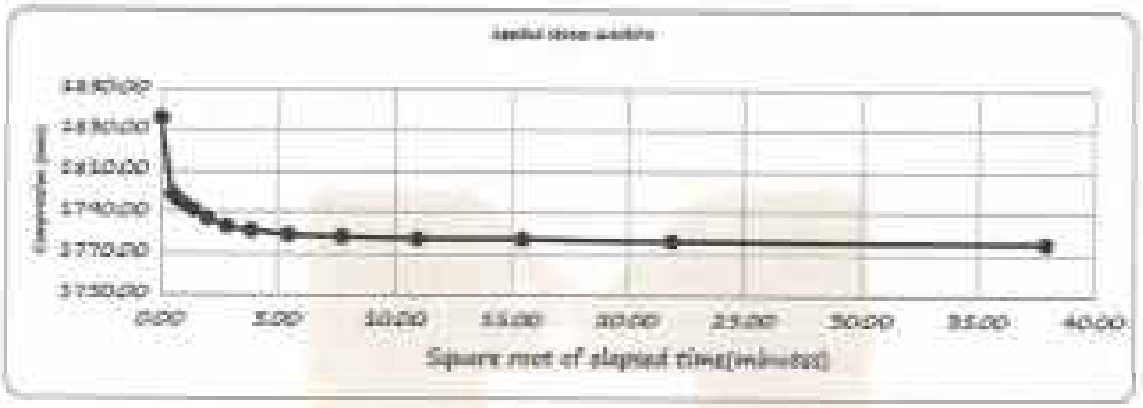



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**Compression Vs square root of time curves**




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# WASTE

## (i) Physical Analysis

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# Moisture Content of Waste Test Report

Report No: ML23/R-01664/1/1
Issue No : 1
Report Date: 12/06/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kaleyil Residency,TC30/1920,Haritha Giri Road, Kanjirampara P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9995923787 |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*: | Waste |
| Work Order ID: | ML23/W-01664 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01664/S1 | Source*: | - |
| Date Sampled: | 09/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 0.200 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 22/05/2023 - 23/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Waste |
| Tested By: | GK | Client Sample Desc.*: | Waste |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Moisture Content, % | 24 | - |

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## Comments

*Information provided by client

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# Moisture Content of Waste Test Report

Report No: ML23/W-01684/12
Issue No : 1
Report Date: 19/06/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kalapil Residency,TC30/1320,Haritha Giri Road, Kanjirampara,P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Uparthunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9995023707 |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.(*): | Waste |
| Work Order ID: | ML23/W-01684- | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01684/02 | Source(*): | - |
| Date Sampled: | 08/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 0.200 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 22/05/2023 - 23/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Waste |
| Tested By: | Gill | Client Sample Desc.*): | Waste |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Moisture Content, % | 22 | - |

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# Test Report

Report No: ML23/W-01664/1
Issue No : 1
Report Date: 29/05/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kaleyil Residency,TC30/1020,Harithe Giri Road, Kanjirampara P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugramoonu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9895533767 |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 23/05/2023 | Client Sample Ref.*): | Waste |
| Work Order ID: | ML23/W-01664 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01664/S1 | Source*): | - |
| Date Sampled: | 09/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 0.200 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 26/05/2023 - 29/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Waste |
| Tested By: | DK/MV | Client Sample Desc.*): | Waste |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISPHEEO (2000) | Percentage of Total Waste | 7.21 | - |

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Thiruvannur, Kozhikode, Kerala, 673029

# Test Report

Report No: ML23/R-01664/1d
Issue No : 1
Report Date: 29/05/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kalapi Residency,TC30/1920,Harittha Girl Road, Kanjirampara,P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9895523787 |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 23/05/2023 | Client Sample Ref.*: | Waste |
| Work Order ID: | ML23/W-01664 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01664/02 | Source*: | - |
| Date Sampled: | 08/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 0.300 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 26/05/2023 - 29/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Waste |
| Tested By: | DK/MV | Client Sample Desc.*: | Waste |
| Test Location: | Matterlab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ICPHEEO (2000) | Percentage of Total Waste | 7.4 | - |

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# Test Report

Report No: ML23/R-01664/1E
Issue No: 1
Report Date: 08/06/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kalapil Residency,TC30/1320,Haritha Giri Road, Kanjirampara,P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9995823787 |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*: | Waste |
| Work Order ID: | ML23/W-01664 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01664/01 | Source*: | - |
| Date Sampled: | 08/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 0.200 Approx |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 29/05/2023 - 29/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Waste |
| Tested By: | GK/DK | Client Sample Desc.*: | Waste |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Density of Waste,kg/m³ | 1031 | - |

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## Comments

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# Test Report

Report No: ML23/K-01664/rp
Issue No.: 1
Report Date:16/06/2023

| | |
|---|---|
| Client: | Kerala Solid Waste Management Project Technical Support Consultants |
| Address: | Kalayil Residency TC30/1320,Haritha Giri Road, Kanjikkampara P.O,Kerala,India |
| Contact: | Mr. Dileep Kumar M |
| Project No: | - |
| Project Name: | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugyarkunnu in Kottarakkara Municipality, Kollam District. |
| Consultant: | - |
| Owner: | - |
| Contractor: | - |
| Project Location: | Kottarakkara Municipality, Kollam |
| Tel / Email: | 9895823767 |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 22/05/2023 | Client Sample Ref.*: | Waste |
| Work Order ID: | ML23W-01664 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-01664/S2 | Source*: | - |
| Date Sampled: | 09/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 0.350 Approx. |
| Sample Location*: | Kottarakkara Municipality, Kollam | Date Tested : | 26/05/2023 - 29/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Waste |
| Tested By: | GK/DK | Client Sample Desc.*: | Waste |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Density of Waste,kg/m$^3$ | 1054 | - |

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## (ii) Chemical Analysis

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# Test Report of Soil

Report No: ML23/R-03636/1
Issue No: 1
Report Date: 29/07/2023

| | |
|---|---|
| **Client:** | Kerala Soil Waste Management Project Technical Support Consultants |
| **Address:** | Kalayil Residency,TC30/1320,Haritha Giri Road,Kanjirampara PO,Kerala,India |
| **Contact:** | Mr Dileep Kumar M |
| **Project Name:** | Geotechnical Examination of Municipal Solid Waste Dumpsite at Ugrankunnu in Kottarakara Municipality,Kollam District |
| **Project Location:** | Kottarakara Municipality,Kollam |
| **Tel No:** | 9895823767 |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 24/07/2023 | **Client Sample ID:*** | Soil and Rock |
| **Work Order ID:** | ML23/W-02636 | **Source:*** | Borehole |
| **Sample ID:** | ML23/W-02636/S3 | **Sampled By:** | Geotechnical division |
| **Date Sampled:** | - | **Sample Location:** | Kottarakara Municipality,Kollam |
| **Tested By:** | Matter Lab and Approved subcontract laboratory | **Date Tested:** | 24/07/23 - 26/07/23 |
| | | **Test Method Variation:** | None |

**CHEMICAL ANALYSIS - Test Method:IS 9334:2021 & CPHEEO Manual**

| Test/Parameters | Unit | Results |
|---|---|---|
| pH | - | 4.80 |
| Electrical Conductivity | mS/cm | 0.55 |
| Nitrogen (N) | % | 0.21 |
| Phosphorus (P) | % | < 0.01 |
| Potassium (K) | % | 0.22 |
| Carbon | % | 1.37 |
| Carbon / Nitrogen Ratio | % | 6.62 |
| Calorific Value | Kcal/kg | < 10.0 |
| Biodegradable Factor | % | < 0.1 |
| **HEAVY METALS - Test Method: EPA 3050 (ICP OES)** | | |
| Arsenic (As) | mg/Kg | < 0.01 |
| Cadmium (Cd) | mg/Kg | < 0.005 |
| Chromium (Cr) | mg/Kg | 0.11 |
| Copper (Cu) | mg/Kg | 0.08 |
| Lead (Pb) | mg/Kg | 0.11 |
| Nickel (Ni) | mg/Kg | 0.07 |
| Zinc (Zn) | mg/Kg | 0.06 |
| Mercury (Hg) | mg/Kg | < 0.01 |

ANWAR. P
For and on behalf of Matter Lab
Lab Manager-Chemistry

**Comments**

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## Baseline Monitoring Studies on site at Ugrankunnu

Below table illustrates the primary data collection conducted at Ugrankunnu. All the major environmental and Social parameters were considered as part of the study. The test results are attached sperately in Annexure

*Table B-1: Baseline monitoring at Ugrankunnu*

| Sl No. | Photos of monitoring studies | Description |
|---|---|---|
| 1 |  | Air quality monitoring |
| 2 |  | Ground water sample collection |
| 3 |  | Consultation with Principal -Vijaya College of Nursing |

| | | |
|---|---|---|
| 5 |  | Social Survey with nearby residents |
| 6 |  | Mobile tower near to dumpsite entrance |
| |  | Geotechnical studies at Ugrankunnu dumpsite |

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/3785/2023 |
|---|---|---|
| M/s. TSC Package A, KSWMP<br>Haritha Giri Road<br>Kanjiampura P.O<br>Thiruvananthapuram | Date of issue | 08/05/2023 |
| | Date of monitoring | 27/04/2023 |
| | Date of sample received | 28/04/2023 |
| | Date of analysis Started | 29/04/2023 |
| | Sample description | Ambient air |
| | Sample Location | Near Main Gate of Dumpsite Ugrankunnu Kottarakkara Municipality ,Kollam Dist<br>**Gps Reading : N- 0 °00'13 08"**<br>**E -76°75'93 38"** |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 50.3 $\mu g/m^3$ | 100 $\mu g/m^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 23.4 $\mu g/m^3$ | 60 $\mu g/m^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 13.4 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 19.5 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Carbon monoxide ( CO) | SOP/PCL/CO/A/17 | 0.8 $mg/m^3$ | 4 $mg/m^3$ |
| Hydrogen Sulphide ($H_2S$) | IS 5182 Part 07 2021 | < 1 $\mu g/m^3$ | - |
| Methane ($CH_4$) | IS 13270 :19992 RA 2003 | Not Detected | -- |
| Odour | --- | Unobjectionable | -- |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
| The results are related only to the sample submitted for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory | For and on behalf of<br>POLUCHEM LABORATORIES (P) LTD<br>SREEJA RAMESH<br>AUTHORISED SIGNATORY |

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TEST REPORT



Ref.No: PL/RT/GW/3708/2023 Date of Issue: 09/05/2023

Name & address of customer : M/s. JSC Package A, KSWMP
Haritha Giri Road
Kanjirampara .P.O
Thiruvananthapuram

Sample drawn by :Polychem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water
Sample Location : Openwell -Mr.Thulaseedharan-Aswathy Bhavan
**Gps Reading : N- 9°00'04.82"**
**E -76°76'00.77"**

Sample code : E/3708/2023
Date of Sample Collected : 27/04/2023
Date of receipt of sample : 28/04/2023
Date of analysis started : 28/04/2023
Date of completion of analysis : 08/05/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 – 1983RA2017 | 5.38 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 5 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 1.8 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 1984RA2013 | 240 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 156 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL- 1mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 12 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 48.29 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 11.94 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 8.7 mg/l | 200 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 10 mg/l | --- |
| TOC | APHA5310 | BDL(MDL - 0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | --- |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 3.2 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1mg/l) | 1.0 mg/l |

Conti...

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Continuation of Test Certificate No: 3708/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59- 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.32 mg/l | 1.0 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Contd..

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Continuation of Test Certificate No: 3708/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 515.1 | <0.025 µg/l | 30 µg/l |
| Alachor | USEPA 525.2 | <0.025 µg/l | 20 µg/l |
| Aldrin | USEPA 525.2 | <0.025 µg/l | 0.03 µg/l |
| Alpha-HCH | USEPA 508 | <0.025 µg/l | 0.01 µg/l |
| Alpha-Endosulfan | USEPA 508 | <0.025 µg/l | 0.4 µg/l |
| Atrazine | USEPA 525.2 | <0.025 µg/l | 2.0 µg/l |
| Beta Endosulfan | USEPA 508 | <0.025 µg/l | 0.4 µg/l |
| Beta -HCH | USEPA 508 | <0.025 µg/l | 0.04 µg/l |
| Butachlor | USEPA 525.2 | <0.025 µg/l | 125 µg/l |
| Chlorpyrifos | USEPA 525.2 | <0.025 µg/l | 30 µg/l |
| Delta HCH | USEPA 508 | <0.025 µg/l | 0.04 µg/l |
| Dieldrin | USEPA 525.2 | <0.025 µg/l | 0.03 µg/l |
| Endosulfan Sulfate | USEPA 508 | <0.025 µg/l | 0.4 µg/l |
| Ethion | USEPA 1657 A | <0.025 µg/l | 3.0 µg/l |
| Isoproturon | USEPA 532 | <0.025 µg/l | 9.0 µg/l |
| Lindane(Gamma HCH) | USEPA 508 | <0.025 µg/l | 2.0 µg/l |
| Malaoxon | USEPA 8141 A | <0.025 µg/l | NA |
| Malathion | USEPA 8141 A | <0.025 µg/l | 190 µg/l |
| Methyl Parathion | USEPA 8141 A | <0.025 µg/l | NA |
| Methyl Parathion | USEPA 8141 A | <0.025 µg/l | 0.3 µg/l |
| Monocrotophos | USEPA 8141 A | <0.025 µg/l | 1.0 µg/l |
| o,p-DDD | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| o,p-DDE | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| o,p-DDT | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| p,p-DDD | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| p,p-DDE | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| p,p-DDT | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| Pendimethalin(Total) | USEPA | <0.025 µg/l | NA |
| Phorate | USEPA 8141 A | <0.025 µg/l | 2.0 µg/l |
| Phorate Sulphone | USEPA 8141 A | <0.025 µg/l | NA |
| Phorate Sulphoxide | USEPA 8141 A | <0.025 µg/l | NA |

Contd....

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Continuation of Test Certificate No: 3708/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | Absent | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

Note: As per the above test results the parameter pH & Turbidity do not conforms to the limit IS 10500 for drinking water purpose.

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
SREEJA
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

*End of the report*

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## TEST REPORT



Ref.No. PL/RT/GW/3710/2023

Date of Issue: 09/05/2023

Name & address of customer : M/s. TSC Package A, KSWMP
Haritha Giri Road
Kanjirampara .P.O
Thiruvananthapuram

Sample drawn by :Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water
Sample Location : Borewell- Uravankunnu MCF/RRF
**Gps Reading : N- 9°00'11 66"**
**E -76°75'9133"**

Sample code : E/3710/2023
Date of Sample Collected : 27/04/2023
Date of receipt of sample : 28/04/2023
Date of analysis started : 28/04/2023
Date of completion of analysis : 08/05/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 7.31 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 0.4 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 210µS/cm | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 136.5 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL- 1mg/l) | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 60 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 83.58 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 14.78 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 2.15 mg/l | 200 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 12 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | --- |
| Nitrate as $NO_3$ | IS 3025 (P)34 - 1988RA2014 | 4.1 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1mg/l) | 1.0 mg/l |

Cont...

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Continuation of Test Certificate No: 3710/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL- 0.05mg/l) | 1.0 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Contd..

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Continuation of Test Certificate No: 3718/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 515.1 | <0.025 µg/l | 30 µg/l |
| Aldrin | USEPA 525.2 | <0.025 µg/l | 30 µg/l |
| Alpha-BHC | USEPA 525.2 | <0.025 µg/l | 0.01 µg/l |
| Alpha-Endosulfan | USEPA 508 | <0.025 µg/l | 0.01 µg/l |
| Atrazine | USEPA 508 | <0.025 µg/l | 0.4 µg/l |
| Beta Endosulfan | USEPA 525.2 | <0.025 µg/l | 2.0 µg/l |
| Beta-BHC | USEPA 508 | <0.025 µg/l | 0.4 µg/l |
| Butachlor | USEPA 508 | <0.025 µg/l | 0.04 µg/l |
| Chlorpyrifos | USEPA 525.2 | <0.025 µg/l | 125 µg/l |
| Delta-BHC | USEPA 525.2 | <0.025 µg/l | 30 µg/l |
| Dieldrin | USEPA 508 | <0.025 µg/l | 0.04 µg/l |
| Endosulfan Sulfate | USEPA 525.2 | <0.025 µg/l | 0.06 µg/l |
| Lindane | USEPA 508 | <0.025 µg/l | 0.4 µg/l |
| Isoproturon | USEPA 1657 A | <0.025 µg/l | 3.0 µg/l |
| Endosulfan Gamma (EI-II) | USEPA 525.2 | <0.0074 µg/l | 9.0 µg/l |
| Malpuson | USEPA 508 | <0.025 µg/l | 2.0 µg/l |
| Malathion | USEPA 8141 A | <0.025 µg/l | NA |
| Methyl Parathion | USEPA 8141 A | <0.025 µg/l | 190 µg/l |
| Methyl Parathion | USEPA 8141 A | <0.025 µg/l | NA |
| Monocrotophos | USEPA 8141 A | <0.025 µg/l | 0.3 µg/l |
| o,p-DDD | USEPA 8141 A | <0.025 µg/l | 1.0 µg/l |
| o,p-DDE | USEPA 8141 A | <0.0074 µg/l | 1.0 µg/l |
| o,p-DDT | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| p,p-DDD | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| p,p-DDE | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| p,p-DDT | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| Pendimethalin | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| Phorate | USEPA 8141 A | <0.025 µg/l | 2.0 µg/l |
| Phorate Sulphone | USEPA 8141 A | <0.025 µg/l | NA |
| Phorate Sulphoxide | USEPA 8141 A | <0.025 µg/l | NA |

Conti....

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Continuation of Test Certificate No: 3710/2023

RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 30 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

Note: As per the above test results the parameter Coliforms do not conforms to the limit IS 10500 for drinking water purpose

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER

*End of the report*

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## TEST REPORT



Ref.No. PL/RT/GW/1707/2023

Date of Issue: 09/05/2023

Name & address of customer : M/s. TSC Package A, KSWMP
Haritha Giri Road
Kanjiramptra P.O
Thiruvananthapuram

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water
Sample Location : Openwell -Mr.Shanavas.S, Aluvilaveedu
**Gps Reading : N- 9 °00'11 38"**
**E -76°76'01 12"**

Sample code : E/3707/2023
Date of Sample Collected : 27/04/2023
Date of receipt of sample : 28/04/2023
Date of analysis started : 28/04/2023
Date of completion of analysis : 08/05/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.36 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 3 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 0.6 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 42 µS/cm | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 27 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL- 1mg/l) | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 2 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 7.96 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 11.83 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 1986RA2014 | BDL(MDL- 1mg/l) | 200 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 6 mg/l | — |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | — |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 - 1988 RA2014 | BDL(MDL- 1mg/l) | — |
| Nitrate as $NO_3$ | IS 3025 (P)34 - 1988RA2014 | 3.2 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1mg/l) | 1.0 mg/l |

Conti...

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Continuation of Test Certificate No: 3707/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Mangnnese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL- 0.05mg/l) | 1.0 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Cont..

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Continuation of Test Certificate No: 3397/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 515.1 | <0.025 µg/l | 30 µg/l |
| Alachor | USEPA 525.2 | <0.025 µg/l | 20 µg/l |
| Aldrin | USEPA 525.2 | <0.025 µg/l | 0.03 µg/l |
| Alpha-HCH | USEPA 508 | <0.025 µg/l | 0.01 µg/l |
| Alpha-Endosulfan | USEPA 508 | <0.025 µg/l | 0.4 µg/l |
| Atrazine | USEPA 525.2 | <0.025 µg/l | 2.0 µg/l |
| Beta Endosulfan | USEPA 508 | <0.025 µg/l | 0.4 µg/l |
| Beta -HCH | USEPA 508 | <0.025 µg/l | 0.04 µg/l |
| Butachlor | USEPA 525.2 | <0.025 µg/l | 125 µg/l |
| Chlorpyrifos | USEPA 525.2 | <0.025 µg/l | 30 µg/l |
| Delta HCH | USEPA 508 | <0.025 µg/l | 0.04 µg/l |
| Dieldrin | USEPA 525.2 | <0.025 µg/l | 0.03 µg/l |
| Endosulfan Sulfate | USEPA 508 | <0.025 µg/l | 0.4 µg/l |
| Ethion | USEPA 1657 A | <0.025 µg/l | 3.0 µg/l |
| Isoproturon | USEPA 532 | <0.025 µg/l | 9.0 µg/l |
| Lindane(Gamma HCH) | USEPA 508 | <0.025 µg/l | 2.0 µg/l |
| Malaoxon | USEPA 8141 A | <0.025 µg/l | NA |
| Malathion | USEPA 8141 A | <0.025 µg/l | 190 µg/l |
| Methyl Parawon | USEPA 8141 A | <0.025 µg/l | NA |
| Methyl Parathion | USEPA 8141 A | <0.025 µg/l | 0.3 µg/l |
| Monocrotophos | USEPA 8141 A | <0.025 µg/l | 1.0 µg/l |
| o,p-DDD | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| o,p-DDE | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| o,p-DDT | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| p,p-DDD | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| p,p-DDE | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| p,p-DDT | USEPA 508 | <0.025 µg/l | 1.0 µg/l |
| Pesticides(Total) | USEPA | <0.025 µg/l | NA |
| Phorate | USEPA 8141 A | <0.025 µg/l | 2.0 µg/l |
| Phorate Sulphone | USEPA 8141 A | <0.025 µg/l | NA |
| Phorate Sulphoxide | USEPA 8141 A | <0.025 µg/l | NA |

Contd ...

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Confirmation of Test Certificate No: 3707/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 30 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

Note: As per the above test results the parameter pH & Coliforms do not coeforms to the limit IS 10500 for drinking water purpose

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

*End of the report*

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## TEST REPORT



| | | |
|---|---|---|
| Client Name & Address | Certificate No: | PL/RT/SW/3786/2023 |
| | Date of Issue: | 08/05/2023 |
| M/s. TSC Package A, KSWMP Haritha Giri Road Kanjirampara .P.O Thiruvananthapuram | Date of monitoring | 27/04/2023 |
| | Monitoring Location | Near Main Gate of Dumpsite Ugrankunnu Kottarakkara Municipality ,Kollam Dist. Gps Reading : N- 9 °00'13.08" E -76°75'93.35" |
| | Sample Description | Ambient Sound Level |

| HOURLY INTERVAL | RESULT | HOURLY INTERVAL | RESULT |
|---|---|---|---|
| 06.00 Hrs | 53.0 dB (A) | 23.00 Hrs | 52.8 dB (A) |
| 07.00 Hrs | 53.1 dB (A) | 00.00 Hrs | 49.2 dB (A) |
| 08.00 Hrs | 50.7 dB (A) | 01.00 Hrs | 48.3 dB (A) |
| 09.00 Hrs | 45.2 dB (A) | 02.00 Hrs | 49.1 dB (A) |
| 10.00 Hrs | 45.8 dB (A) | 03.00 Hrs | 50.6 dB (A) |
| 11.00 Hrs | 45.5 dB (A) | 04.00 Hrs | 50.1 dB (A) |
| 12.00 Hrs | 55.0 dB (A) | 05.00 Hrs | 51.3 dB (A) |
| 13.00 Hrs | 55.3 dB (A) | | |
| 14.00 Hrs | 47.1 dB (A) | | |
| 15.00 Hrs | 45.7 dB (A) | | |
| 16.00 Hrs | 47.8 dB (A) | | |
| 17.00 Hrs | 45.7 dB (A) | | |
| 18.00 Hrs | 50.8 dB (A) | | |
| 19.00 Hrs | 58.1 dB (A) | | |
| 20.00 Hrs | 54.4 dB (A) | | |
| 21.00 Hrs | 52.6 dB (A) | LeqDay | 50.4 dB (A) |
| 22.00 Hrs | 52.1 dB (A) | LeqNight | 50.2 dB (A) |

Limits, Industrial Area Day Time:-75dB(A),Night Time- 70dB(A),Commercial area Day Time:-65 dB(A),Night Time:55dB(A)
Residential area Day Time -55 dB(A),Night time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am

*End of the Report *

For Poluchem Laboratories (P) Ltd.

Authorised Signatory

SINDHU K S
QUALITY MANAGER
POLUCHEM LABORATORIES

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/3785/2023 |
|---|---|---|
| M/s. TSC Package A, KSWMP<br>Haritha Giri Road<br>Kanjirampara .P.O<br>Thiruvananthapuram | Date of issue | 08/05/2023 |
| | Date of monitoring | 27/04/2023 |
| | Date of sample received | 28/04/2023 |
| | Date of analysis Started | 29/04/2023 |
| | Sample description | Ambient air |
| | Sample Location | Second floor Terrace of Vijaya college of Nursing<br>**Gps Reading : N- 9°00'16. 1"<br>E -76°45'24 .0"** |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 36.5 µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 15.6 µg/m$^3$ | 60 µg/m$^3$ |
| **Sulphur Dioxide ( $SO_2$)** | **I S 5182 Part 2 2001 RA 2017** | **<1 µg/m$^3$** | **80 µg/m$^3$** |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 3.2 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/CDA/17 | 0.4 mg/m$^3$ | 4 mg/m$^3$ |
| **Hydrogen Sulphide ($H_2S$)** | **IS 5182 Part 07 2021** | **< 1 µg/m$^3$** | **--** |
| Methane ($CH_4$) | IS 13270 :19992 RA 2003 | Not Detected | -- |
| Odour | --- | Unobjectionable | -- |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

## ANNEXURE -SITE VISIT PHOTOS –UGRANKKUNU DUMPSITE KOTTARAKKARA

| Sl no | Photos | Description |
|---|---|---|
| 1 |   | Current view of Dumpsite |
| 2 |  | Front gate of the MCF/RRF entrance |
| 3 |  | Concreted access way inside MCF/MRF Compound |
| 4 |   | Ugrankunnu Devi Temple-Nearest Sensitive Receptor |

| | | | |
|---|---|---|---|
| 5 | |  | Interaction with nearby communities |
| 6 | |  | Measurement of Well water depth from nearby dug wells |

# SITE MANAGEMENT PLAN-
## UGRANKUNNU DUMP SITE



Annexure 2



# Proposed Operational Plan

The project of the Bio-mining with 100% land recovery will be implemented through 100% outsourcing model. The detailed operations of 100% land recovery is provided below:

1. Project Kick-off

The existing legacy waste dumpsite should be visited jointly by representative of implementation agency, officials ULB and experts of PMU/PMC & TSC for the following

- For assessment of As –Is Situation of local settings viz., human settlement & environmental settings etc.,
- For validation of profile, quantity & physical characterization of legacy waste.
- Available services viz., electrical power, source of water and access road etc.,
- For ground truthing the sampling locations of baseline environmental parameter, locations where monitoring will conduct during operation phase and post reclamation phase
- For sensitizing/awareness of the upcoming the project activity to the stakeholders within the vicinity of the dumpsite.
- For understanding the sensitive of environmental & social aspects/social considerations viz., educational institutions, religious places and settlements settings.
- For ensuring that the implementation agency understands and to complies with all local and national regulations related to project activities.

2. Site Management Plan

The position of the machineries and other auxiliary machineries/equipment's in-line with the defined process of biomining with 100% land recovery play imperative role in effective implementation of the project activities.

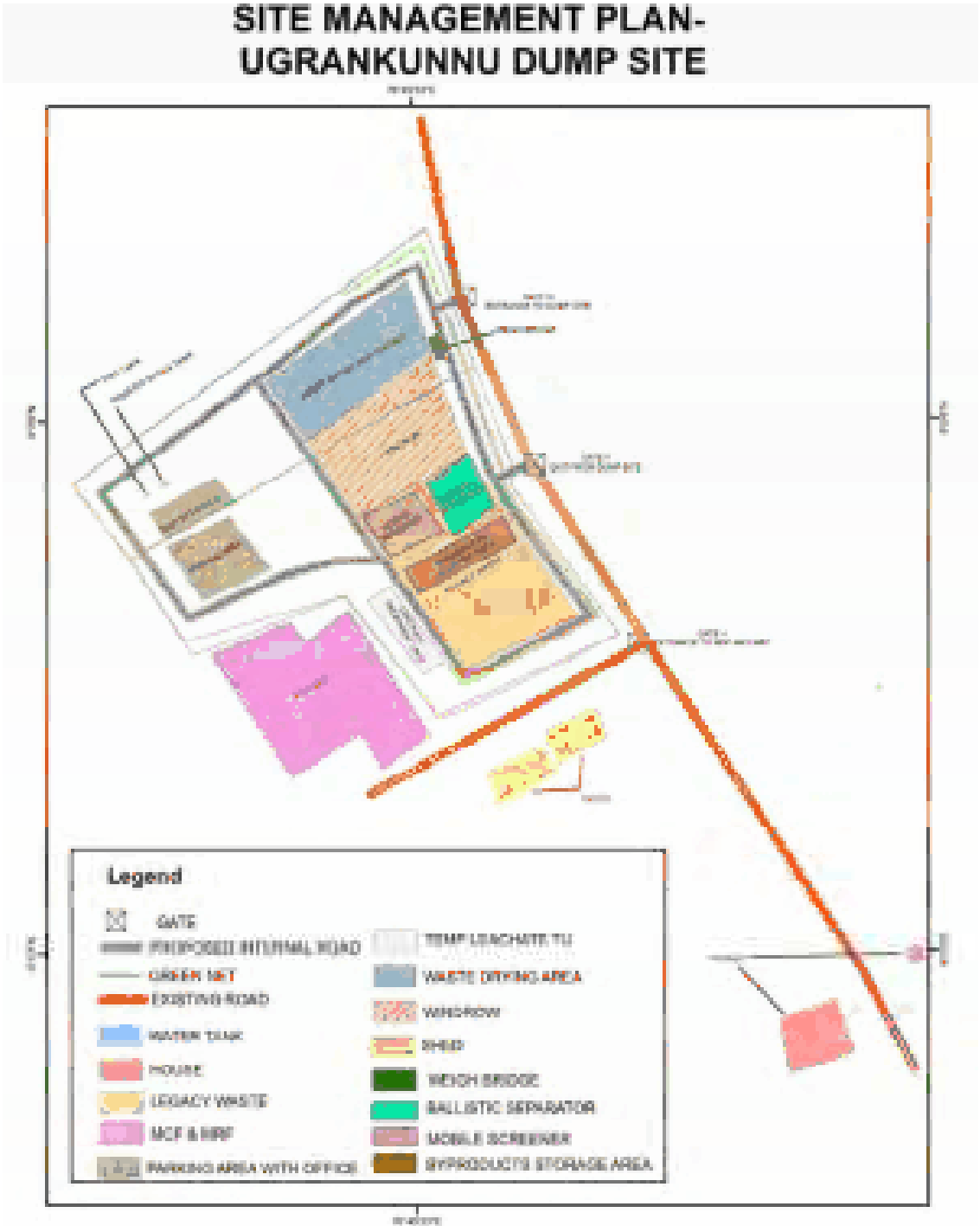
A detailed site management plan is prepared including the details of excavation & pre stabilization area in phases (1to 4), machineries, weigh bridge, area allocation for by-products storage, vehicle parking area and position of CCTV cameras. The detailed site Management plan is provided below.

3. Site Preparation

The portion of the legacy waste dumpsite will be clear vegetation and levelling the area to create a stable & level platform for positioning of bio-mining machineries/equipment's and for processing of legacy waste.

4. Procurement of Machinery & Vehicles and Equipment's

An indicative list of Machineries &Vehicles and equipment's are proposed to for effective processing the quantity of existing legacy waste in-tune to the timeline of NGT orders. The indicative list of the Machinery & Vehicles and equipment's are provided in the Section 8.5 IN FR




**Site plan Figure**

5. Mobilization of Manpower

For effective management of the project activities, an indicative list Manpower provided in the Section 8.6.2 shall be mobilize required.

6. Statutory Approvals

The implementation agency is responsible for obtaining all required permission/consent/approvals from the competent authorities. The ULB/DPMU/DPMC will only facilities implementation agency in obtaining the approvals etc. The indicative list of statutory approvals required for the project is provided below.

a. Site Authorization from KSPCB in conforming to SWM Rules 2016 and Consent to Establish/Operate KSPCB.

b. Dept. of mining and geology

c. Necessary permission for storage of process materials and chemicals

d. NOC from Dept. of Fire and Rescue

e. Segregated Hazardous waste disposal arrangement (eg: KEIL Ambalmedu, Kochi)

f. Any other statutory approvals/ permissions

7. Establishment of forward linkages

The By-products from the bio-mining process/operations viz., Bio earth/ C&D waste (Inert), RDF and Recyclables will be stored in the designated place (as indicated in the site management plan) within the dumpsite. The contractor is responsible for management/establishment of forward linkages. Utilization of Bio earth/C&D (inert) may be finalized in consultation with ULB. An indicative forward linkage is provided in the Section 8.7. The compost should conform to Schedule II of SWM Rules 2016, and RDF should conform to the Guidelines on Usage of RDF in various Industries issued by MoHUA. Bi-weekly sampling will be carried out to confirm the same.

**Bio-mining operations**

. | Step-1 – Waste Stabilization

The initial step involves the use of a front-end loader to excavate the legacy waste, allowing for the leachate to dry out through exposure to solar radiation and for the removal of trapped methane from the heap. To ensure the decomposition of biodegradable waste such as discarded food, fruits, flowers, and garden waste, proper aeration is necessary to prevent the generation of leachate and odors. The top layer of the legacy waste, approximately 150 mm in depth, is repeatedly loosened using the front-end loader. Additionally, the waste is lightly mist-sprayed with biocultures to manage odors and disperse decomposing microbes throughout the waste. The loosened legacy waste forms windrows.

: | Step-2 – Windrow Formation

The second step involves creating windrows of the legacy waste using backhoe. Composting bio-cultures are added to accelerate decomposition and generate biological heat within the waste, aiding in drying it out and reducing its volume. These windrows are turned every 3 days to ensure proper biological treatment and moisture loss. After 12weeks, when the heaps have reached a suitable consistency for screening, the material is weighed and transferred to a Mobile Trommel, which consists of rotating cylinders with different-sized perforations.

Step-3 – Sorting and Segregation by Mobile Trommel

The third step is to move stabilized waste to mobile trommel to get 3 different sizes of fractions

- Fraction 1 – (minus 30 mm) – Bio Soil/earth -Used for filling low lying areas
- Fraction 2 – (30-80) mm – Mixed fraction – Plastics with C&D (send to Ballistic Separator)
- Fraction 3 – (80 +) mm – Mixed fraction – (send to Ballistic Separator)

The Fraction-2 & Fraction-3 (30-80) mm & (80 +) mm is required to move for further separation process through ballistic separator.

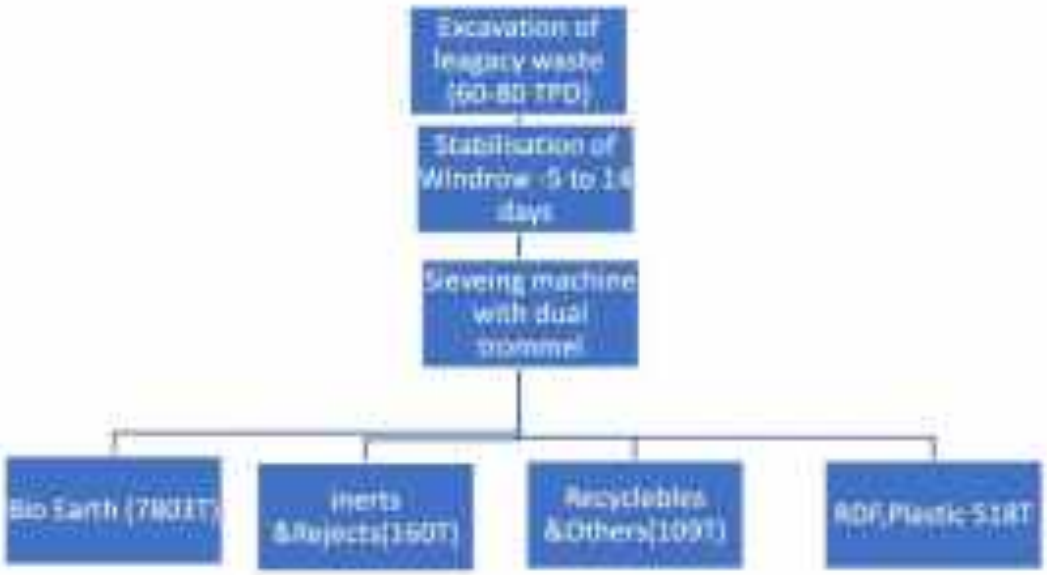
Step-4 – By - products – C&D materials

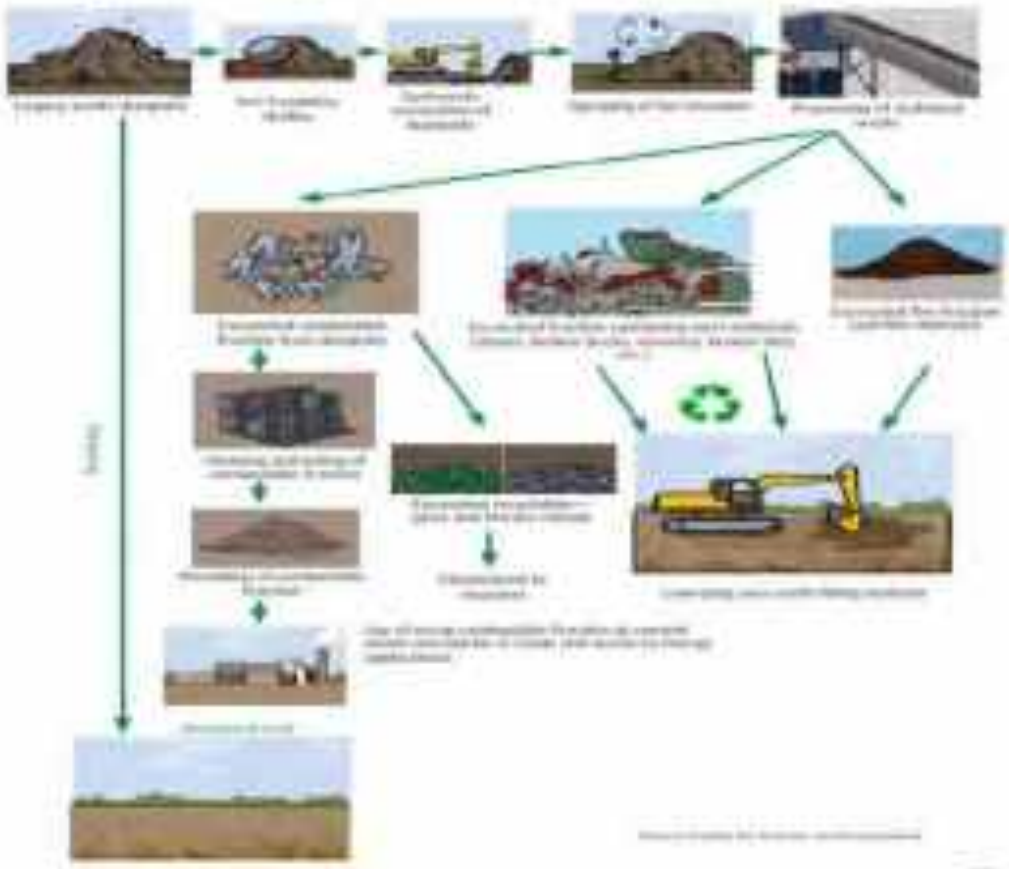
In the fourth step, the fraction-2 and fraction-3 are sorted into three types based on their shape and weight: heavy and rolling fraction (referred to as 3D) - C&D Material, light fraction (referred to as 2D) – RDF, and the sieved fraction (or under-screen fine fraction) – Plastic.

Step-5 – By products – RDF

In the fifth step, the RDF sorted by the ballistic separator (30TPH) is moved to the baling machine (50TPD) for packaging the RDF fractions. The baled RDF is then transported to Cement plants via a weigh bridge (30Ton), where a co-processing facility is available.

**STEPS IN BIOMINING PROCESS**



8. Monitoring & Supervising Mechanism

Supervision and monitoring during dumpsite remediation by TSC/PIU/DPMU

9. Record keeping and Reporting

- The Implementation agency shall maintain a record of the daily processed legacy waste and also keep proper record of all the recovered and disposed of materials.
- The Implementation agency shall maintain authorized weigh bridge records at the point of receipt by end designated agency. A consolidated weigh bridge records certified by the Plant Manager/competent authority of the authorized Cement plant/ WtE or such units certifying the total RDF received from the Project is a valid proof of compliance.
- The Implementation agency shall maintain all the statutory records, as per SWM Rules, 2016, and also conditions stipulated in Site Authorization/Consent to Establish/Operate by KSPCB if any, KSWMP/WB requirements and other project relevance statutory requirements.
- The site shall be operated in CCTV surveillance with data storage of entire contract period. For CCTV surveillance High-Definition IP based cameras in adequate numbers. As per the requirement of the ULB/KSWMP link with mobile compatibility may be provided for online monitoring of the project activities.
- The vehicles engaged for the project activities shall be equipped with Vehicles Tracking System (VTS) by equipping with GPS and online monitoring system.
- The agency is required to maintain loading and unloading weighbridge slips, e-way bill, LR copy, RDF receipt acknowledgement letter from the cement factory/ WtE facility for complete traceability of the recovered fractions.

10. 100% land recovery/project closure

Land shall be reclaimed i.e. all the legacy waste will be removed till it reaches the surface of the earth/ soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the bidder to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to bi-weekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site.

# GOVERNMENT OF KERALA

**Abstract**

Local Self Government Department - Guidelines for Remediation of Legacy Waste Dumpsites through Bio Remediation - orders issued.

**DEPARTMENT**

G.O.(Rt)No.2629/2022/LSGD Dated,Thiruvananthapuram, 29-10-2022

Read 1 Letter No. 2683/C2/2022/SM dated 16.09.2022 from Executive Director Suchitwa Mission.

**ORDER**

As per the letter read above, Executive Director, Suchitwa Mission had submitted draft guidelines for implementation of project for remediation of Legacy Waste Dumpsites through Bio Remediation.

2) Government have examined the matter in detail and are pleased to approve the guidelines enclosed herewith for implementation of project for reclamation of legacy waste dumpsites through bio remediation.

(By order of the Governor)
SHIBI ABRAHAM
DEPUTY SECRETARY

To:

Principal Director Local Self Government Department

Director Local Self Government(Urban) Department

Director, Local Self Government (Rural) Department

Executive Director, Suchitwa Mission

Principal Accountant General (A&E/Audit-I/Audit-II)Kerala, Thiruvananthapuram.

Executive Director, Information Kerala Mission.

The Information Officer (Web & New Media ) I&PRD

Stock File / Office Copy

G.O.(Rt.)No.3689/BMS-I/LSGD

Forwarded /By order

Signed by Prasanth C
Date: 29-10-2022 14:59:04

Section Officer

Copy to:- PS to Minister LSGD

PA to ACS LSGD

CA to SO LSGD

**ബ്രഹ്മപുരത്തിലെയടക്കം നഗരത്തിലെ മാലിന്യ സംസ്കരണ പ്ലാന്റുകൾ നിരീക്ഷിക്കാൻ കേന്ദ്ര സംഘം**

കൊച്ചിയിലെ മാലിന്യ സംസ്കരണ പ്ലാന്റിൽ 2019-ലെ വേനൽക്കാലത്ത് തീപിടിത്തമുണ്ടായതിനെത്തുടർന്ന് ഉയർന്നുവന്ന പരാതികൾ പരിഹരിക്കുന്നതിനുള്ള നടപടികൾ നിരീക്ഷിക്കുന്നതിനായി കേന്ദ്ര സർക്കാർ ഒരു സംഘത്തെ നിയോഗിച്ചു. കേന്ദ്ര പരിസ്ഥിതി, വനം, കാലാവസ്ഥാ വ്യതിയാന മന്ത്രാലയത്തിലെ ഉദ്യോഗസ്ഥരടങ്ങുന്ന സംഘമാണ് ബ്രഹ്മപുരത്തിലെത്തിയത്. കൊച്ചി കോർപ്പറേഷൻ ഉദ്യോഗസ്ഥരുമായി സംഘം കൂടിക്കാഴ്ച നടത്തി. ബ്രഹ്മപുരത്തെ മാലിന്യ സംസ്കരണ പ്ലാന്റിന്റെ പ്രവർത്തനം വിലയിരുത്തുന്നതിനായി ദേശീയ ഹരിത ട്രൈബ്യൂണൽ (എൻ.ജി.ടി.) രൂപീകരിച്ച സമിതിയാണ് സംഘത്തെ നിയോഗിച്ചത്. കേന്ദ്ര പരിസ്ഥിതി, വനം, കാലാവസ്ഥാ വ്യതിയാന മന്ത്രാലയത്തിലെ ഡയറക്ടർ ഡോ. ഹിമാൻഷു പാഠക്, കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡിലെ (സി.പി.സി.ബി.) ശാസ്ത്രജ്ഞൻ ഡോ. ബി. ശർമ്മ എന്നിവരടങ്ങുന്നതാണ് സംഘം. കേരള സംസ്ഥാന മലിനീകരണ നിയന്ത്രണ ബോർഡിന്റെ (കെ.എസ്.പി.സി.ബി.) പ്രതിനിധികളും സംഘത്തിലുണ്ട്. ബ്രഹ്മപുരത്തെ മാലിന്യ സംസ്കരണ പ്ലാന്റിൽ 2019 മാർച്ച് 2-നുണ്ടായ തീപിടിത്തത്തിനുശേഷം പ്രദേശത്തെ വായുവിന്റെ ഗുണനിലവാരം മോശമായതിനെത്തുടർന്ന് നിരവധി പരാതികൾ ഉയർന്നിരുന്നു. ഇതിനെത്തുടർന്ന് കൊച്ചി കോർപ്പറേഷൻ സെക്രട്ടറി നൽകിയ പരാതിയിൽ എൻ.ജി.ടി. സ്വമേധയാ കേസെടുത്തിരുന്നു. ഈ കേസിലാണ് ട്രൈബ്യൂണൽ സംഘത്തെ നിയോഗിച്ചത്. ബ്രഹ്മപുരത്തെ പ്ലാന്റിൽ നിലവിൽ കെട്ടിക്കിടക്കുന്ന മാലിന്യത്തിന്റെ അളവ്, പുതിയ മാലിന്യം കൈകാര്യം ചെയ്യുന്നതിനുള്ള സംവിധാനങ്ങൾ, പ്രദേശത്തെ വായുവിന്റെയും വെള്ളത്തിന്റെയും ഗുണനിലവാരം, പ്രദേശവാസികൾക്കുണ്ടായ ആരോഗ്യപ്രശ്നങ്ങൾ തുടങ്ങിയവ സംഘം പരിശോധിക്കും. ഇതിനുശേഷം സംഘം ട്രൈബ്യൂണലിന് റിപ്പോർട്ട് സമർപ്പിക്കും. ഈ റിപ്പോർട്ടിന്റെ അടിസ്ഥാനത്തിലാകും ട്രൈബ്യൂണൽ തുടർനടപടികൾ സ്വീകരിക്കുക.

**പരിശോധന മാനദണ്ഡങ്ങളും മാർഗ്ഗനിർദ്ദേശങ്ങളും**

- കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ് 2019-ൽ പുറത്തിറക്കിയ "ലാൻഡ്ഫിൽസ് ഓഫ് വിജനമായ ഓഫ് മുനിസിപ്പൽ സോളിഡ് വേസ്റ്റ്"

- കേന്ദ്ര പാർപ്പിടനഗരകാര്യ മന്ത്രാലയവും (MoHUA) നഗരകാര്യ വകുപ്പിലെ പബ്ലിക് ഹെൽത്ത് & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ് ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന് 2020-ൽ പ്രസിദ്ധീകരിച്ച "സബ്ജ് മാനേജ് മിഷൻ (അർബൻ)-അഡൈസറി നോട്ട് ലാൻഡ്ഫിൽ റിഹൈബിലിറ്റേഷൻ (SBM U - Advisory on Landfill Reclamation)"

- പ്രസ്തുത വിഷയവുമായി ബന്ധപ്പെട്ട് കാലാകാലങ്ങളിൽ കേരള സർക്കാർ പുറപ്പെടുവിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങൾ

**കേന്ദ്ര സംഘത്തിന്റെ സന്ദർശനത്തിനുശേഷം ബ്രഹ്മപുരത്തെ മാലിന്യ സംസ്കരണ പ്ലാന്റിൽ നടപ്പിലാക്കുന്നതിനുള്ള മാർഗ്ഗങ്ങൾ**

- 100% ശാസ്ത്രീയമായ രീതിയിൽ മാലിന്യ സംസ്കരണം (MoHUA-യും CPHEEO-യും പ്രസിദ്ധീകരിച്ച "സബ്ജ് മാനേജ് മിഷൻ (അർബൻ)-അഡൈസറി നോട്ട് ലാൻഡ്ഫിൽ റിഹൈബിലിറ്റേഷൻ" പ്രകാരം)

**മാലിന്യ സംസ്കരണ പ്ലാന്റിലെ നിർദ്ദിഷ്ട പ്രവർത്തനങ്ങൾ**

- മാലിന്യ സംസ്കരണ പ്രവർത്തനങ്ങളുടെ നിരീക്ഷണം കേന്ദ്ര സംഘത്തിന്റെ ചുമതലയിലായിരിക്കും

**നിർമാർജനം ചെയ്യേണ്ട മലിനീകരണ വിഭാഗങ്ങളുടെ അളവ് തിട്ടപ്പെടുത്തൽ**

- പൊതുവായി, നിർമാർജനം ചെയ്യേണ്ട മലിനീകരണത്തിന്റെ അളവ്(കൂമ്പാര തിട്ടയിൽ) ടോട്ടൽ സ്യൂഡോ സർവേയിലൂടെ കണക്കാക്കുന്നതാണ്. എന്നാൽ ടോട്ടൽ സ്യൂഡോ സർവേ സാധ്യമല്ലാത്ത സാഹചര്യത്തിൽ ഒരു ഖരം കൂമ്പാര തിട്ടയിൽ ഇടാനുള്ള വലിയ വ്യപ്തകണ്ടെയ്നറുകളുടെ കാര്യത്തിൽ സ്യൂഡോ സർവേ നിർബന്ധമാക്കുന്നതാണ്.

- ആവശ്യമുള്ള ചതുര, പ്ലാവെയുള്ള സർവേ ഏജൻസികളെ നിശ്ചിത നടപടിക്രമങ്ങൾ പാലിച്ച് ഇതിനായി ഏൽപ്പിക്കുന്നതാണ്. അതിനുള്ള ചെലവ് മലൂകാ ഫണ്ടിൽ നിന്ന് തന്നെ സംസ്ഥാന സർക്കാരുകളാണ് വഹിക്കേണ്ടതുമാണ്.

- മൊത്തത്തിൽ കൊണ്ടുപോകുന്ന മാലിന്യത്തിന്റെ അളവ് തന്നെ സംസ്ഥാന സർക്കാരുകൾ എസ്റ്റിമേറ്റ് പരിശോധിച്ച് അംഗീകരിക്കേണ്ടതുമാണ്.

**എസ്റ്റിമേറ്റ് തയ്യാറാക്കുന്ന പദ്ധതി ഇപ്രകാരമാണ്.**

- മൊത്തത്തിൽ നിലവിലെ അവസ്ഥ, മാലിന്യത്തിന്റെ സ്വഭാവഗതകൾ, മാലിന്യ നിക്ഷേപത്തിന്റെ കാലയളവ് തുടങ്ങിയവ വിശദമാക്കുന്ന എസ്റ്റിമേറ്റിനോടൊപ്പമുള്ള വിശദമായ റിപ്പോർട്ട് അനുബന്ധം I ൽ നൽകിയിരിക്കുന്ന പ്രൊഫോർമയിൽ തയ്യാറാക്കേണ്ടതാണ്

- അനുബന്ധം-II ൽ നൽകിയിരിക്കുന്ന മാനദണ്ഡങ്ങളുടെ വാസ്തവം അനുസരിച്ച് തയ്യാറാക്കിയത് എന്ന പ്രസ്താവന നടപ്പിലാക്കുന്നതിന് എസ്റ്റിമേറ്റ് തയ്യാറാക്കേണ്ടതാണ്.

- പ്രൊപ്പോസൽ തയ്യാറാക്കുന്നതിന്റെ ഭാഗമായി പ്രസ്തുത പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള എല്ലാത്തരം ചെലവുകളും പരിഗണിക്കേണ്ടതാണ്.

- വാർഷിക പദ്ധതിയുടെ ഭാഗമായി മുഴുവൻ എസ്റ്റിമേറ്റുകളും മലൂകാ മാനുവലുകളിൽ നിന്നും പണം വകയിരുത്തേണ്ടതുമാണ്.

**സാങ്കേതിക അനുമതി**

നിലവിലുള്ള സാങ്കേതിക അധികാരങ്ങൾ അനുസരിച്ച് തന്നെ സംസ്ഥാന വകുപ്പ്(ബോർഡ് ഇൻഫ്രാസ്ട്രക്ചർ & എസ്റ്റിമേറ്റിംഗ് വിഭാഗ്) ഒരു സ്ഥാപിത എസ്റ്റിമേറ്റിന് സാങ്കേതിക അനുമതി നൽകുകയും ഭരണനിർവഹണ പാലിക്കുന്നതിനായി ചീഫ് എഞ്ചിനീയർ എക്സിക്യൂട്ടീവ് എഞ്ചിനീയർ (സൂപ്രണ്ടിംഗ് വിഭാഗ്) ആവശ്യമായ നിയന്ത്രിക്കുകയും ചെയ്യുന്നതാണ്.

മറ്റുള്ള സംസ്ഥാന സർക്കാരുകൾ മലൂകാ മാലിന്യ നിക്ഷേപ മൊത്തത്തിൽ നിലവിലുള്ള പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള നടപടി ക്രമങ്ങൾ

**ടെണ്ടറിംഗ്**

- മലൂകാ മാലിന്യ നിക്ഷേപ മൊത്തത്തിൽ നിലവിലുള്ള പ്രവൃത്തിയുടെ വിശദമായ സ്കോപ്പ് ഓഫ് വർക്ക് നിബന്ധനകളും വ്യവസ്ഥകളും ഉൾപ്പെടെ വ്യക്തമായി പ്രതിപാദിക്കുന്ന '2 കവർ ബിഡ്ഡ് അപേക്ഷ ക്ഷണിക്കൽ'(Request for Proposal - Two Cover Bid) തയ്യാറാക്കേണ്ടതും അതത് നടപടിക്രമങ്ങൾ പാലിച്ച് പ്രസിദ്ധീകരിക്കേണ്ടതും ചെയ്യേണ്ടതാണ്.

- കേന്ദ്ര ഹൗസിംഗ്-നഗരകാര്യ മന്ത്രാലയവും (MoHUA) സെൻട്രൽ പബ്ലിക് ഹെൽത്ത് & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ് ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന് പ്രസിദ്ധീകരിച്ച "സപ്ലൈ ഓഫ് ഡ്രിങ്കിങ് (ടാർഗെറ്റ്)-അക്കൗണ്ടബിൾ ഗവൺ ഡ്രാഫ്റ്റിംഗ് റിപ്പോർട്ട്" ൽ നൽകിയിരിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങളെ

അടിസ്ഥാനമാക്കി RFP-യിലെ ആവശ്യകതകളുടെ മാനദണ്ഡങ്ങൾ നിശ്ചയിക്കുന്നതാണ്

- ഒരു ലിസ്റ്റിംഗിനെ നിരത്തുന്ന ലൊക്കേഷൻ പ്രൊഫൈൽ "ലൊക്കേഷൻസ് ടാബ് വിശദാംശങ്ങൾ ടാബ് ലൊക്കേഷൻ ഫീൽഡുകൾ നൽകുന്നു" പ്രകാരം ലൊക്കേഷൻ മാനേജ്മെന്റ് സിസ്റ്റത്തിലെ ലൊക്കേഷനെന്നതിനെ നിലവിലെ പ്രൊഫൈലുകൾ 'മൂല്യം ലഭ്യമല്ല' ഉൾപ്പെടുത്തിയേക്കാം ഇവ വിലയിരുത്തുന്നതാണ്

- ലൊക്കേഷൻ ലെവൽ നിയമങ്ങൾ പരിഷ്കരിച്ച് വിലയിരുത്തുകയും സാങ്കേതിക ലാഭവും നേട്ടവും തിരിച്ചറിയാൻ ഉപഭോക്താവിന്റെ ഇപ്പോൾ ഡാറ്റയിലൂടെ കൊടുത്തിരിക്കുന്നു ചെയ്യുന്നതാണ് ലെവൽ നിയമങ്ങൾ ഉൾപ്പെടുത്തുകയും സമ്മതിപ്പിക്കുന്നതിനായി താഴെപ്പറയുന്ന അധികമായ ഉൽപ്പന്നങ്ങൾ നൽകുന്ന സമയം സമയം ലൊക്കേഷൻ സാങ്കേതിക സമീപ ഇപ്രകാരമായിരിക്കുന്നതാണ്

  - വെയ്റ്റഡ്

  - LSQI (LED & EW) എൻജിനീയർ

  - ഓൺലൈൻ വിലാസം ഉപയോഗിച്ചുള്ള നൽകുന്ന സമയം സാധനങ്ങളുടെ കാര്യത്തിൽ

  - ഒരു ഉപഭോക്താവിന് നിന്നുള്ള സാങ്കേതിക വിവരങ്ങൾ

  - ഒരു ലിസ്റ്റിംഗിനെ നിരത്തുന്ന ലൊക്കേഷന്റെ പ്രൊഫൈൽ

  - ലൊക്കേഷൻ സാധനങ്ങളിൽ നിന്നുള്ള മറ്റ് വിവരങ്ങൾ

- ലൊക്കേഷൻ സമയം സമയം ലൊക്കേഷൻ സാങ്കേതികമായി ലൊക്കേഷൻസിനെ ഒരു ലൊക്കേഷനിലെ പരിഗണിക്കുന്നതിന് വിശ്വസനീയമായ ഉപഭോക്താക്കളും സേവനങ്ങളും പാലിച്ച് അപേക്ഷിക്കേണ്ടതാണ്

- ലിസ്റ്റിംഗുകളുടെ കാര്യക്ഷമതയ്ക്കുവേണ്ടി ലൊക്കേഷൻ ലൊക്കേഷൻ ലൊക്കേഷൻ | L O A | നൽകുന്നു കാലിൽ എടുക്കുന്നതാണ്

നിയന്ത്രണം, മാർഗരേഖ, തിരുത്തൽ ആവശ്യങ്ങൾ

  - ലൊക്കേഷൻ സമയം സമയം ലൊക്കേഷൻ ലൊക്കേഷൻ സമയം ലൊക്കേഷൻസ് എൻജിനീയറും മാർഗ്ഗ പരിശോധന പ്രവർത്തനങ്ങളുടെ നിർണ്ണയം എന്നെഴുതുന്ന ഉപഭോക്താവ് അല്ലെങ്കിൽ ഒരു മാർഗരേഖ സമയം ലൊക്കേഷൻ Supervisor Commission ഉൾപ്പെടുത്തുന്നതാണ്

  - R F P മാനദണ്ഡത്തിലും കരാറിലും ഉൾപ്പെടുത്തിയിട്ടുള്ള 'മൂല്യം ലഭ്യമല്ല' രേഖപ്പെടുത്തൽ ഉപയോഗിച്ച് പ്രവർത്തനങ്ങളും എന്ന് നിർദ്ദേശിക്കുന്നതിനുമായി ലൊക്കേഷൻ സമയം ലൊക്കേഷൻ മാനേജ്മെന്റ് എന്നതിനെ ലൊക്കേഷനെന്നതാണ്

  - ഗ്രൂപ്പ് ഗ്രൂപ്പിന് 'മൂല്യം ലഭ്യമല്ല' നിർണ്ണയിക്കുന്ന പ്രവർത്തനങ്ങളാണ് മാർഗരേഖ സമയം ലൊക്കേഷൻ ഉപയോഗം പരിശോധിക്കുകയും നിർദ്ദേശിക്കുകയും ചെയ്യുന്നതാണ്

  - ലൊക്കേഷൻ സമയം ലൊക്കേഷൻ എൻജിനീയർ കരാറുകാരന് എന്നെഴുതിയ ലൊക്കേഷൻ ലൊക്കേഷൻ ലൊക്കേഷൻ സമയം സമയം ലൊക്കേഷൻ സാങ്കേതികവിദ്യയുടെ നിർദ്ദേശിക്കുന്നതിനുള്ള നിയമ സമയം ലൊക്കേഷൻ ചെയ്യുന്നതാണ്

  - മാർഗരേഖ പ്രവർത്തനങ്ങൾ നിർദ്ദേശിക്കുന്നതിന് എന്നെഴുതിയ ഉപഭോക്താവ് ഗ്രൂപ്പ് പ്രവർത്തനങ്ങൾ ഉൾപ്പെടുന്ന മാർഗരേഖ പരിശോധനയുടെ ലൊക്കേഷൻ പ്രവർത്തനങ്ങളുടെ നിർണ്ണയം കാലിൽ. മാർഗരേഖ

അംഗീകാരം, ലഭിക്കേണ്ട നിരാക്ഷേപ സർട്ടിഫിക്കറ്റുകൾ, തുടർന്നുള്ള പ്രവൃത്തികൾ എന്നിവയ്ക്ക് മാർഗ്ഗരേഖ, വർഗ്ഗീകരണം, കാറ്റഗറൈസേഷൻ എന്നിവയ്ക്ക് മാർഗ്ഗരേഖ, സർക്കാർ തലത്തിൽ ഉണ്ടാകേണ്ട നിയമപരമായ നിർദ്ദേശങ്ങൾ തുടങ്ങിയവയാണ്.

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ വിഭാഗത്തിൽ 'ഇൻചാർജ്', 'ഇൻഡിപെന്റന്റ്', 'ഓഫീസർ' തസ്തികകൾ എന്നിവ ഏതൊക്കെ തലങ്ങളിൽ ലഭ്യമാണെന്നതിനെപ്പറ്റിയും, തദ്ദേശ സ്വയംഭരണ വകുപ്പിന് നിലവിലെ സാഹചര്യത്തിൽ ലഭ്യമായിട്ടുള്ള തദ്ദേശ സ്വയംഭരണ വകുപ്പ് (എൻജിനീയറിംഗ് & ഇലക്ട്രിക്കൽ) എഞ്ചിനീയർ പോസ്റ്റിന്റെ സ്റ്റേറ്റസും പരിശോധിച്ചാണ്.

- കോവിഡ് നിയന്ത്രണങ്ങളുടെ അടിസ്ഥാനത്തിൽ നിലവിൽ പൊതുജനങ്ങൾക്ക് ഓഫീസുകൾ/ഏജൻസികൾ തുടങ്ങിയ പ്രവൃത്തികളുടെ വർക്ക് സ്റ്റേറ്റസ് തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ തലത്തിലെങ്കിലും തദ്ദേശ സ്വയംഭരണ സ്വയംഭരണ വകുപ്പിന് ലഭ്യമായ സംവിധാനത്തിലൂടെ ലഭ്യമാക്കുന്നു തദ്ദേശ സ്വയംഭരണ വകുപ്പ് (എൻജിനീയറിംഗ് & ഇലക്ട്രിക്കൽ) എഞ്ചിനീയർ പോസ്റ്റിന്റെ സ്റ്റേറ്റസും പരിശോധിക്കുന്നതാണ്.

- <u>GUIDELINES FOR IMPLEMENTATION OF PROJECTS FOR RECLAMATION OF LEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION (BIO MINING AND MANAGEMENT OF RECOVERABLES AND REJECTS)</u>

As per the provisions of Solid Waste Management Rules 2016, local bodies are mandated to remediate legacy waste dumpsites and reclaim the land based on the guidelines issued by CPCB. Remediation of legacy dumpsites involves various activities such as assessment of the nature and quantity of waste to be remediated, excavation works to open the dumps, screening and sorting to segregate the waste fractions, reuse and sale/marketing of recovered materials, scientific disposal of rejects as per the norms. The remediation of dumpsites is further directed by Honorable NGT in its order on OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. However, the progress of implementation of such projects has not been satisfactory so far. One of the main reasons is that there is a lack of clarity in the procedures to be followed for legacy waste remediation projects right from the approval of the project to the mode of execution (including sale and disposal of recovered materials) by LSGIs since the nature of such projects is not similar to the general public construction/civil works. Also, the nature, quality and quantity of material that can be recovered from an existing legacy dumpsite cannot be accurately predetermined without opening up such dumpsites and hence it is not practical to prepare a workable estimate for the same like other public works . In order to tackle these issues, Swachh Bharat Mission(Urban) and CPHEEO have issued an "Advisory on Landfill reclamation", and suitable provisions of this advisory can be adopted for the State of Kerala. In these circumstances, the Government has examined this matter in detail, and the following guidelines are issued for the implementation of projects for remediation of legacy dumpsites by Local Self Government Institutions.

**<u>Standards, guidelines and advisories to be followed</u>**

- "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" issued by Central Pollution Control Board
- "SBM-U Advisory on Landfill Reclamation" published by MoHUA and

CPHEEO

- Guidelines issued by Government of Kerala in this regard from time to time

**Models for implementing legacy waste dumpsite remediation by LSGI's**

- 100% outsourced model (As per "SBM -U Advisory on Landfill Reclamation" published byMoHUA and CPHEED)

**Implementing officer for legacy waste dumpsite remediation projects**

The implementing officer for legacy waste remediation shall be the Engineer of the LSGI

**Quantification of legacy waste to be remediated**

- The volume of legacy waste (in m3) to be remediated shall be generally assessed through Total Station Survey. If a total station survey is not feasible, a drone survey may be adopted for large dumpsites having a volume of more than 1 (One) Lakh m3.
- If required, external survey agencies may be engaged following laid down procedures and the cost for the same shall be met by LSGI from available funds.
- Contour mapping of the site shall be prepared and approved by the Engineer of the LSG

**Project Cost Estimation and Formulation by LSGI**

- Detailed report regarding the site conditions, nature of dump, history of dumping and other basic details shall be prepared in the format given in **Annexure - I**
- The estimate for biomining shall be prepared as per the specification and data given in
  - **Annexure -II**
- The overall cost for the implementation of the project shall be considered as part of the proposal.
- Project shall be taken up as per annual projects and funds from available sources shall be ear marked

**Technical Sanction**

- Technical sanction for the project shall be issued by the concerned Engineer in LSGO (LID & EW) as per the existing financial powers and necessary reporting to the Chief Technical Examiner (Finance Wing) may be ensured for compliance as per norms

**Implementation steps for remediation of legacy waste dumpsites by LSGIs**

**Tendering**

- Request for Proposals (RFPs-Two cover bid) clearly mentioning the scope of work, terms and conditions for reclamation of legacy waste dump sites shall be prepared and published as per laid down procedures.
- Conditions/eligibility criteria in the RFP shall be fixed based on the guidelines given in"**SBM-U Advisory on Landfill Reclamation"** published by MoHUA and CPHEEO
- It shall be ensured to mention in the scope of work that remediation of legacy waste dumpsites shall be undertaken as per the **"Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)"** issued by Central Pollution Control Board.
- The technical proposals received should be evaluated and technically qualified bidders shortlisted for further stage of bid approval. A Technical committee shall be formed at LSGI level for evaluation of the technical bids with the following members;
    - Secretary
    - LSGD (LID & EW) Engineer
    - Health Official (in the case of Urban local bodies)
    - Technical expert from District Suchitwa Mission
    - Representative from District Pollution Control Board
    - Other experts from academic institutions if any
- Financial bids of the technically shortlisted firms should be opened at LSGI level and approved as per procedures and norms
- Letter of Award (LoA) is to be issued to the selected contractor/agency and agreement executed.

**Execution, Supervision and preparation of bills**

- LSGI shall constitute a supervision committee consisting of LSGI Engineer and the officer in charge of monitoring waste management activity
    - LSGI shall authorise the supervision committee to monitor that the contractor correctly follows the scope of work included in the RFP document and agreement.
- The supervision committee shall inspect and monitor that the work is being carried out as per the scope defined.
- LSGI Engineer shall hand over the site and provide support for execution of work at the site by the contractor/agency
- The officer in charge of monitoring waste management shall oversee the waste management related activities such as formation of windrows, segregation of waste into various streams,ensuring pollution control measures and health matters involved in the project and shall give direction to the contractor/agency through the supervision committee.

- LSGI Engineer shall measure, record quantities by taking initial, intermediate and final levels in M-book and Check measurements shall be done by the officials of LSGD (LID & EW) as per the powers vested with in the Local Self Government Department.
- LSGI Engineer shall prepare the work bills claimed by the contractor/agency after completing stages of work detailed in the agreement and check measurement shall be made by the officials of LSGD (LID & EW) as per the powers vested within Local Self Government Department.



PROPOSAL FOR BIO – MINING / BIO REMEDIATION OF LEGACY WASTE DUMPSITE AT ..... CORPORATION /MUNICIPALITY/ GRAMA PANCHAYAT

BASIC DETAILS OF DUMPSITE

| | | |
|---|---|---|
| Name of LSGI | : | |
| Name of location of legacy dumpsite | : | |
| Extend of land (Acres) | : | |
| Survey No | : | |
| Land owned by | : | |
| Volume of waste (m3) | : | |
| Maximum depth below ground level (m) | : | |
| Maximum height above ground level (m) | : | |
| Approx. level of water table (m) | : | |
| GPS location (Co-ordinates & link to google map) | : | |
| Period from which dumping is done (in Years) | : | |
| Whether waste is still dumped at the site (Yes/No) | : | |
| Availability of water source for remediation process (Yes/No) | : | |
| Availability of Electricity (Yes/No) | : | |

DETAILED REPORT

- Introduction (Brief about the site including site photographs)
- Survey details (Methodology adopted. Details of field measurements and quantity calculation)
- Cost estimate
  - Abstract estimate
  - Detailed estimate
  - Data

Signature

Designation of Engineer in-charge

Name of ULB

[illegible] - 8

SPECIFICATION & OBSERVED DATA FOR REGULARATION OF LEGACY DUMPSITE THROUGH BIO REMEDIATION (Bio mining, managing recoverable and rejects)

Bio remediation (Bio mining, managing recoverable and rejects) by

a. Excavating the existing mixed unsorted garbage which underwent biological degradation in the land portion allocated and spraying with microbial inoculum for sanitising and stabilising the excavated mass, sieving them using Mechanical sieving machine or any other equipment,

b. Control of malt odour using deodorizing agent and stabilising the waste using Bio Culture for aerobic composting.

c. Eco friendly and non-polluting process in order to reduce the impact of dumping site in the adjacent areas.

d. Segregate the excavated garbage in the land portion earmarked, into as many kinds and categories as possible by mechanical means including the cost of any power or fuel consumption.

e. Creation and maintenance of infrastructure facilities and amenities for sieving, the excavated garbage, storing the segregated materials.

f. Deployment of necessary manpower, materials, equipment, tools and creation of facilities for handling, separating, segregating and storing for the operation of the plant.

g. Levelling the earth's surface by bulldozer or any other earth moving equipment

h. Providing security arrangements for the plan project site, machineries, equipment etc.

**DSR 2018 Cost Index- 100 (For reference)**

| Code | Description of items | Unit | Quantity | Rate | Amount |
|---|---|---|---|---|---|
| | *Details of cost for 50 m3/day* | | | | |
| | LABOUR | | | | |
| T5 | Coolie | day | 20.00 | 558.00 | 11160.00 |
| | MACHINERY | | | | |
| MR | Double stage screener with conveyor | day | 1.000 | 7200.00 | 7200.00 |
| MR | Magnetic separator- capacity 5HP | day | 1.000 | 600.00 | 600.00 |
| MR | Dust screening remover | day | 1.000 | 900.00 | 900.00 |
| MR | Bailing press | day | 1.000 | 450.00 | 450.00 |
| 17 | Hire and running charges of tipper 5 m3 | day | 2.000 | 1700.00 | 3400.00 |
| 20 | Hydraulic excavator 3D with driver and fuel | day | 1.000 | 7000.00 | 7000.00 |
| 18 | Hire and running charges of loader | day | 1.000 | 5000.00 | 5000.00 |
| 9999 | Deodorizer & Inoculum | LS | 124.860 | 2.00 | 249.72 |
| | **Total** | | | | **36659.72** |
| | **Market Rate cost** | | | | **9150.00** |
| | Add water charges 1% on MR | | | | 91.50 |
| | **Net Total ( A)** | | | | **9241.50** |
| | Total excluding Market rate | | | | 26909.72 |
| | Add water charges 1% on this | | | | 269.10 |
| | **Net Total (B)** | | | | **27077.82** |
| | **Total A + Cost index B** | | | | **36319.32** |
| | Add OPOH 15% | | | | 5447.90 |
| | **Total for 50 m3** | | | | **41767.22** |
| | **Rate for 1 m3** | | | | **835.34** |

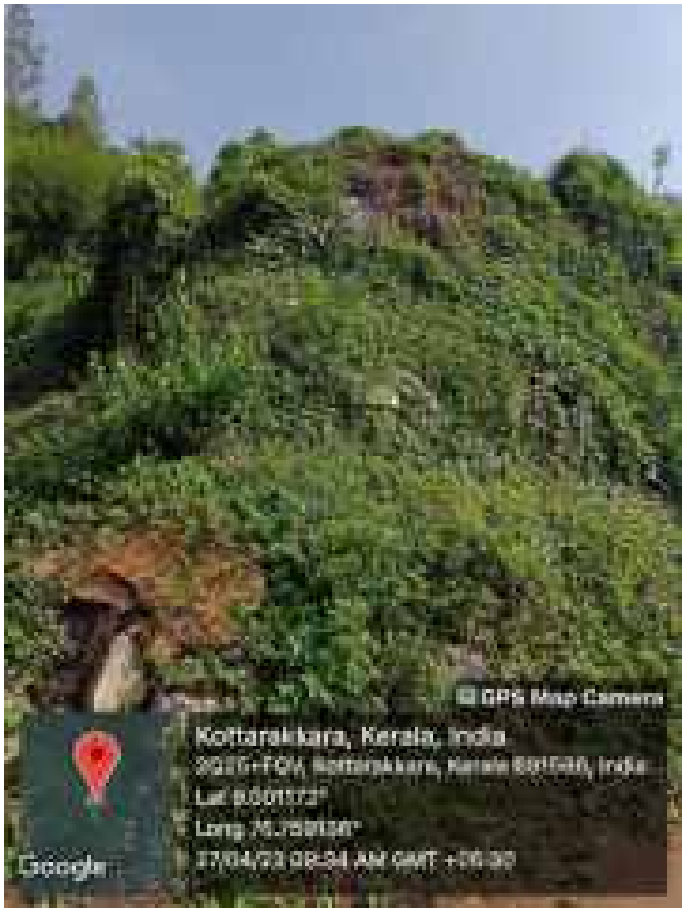
**NB:-** **Rates shall be prepared based on the cost index applicable to each locality*

**PART B**

**SOCIAL IMPACT ASSESSMENT**

KSWMP

KERALA SOLID WASTE MANAGEMENT PROJECT



## 1.1 Introduction

The Social Impact Assessment (SIA) for the remediation of the dumpsite at Ugrankunnu, ward 26 (Railway station ward) of Kottarakkara Municipality, is to identify the social risks, potential impacts, mitigation measures to address such risks and finally preparing social management plan. Transect Walk and Social Screening Checklist were used as tools for identifying the risks and possible impacts. The proposed project is for remediating the dumpsite of the accumulated waste and reclaiming the abandoned land. The transect walk was conducted on 2nd and 16th of June 2023. A consultation meeting with different stakeholders including local residents, ULB functionaries, NGO representatives, ASHA, Anganwadi workers, residents' associations and line departments was held on 01-08-2023. The mitigation measures proposed are from the first-hand experience, outcome of the Key Informants Interviews (KII), FGD, transect walk, stakeholder consultation and social screening assessment, along with local's view and perception regarding dumpsite clearance.

***Table 1.1 Demographic profile of the project area***

| **Particulars** | **Male** | **Female** | **Total** |
|---|---|---|---|
| Ward Population | 418 | 490 | 908 |
| BPL | 16 | 19 | 35 |
| SC | 19 | 29 | 48 |
| ST | 0 | 0 | 0 |
| OBC | 114 | 133 | 247 |
| Differently Abled | 7 | 2 | 9 |

*Source: ICDS and UPHC

***Table 1.2 Dumpsite Profile***

| | |
|---|---|
| *Location of the project area / name of ward and number* | Location: Ugrankunnu<br>Railway Station Ward/ Ward 26 |
| *GPS coordinate of the Site* | Latitude: 9.0011397, Longitude: 76.7590466 |
| *Name of the sub-project* | KTR01CII Ugrankunnu Solid Waste Dumpsite Reclamation by Biomining |
| *Name of ULB* | Kottarakkara |
| *District* | Kollam |
| *Taluk* | Kottarakkara |
| *Total population in the ULB* | 33772 (Source: Ward level survey by ASHA, ULB) |
| *No of functional MCF* | 1 |
| *No of functional RRF* | 1 |
| *Proposed dumpsite area (in acres)* | Total Area of compound: 1 Acre 50 Cent<br>Area of dumpsite: .37.66 Cent |

*Source: Primary data collected by TSC Package A

### 1.1.1 Vulnerability Mapping

Gender, Caste, Race, Ethnicity, Religion, Occupation, Level of Knowledge, and skills etc. access of exclusion for assessing the vulnerability and social inclusion the following aspects are covered.

***Table 1.3 Vulnerability mapping details***

| Sl.No | Categories | Male | Female | Total |
|---|---|---|---|---|
| 1 | Below 6 Years | 3 | 6 | 9 |
| 2 | Differently abled Persons | 1 | 0 | 1 |
| 3 | Persons under Palliative care | 1 | 0 | 1 |
| 4 | Persons above 60 years | 6 | 8 | 14 |
| 5 | Destitute | 0 | 0 | 0 |
| 6 | Pregnant women | - | 2 | 2 |
| 7 | Women headed family | - | 6 | 6 |
| 8 | Total No of lactating mothers | - | 3 | 3 |
| 9 | Scheduled Caste Members | 7 | 8 | 15 |
| | **Total** | **18** | **33** | **51** |

*Source: ICDS and UPHC

### 1.1.2 Land

The site, in a hilly terrain is owned by Kottarakkara Municipality. An MCF, RRF, restroom, and Animal Birth Control programme office are there in the same compound. A newly constructed crematorium is also there. The dumpsite occupies 37.66 cents of the total area, has access to a high gradient CC road with single lane configuration (3 m road). On the southern side, about 150 metres from the site, there is a temple called Ugrankunnu Sree Bhadra Bhagavathi Temple and on the Northern side, 200 m away, there is a Nursing (Vijaya Nursing College) college. On the eastern side a rubber plantation and 17 residential houses are there and on the western side is MCF and RRF.

The remediation project requires additional land to accommodate heavy equipment and machines and to ensure operation of vehicles including earth movers. The ULB has already started negotiations with adjacent vacant landowner to get it on lease.

### 1.1.3 Community engagement

There are socially and economically weaker and vulnerable groups in the project area and they must be associated with the project during different stages. Focus Group Discussions (FGD) were held, and suggestions were collected from households and other stakeholders. The findings of the transect walk is also attached as last section of the social safeguard chapter.

## 1.2 Social Impact Assessment Process

The Social impacts were identified through the identification matrix, apart from these socio-economic conditions of the host communities such as Vulnerability/Livelihood/Labour issues/Gender/responsive Grievance Redressal Mechanism/Disruption of utilities etc. its impacts were analysed, and mitigation measures were formulated.

The process included application of social screening check list, stakeholder consultation, Focussed Group Discussion, key informant interviews and transect walk in the project area while preparing the F.R.

### 1.2.1 Steps involved in Social Impact Assessment

First part of SIA was baseline data collection of the specific project site (Ugrankunnu) from the ULB. The second step was stakeholder analysis with a brainstorming session at ULB by the help of service providers, elected representatives, and officials especially health Dept.

The proposed project involves various stakeholders with various roles/responsibilities. The below table 7.4 shows the stakeholder mapping

***Table 1.4 Stakeholder mapping details***

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| 1 | ULB Council | Bidding with stipulated conditions, finalization, and deputing contractor/agency for remediation |
| 2 | Govt institutions like PCB, KSEB, KWA etc | To deliver necessary approvals and provide necessary services for remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | DPMU | Monitoring and Evaluation |
| 5 | TSC/PMC | Technical support, consultation, and monitoring |
| 6 | Contractor | Execution of the Remediation work in accordance with bid conditions |
| 7 | Service providers/HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| 8 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |
| 9 | Waste Generator in Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |
| 10 | End recyclers | Process the inert and legacy waste safely after remediation |

In continuation with the above process, social screening, potential impact of identified social risk, mitigation measures, implementation plan, monitoring plan and social management plan. The social audit process is also proposed.

### 1.2.2 Social screening Output

The social screening with a checklist for SIA points out that the only anticipated and associated risk is with labour. No other adverse social impact on dwellings, land, livelihood, or community resources of the host and other vulnerable communities has been detected. The assessment screening indicates that the remediation of the dumpsite will have a positive impact on the living conditions of the area.

From the Key Informants Interview (KII), it was found that the present dumpsite area was used by police as well as municipal authorities, as a burial ground and for disposal of unidentified/ unclaimed dead bodies. It led to public protest and was one of the reasons for the closure of the site in 2018.

There will not be any damage to public properties or commercial establishments near the site. There are no scheduled tribes, rag pickers living near the dumpsite. Scheduled caste families are there within the

radius of 200 metres. Due to the low risk associated with the social and economic conditions of the host communities, the dumpsite can be categorized as "Moderate Risk."

### 1.2.3 Scoping of SIA

The proposed dumpsite remediation will be helpful for a healthy life. The overall development of the area will be ensured. Required action plans prepared will be beneficial to the labourers and women by ensuring Social Safeguards.

**Required Action Plans**

- Labour – Included
- Labour Influx – Included
- Gender Based Violence Action Plan – Included
- Citizen Engagement Plan – included.

### Livelihood

The proposed project will not affect the livelihood of either the ordinary or vulnerable population of the area or the HKS members. Since the dumpsite has closed for the last several years the rag pickers are not there. So, it will not affect them also.

**Land requirement**

As per the identification from social screening, there is no requirement of additional land to implement the project/remediation process

### 1.2.4 Key Findings- Potential Social Risks and impacts of the proposed project.

The following findings were identified through the process of application of various tools for social screening as described in the process.

The dumped legacy waste is a serious concern which affects the quality of life of the residents of the area. Within 200m radius of dumpsite 17 families reside, of which four belong to the SC category. Majority of the families are poor and mainly engaged in daily wage labour. During the interaction, it was observed that each family has an average of four members including kids and old people. Most of the families use well water for drinking and household purposes. Some families have KWA connection for water usage. Remediation of the dumpsite will certainly improve the quality of life of the 17 families with 62 inhabitants residing within 200 meters of it.

The only institution within 200 m from the dumpsite is a nursing college with 300 students and 50 staff members. The three college buses and the vehicles of the staff members take this road to travel on every working day from 7.30am to 9 am and 3.30 pm to 5 pm.

The Municipality plans a plastic recycling unit funded under National Urban Livelihood Mission once the dumpsite remediation is over.

The proposed dumpsite rehabilitation project will not have any adverse impact on livelihood of rag pickers, host community or HKS members. The project will not affect the livelihood activities of any local people, particularly artisans, small traders, or others. So, livelihood action plan is not required in the SMP. Tribal Development Plan is not required as there is no tribal hamlet.

There are no non-titled land users living or doing business in the proposed site. As no families have to be resettled, a resettlement plan is not relevant. An approximate of 20- 25 labours will be engaged daily, a labour influx management plan is incorporated in the SIA. The proposed project does not affect any community resources and will not cause any economic displacement, or loss of assets or resources.

There is no activity in the site after its closure, and hence the land is filled with bushes and vegetation. The compound wall, which separates the nearby RRF is cracked and is in a dangerous condition. All relevant safety precautions should be ensured during the execution of the project.

## 1.3 Labour Management Plan

### 1.3.1 Scope and structure of the Labour Management Plan

It is estimated that 2250 man-days are needed for remediation of dumpsite. The period of work is six months. Nearly 15 to 20 labourers are to be engaged in the site daily. So, there may be a labour influx. The contractor to be engaged should have a Labour License. Working hours should be regulated to eight hours. If their work time exceeds eight hours overtime allowance must be given to them. Primary basic amenities must be arranged by the contractor. (Shelter for workers, Toilet, Drinking water rest room facilities, first aid facilities, health insurance etc). The workers engaged by the contractor includes contractors' permanent workers daily wages, workers, and skilled workers. Minimum wages are to be given to them. Safety measures, food transportation etc. are to be ensured by the contractor. A wage register is to maintain by the contractor for avoiding disparity among the labours. Details of migrants' workers shall be registered and copy of the same shall be forwarded to the police station by the contractor.

### 1.3.2 Assessment of Key Potential Labour Risk

- Injuries /accidents / impairment as well as death is untoward incidents of labourers and damages to the machinery.
- Inadequate accommodation, inadequate health facility and basic amenities.
- Nonpayment of minimum wages and other eligible benefits.
- Discrimination of employment (eg. termination from employment, working condition wages or benefits)
- Engagement of Child Labour.
- Labour rights of women
- Sexual abuse at work site and security of women workers.
- Inadequate facility for pregnant women, lactating mothers, and children of work force.
- Possibility of GBV as the work site is near to existing MCF / RRF, since HKS workers are women workers.
- Denial of workers right to form workers organization.
- Misuse of GRM

### 1.3.3 Overview of Labour legislations

Following exactments are applicable to Labourers.

- Employees Compensation Act 1923.
- Contract Labour (Regulation and Abolishment Act) 1970.
- Minimum wages Act 1948.
- Payment of Wages Act 1936.
- Equal Remuneration Act 1936.
- Interstate Migrant workers (regulation Employment and Conditions of Service) Act 1974.
- Child Labour (Prohibition and Regulation) Act 1986.
- Employees State Insurance Act 1948.
- Sexual Harassment of Women at Workplace (Prevention, Prohibition, and Redressal) Act 2013.
- Industrial Dispute Act 1947.
- Trade Union Act 1926.

### 1.3.4 Responsibility Mapping

The proposed work shall be awarded to the contractor through competitive bids by the ULB. The contactor who engages labourers for civil and skilled work should take measures for protection and assistance to vulnerable group of workers (people with disabilities, migrant workers, women workers etc.) and that should be included in the work agreement. The ULB should monitor the same. The occupational health and safety should be ensured by the contractor. Training to workers to be imparted by the ULB. There must be a ULB level forum to address grievances of workers. The Labourers working in the site are to be registered.

### 1.3.5 Code of Conduct

A code of conduct needs to be incorporated in the contract terms. The contractor should conduct continuous awareness generation and training activities to ensure that the workers abide by the code of conduct.

### 1.3.6 Transparency in contract specific terms and conditions

The contract must contain provisions for wages, working hours, Leave, other benefits, notice of termination, collective agreement that apply to the project, GRM etc.

***Table 1.5 Labour Management Plan Matrix***

| Sl.No | Activities | Target | Timeline | Means of verification | Respon sibility |
|---|---|---|---|---|---|
| 1 | To complete the registration by the Principal Employer, the ULB, as per the provisions of the Contract Labour (Regulation & Abolition) Act 1970 (CL Act), Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979 (ISML Act) and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 (BOCW Act) and procure certificate to that effect. | Three Registration Certificates to be procured by the ULB under CL Act, ISML Act and BOCW Act respectively. | Before Awarding works | Registration Certificate issued by District Labour Officer under CL Act, ISML Act and BOCW Act | PIU |
| 2 | To Procure license under CL Act, ISML Act and registration under BOCW Act by the contractor | Two Licenses and One registration under CL Act, ISML Act and BOCW Act respectively. | Before commenci ng the work at site | License and registration certificate issued by the competent Authority. | Contractor |

| | | | | | |
|---|---|---|---|---|---|
| 3 | To procure Workmen Compensation insurance policy proportionate to the number of labour force deployed. (By the Contractor) | One insurance policy. | Before commencing work at site | Copy of insurance policy | Contractor |
| 4 | To display a copy of the certificate of registration at the conspicuous place on the premises where the building and other construction work is being carried on.<br><br>To establish a labour information signboard at camp site by including following details like, date of payment of wages, working hours, holidays, wages rates for different categories of labours and name and contact details of local labour inspector and his/ her office and emergency contact numbers. | One notice board<br><br>One notice board | As soon as the work is started.<br><br>Do | Photographs of the notice board where the license is displayed.<br><br>Do | Contractor |
| 5 | To conduct pre-employment medical examination (as per the provisions of BOCW Act)- to ensure medical fitness of the employee. | All workers must be examined | No of workers employed by the contractor | Pre-Medical Examination certificate issues as per Rule 223(C) of BOCW Act (Form No. IX) by the Registered Medical Practitioner. | Contractor |
| 6 | To conduct Periodical Medical Check-ups (once in every six months) | All workers must be examined. | No of workers employed by the contractor | Medical Examination certificate issued by a registered medical practitioner. | Contractor |
| 7 | To provide safe drinking water. The contractor must provide safe drinking water at worksite as well as camp site* (Guideline is provided along with this document) | As per requirement | During the entire contact period | Photographs of supply of potable water, Bill of water purchase. | Contractor |

| | | | | | |
|---|---|---|---|---|---|
| 8 | To arrange first Aid facility at work site as well as camp site (Specifications and items to be maintained in the box is mentioned in this document) | As per requirement | During the entire contract period | First Aid Register, Bill of purchase, photographs of First Aid kit | Contractor |
| 9 | To arrange separate First Aid room at work site | Allot one specified room | To be made available during the constructio n period | Photographs of the facility | Contractor |
| 10 | To provide first Aid training to selected labours or staff members through an authorised agency. | One training with authorized agency | Within one month of commence ment of the work | Training records & Photographs | Contractor |
| 11 | To establish linkage with local hospitals/ health care institutions for emergency medical assistance | Tie up with at least one hospital | Within one month of the commence ment of the work | Letters issued by the hospital or correspondence and agreement with the hospital. | Contractor |
| 12 | To establish rest room at work site or camp site | | Before the commence ment of the work | Photographs of the rest room | Contractor |
| 13 | To establish Canteen facility for labours if the contractor engages more than 250 labours | | Before the commence ment of the work | Photographs of the facility, canteen register etc | Contractor |
| 14 | To maintain essential registers and records like Form A (Registration of employees), Attendance Register, Wages Register, and other registers like incidents registers including Accident register, Harassment complaints, recovery register, Maternity leave, Termination etc | | As and when the work starts | Copy of registers. | Contractor |
| 15 | Constitute GRC for labours (maximum members to be six. Number of members from employer and employee to be equal. | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |

| | | | | | |
|---|---|---|---|---|---|
| | Female members should be minimum 50%. ) | | | | |
| 16 | Constitution of ICC (minimum members to be four. The presiding member should be a senior female employee) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| 17 | To publish the abstract of labour laws within the premises of the labour camp.<br>The Payment of Wages Act<br>The Employee compensation Act<br>The Building and Other Construction Workers (BECS) Act<br>The Contract Labour (A&R) Act<br>The Child and Adolescent Labour (P&R) Act<br>The Maternity Benefit Act | Abstract of Six acts | As and when the camp is established | Photos of the notices published. | Contractor |
| 18 | To establish code of conduct and provide induction trainings | | As and when new employees are joined | Training reports and other documents | Contractor |
| 19 | Conduct HIV/AIDS awareness programmes | As per requirement | Once in six months | Reports, photographs etc | Contractor |
| 20 | All the Drivers should possess effective and valid Driving License | Drivers should be selected after verification of DL | As and when drivers are appointed | Photocopy of license ID is to be collected | PIU |
| 21 | All the vehicles involved in the project shall be insured to cover the third-party risk | Vehicle must be allowed to be plied in the project only after procurement of third-party insurance to the vehicle | As and when vehicles are plied in the project | Photocopy of insurance is to be collected | PIU |

**Budget for LMP**

| S.No | Item | Cost |
|---|---|---|
| 1 | **Labour compliance as per LMP** | [redacted] |

## 1.4 Labour Influx Management Plan

### 1.4.1 Scope and structure of Labour Influx Management Plan

Nearly 42 HKS are working in the MCF and RRF. A Nursing College is also functioning near the site. The contractor must provide halting place for the workers, Toilet, Drinking water, First aid facility etc. The remediation work shall not affect the functioning of MCF /RRF and Nursing College. Most of the HKS workers and College students are girls/women. So, precautions must be taken by the contractor for preventing GBV. The road leading to the facility is a narrow, hence precaution may be given for transportation of waste. The work shall not affect the functioning of Nursing College or MCF / MRF.

### 1.4.2 Overview of Labour influx on the project

It is estimated that 2250 Labour days needed for the remediation work. The estimated period of work is for 5 months. Nearly 15 to 20 workers shall be engaged per day.

### 1.4.3 Mapping of impact done to Labour influx

Daily 15 to 20 workers employed by contractor are expected to be at the site. There are ,17 houses near the site. 42 HKS workers are working at the MCF/ RRF. Nursing College is functioning nearly 200m from the site. Precautions must be taken by the contractor and ULB to avoid public nuisance issue and to prevent GBV.

### 1.4.4 Align the remediation work plan with the requirement of Labour

The work force to be employed includes mechanics, machine operators etc. and the migrant labourers may have to stay at the site. The possibility of involving HKS volunteers in the labour force should be explored.

### 1.4.5 Profile of the host community

There are 17 dwelling units, one Nursing College, one temple within 200 M radius of the site. The population density of the area is low.

### 1.4.6 Impact assessment

Since the work site is in an interior area, the contractor must make arrangements for the accommodation of labourers, to meet their primary needs, food, security and emergency response system etc. There must be a first aid facility in the work site. A code of conduct for the workers is also necessary. AIDS /HIV awareness must also be given to the workers. GRM system is to be established. These are to be included in the contract agreement.

***Table 1.6 Labour Influx Management Plan Matrix***

| Sl.no. | Risk | Mitigation measures | Implementation responsibility | Monitoring indicators | Monitoring responsibility |
|---|---|---|---|---|---|
| 1 | Social and Community wellbeing | There is no adverse impact | NA | NA | NA |
| 2 | Economic and Livelihood Issues | No economic and Livelihood issues. Local people may be provided job opportunities by the contractor | NA | NA | NA |
| 3 | Accommodation /labour camp | Accommodation must be arranged by the contractor | Contractor | Personal verification observations Interviews | TSC/ DPMU |
| 4 | Communicable Diseases | Screening regular medical check-up Hospital facility | Contractor | SoP for prevention of communicable diseases and health well-being on work site and Labour camp. Report on Medical Check up | TSC/ DPMU |
| 5 | Crimes | Code of conduct and SoS | Contractor | Work site complaint Register Number of cases reported, and action taken | TSC/ DPMU |
| 6 | Child Labour | Must not be allowed | Contractor and TSC | No. of child Labour issue Reported | ULB / DPMU |
| 7 | Labour licences | Contractor must have a valid Labour License. | Contractor/PIU | Number of labours having licence | DPMU |

## 1.5 Gender Based Violence Prevention Plan (GBVP)

From the site-specific field study, it was observed that there is a lack of security. So, there is possibility of vulnerability of women to violence, sexual exploitation and abuse, harassment during the dumpsite remediation. It came to the notice of TSC team that women as service providers, especially HKS members often have to work in unprotected work environment, and are susceptible to many hazards. They work in poorly maintained areas and are often exposed to violence, harassment, and abuse by unwanted elements of society. This may also affect their social security. Effective responsive mechanisms for harassment redressal at ULB level are often not enough to address such issues. Gender insensitivity needs to be addressed at all levels through intensive IEC, and BCC campaigns and capacity building programmes at ULB level. Care should be taken to prepare and disseminate information regarding Internal Complaints Redressal Committee (ICRC), emergency contact number. From the assessment on gender risks the following GBVA Plan is prepared.

***Table 1.7 GBV Action Plan***

| **Action** | **Tasks** | **Timeline** | **Primary Responsibility** | **Monitoring Indicators** | **Monitoring Responsibility** |
|---|---|---|---|---|---|
| Formation of Internal Complaints Redressal Committee (ICRC) | Work in collaboration with ICRT<br><br>Orientation training<br><br>Organize meetings.<br><br>Documentation of meetings<br><br>Information dissemination regarding ICRC | 30 Days | ULB | Minutes of formation committee meeting<br><br>Details regarding drafting of TOR and finalizing.<br><br>Reports, attendance, decisions | DPMU |
| Crime Mapping on issues. | Mapping of Reported cases of sexual abuse/ rape/harassment issues/GBV | 60days | ULB | Monthly report<br><br>Issue tracking system in place<br><br>Feedback report (monthly) | DPMU |
| Review and quality assessment of services | Establishing a committee by Mobilizing services of experts in counseling, lawyers, | After 30 days | ULB | Directory of service providers<br><br>List of key partners | PIU/DPMU |

| | | | | | |
|---|---|---|---|---|---|
| | identifying local NGOs<br><br>Documentation service providers in terms of prevention, protection, rescue, rehabilitation, restoration, reintegration, and follow-up action | | | Mapping of roles and responsibilities Gap Identification strategy formulation<br><br>Monthly progress report on quality Assessment | |
| Capacity building on GBV awareness and information regarding provisions for protection safeguards to services and Committee members. providers | Organize sensitization activities.<br><br>Display sign boards around the project site. | 30days | ULB/Contractor | Detailed activity plan<br><br>Progress reports<br><br>Completion report | PIU/DPMU |
| Create a GBV responsive support mechanism (rehabilitation centres, counselling centres etc.) | Seek partnership for GBV support (Police Station & Local NGO)<br><br>Create a Standard Operation Procedure for prevention, protection, rescue, rehabilitation, restoration.<br><br>Prepare plan for awareness generation, training, and documentation | | ULB/Contractor | Standard Operation Procedure (SOP) for prevention, protection, and rehabilitation<br><br>IEC plan for awareness generation<br><br>Implementation report (IEC) | PIU/DPMU |
| Reporting, monitoring, and review | Create GBV database.<br><br>Monthly,Quarterly reports<br><br>Conduct review | Every 3 months (immediately after the incidents occurred) | ULB | Progress reports (Monthly, quarterly)<br><br>Crime Bureau (CB) report | PIU/DPMU |

| | | | | | |
|---|---|---|---|---|---|
| | | | | Monthly complaint status and action taken report.<br><br>Establishment of Feedback system | |

### 1.5.1 Implementation Plan

***Table 1.8 Implementation Plan***

| Sl No | Activity | Timeline | Primary Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 1 | Formation of ICRC | 30 days | DPMU | TSC |
| 2 | Crime mapping | 30 days | TSC | DPMU/ULB |
| 3 | Mobilizing support services and quality assessment | 30 days | ULB/DPMU | TSC/DPMU |
| 4 | Capacity building | 30days | ULB/TSC/DPMU | TSC/DPMU |
| 5 | IEC Activities | 90 days | ULB/TSC/DPMU | TSC/DPMU |

### 1.5.2 Monitoring Plan

***Table 1.9 Monitoring Plan***

| Activity | Monitoring Indicators | Means of Monitoring | Reporting Period | Responsibility |
|---|---|---|---|---|
| Formation of Internal Complaints Redressal Committee (ICRC) | Minutes of formation committee meeting<br><br>Details regarding drafting of TOR and finalizing Reports, attendance, decisions | Review of records, minutes of the meeting attendance and related documents | Every 3 months | ULB/DPMU/TSC |
| Crime Mapping on issues. | Monthly report<br><br>Issue tracking system in place and Feedback report | Records, documents regarding related evidence | 30 days | ULB/DPMU/TSC |
| Review and quality assessment of services | Directory of service providers<br><br>List of key partners<br><br>Mapping of roles and responsibilities<br><br>Monthly progress report on quality Assessment | Reports and related documents | 30 days | ULB/DPMU/TSC |

| | | | | |
|---|---|---|---|---|
| Capacity building | Detailed activity plan<br><br>Progress reports<br><br>Completion report<br><br>Feedback report | Documents regarding conduct of training number and level of participants, communications | 60 days | ULB/DPMU/TSC |
| Linkage with support mechanism | MoU with support mechanism institutions.<br><br>Sop<br><br>Action Plan report | IEC activities<br>Sop activities | 90 days | ULB/DPMU/TSC |
| Reporting, monitoring, and review | Data base on GBV<br><br>Quarterly reports<br><br>Review reports | Progress reports (Monthly, quarterly)<br><br>Crime Bureau report<br><br>Monthly complaint status and action taken report.<br><br>Establishment of Feedback system | Every month | ULB/DPMU/TSC |

### 1.5.3 Budget

*Table 1.10 Budget for GBV and associated activities*

| S. No | Activity | Specification | Quantity | Cost (₹) |
|---|---|---|---|---|
| 1 | Sensitization program | Waste generators (Residents) on GBV | 1x [redacted] | [redacted] |
| 3 | Sensitization programs | Service providers (HKS) on GBV | 2 x [redacted] | [redacted] |
| Total | | | | [redacted] |

## 1.6 Citizen Engagement Plan

### 1.6.1 Communication and Community Engagement

Each stage of the project like planning, decision making, implementation and impact assessment will be implemented through participatory methods, engaging different community groups (Residents Associations, NGOs, Institutions, ULB, HKS) other employees and Community Based Organizations (CBOs). Social and Behavioural Change Communication (SBCC) activities would be imparted during the implementation of the project.

The social Management activities ensured the strategy for social inclusion and benefits to vulnerable communities along with gender concerns, Livelihood improvements, Proper Labour Management, and adequate provision for community engagement

***Table 1.11 Concerns of Communication and Community Engagement and Mitigation***

| **Concern** | **Mitigation** |
|---|---|
| Non-co-operation and protest. | Community participation through various SBCC activities |
| Lack of community ownership feeling | Participatory monitoring will be ensured |
| Lack of civic sense regarding waste management | Campaign, IEC materials distribution, street plays, flash mob etc. to influence public be- haviour in favour of dumpsite remediation |

### 1.6.2 Stakeholder Identification

From the field study through consultation with the community, it was identified that the major stakeholders are service providers and waste generators. There are two types of service providers, primary and secondary. HKS members, elected representatives, health officials are the primary service providers directly involved with the community in SWM processes. Other service providers come under the secondary category.

***Table 1.12 Waste generators in ULB***

| **Waste generators** | |
|---|---|
| **Category** | **Numbers** |
| Households, commercial establishments, and Public Service Institutions | 10087 |

***Table 1.13 Service providers at ULB***

| **Service providers at ULB level** | |
|---|---|
| Category | Numbers |
| Elected representatives | 29 |
| ULB Officials | 28 |
| permanent Sanitation workers | 11 |
| Casual sanitation workers | 7 |
| Rag pickers | 20 |
| Scrap dealers | 4 |
| HKS | 42 |
| IRTC coordinator | 2 |

***Table 1.14 Demographic Profile of the project area***

| **Particulars** | **Male** | **Female** | **Total** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Ward Population | 418 | 490 | 908 |
| BPL | 16 | 19 | 35 |
| SC | 19 | 29 | 48 |
| ST | 0 | 0 | 0 |
| OBC | 114 | 133 | 247 |
| Differently Abled | 7 | 2 | 9 |

### 1.6.3 Need of the plan

Citizen engagement plan aims to actively engage with the citizens, to address their concerns and provide valuable content and support to the plan. The direct and indirect involvement of citizens during various stages of the remediation process will be helpful to ensure transparency and accountability in governance, cost effectiveness, credibility, sense of ownership, sustainability and ensured democratic participation.

### 1.6.4 Objective of the Plan

The main objectives of the plan are.

- To learn and mobilize the community.
- To create awareness regarding the relevance of the citizens engagement plan
- To initiate leadership from the community
- Democratic participation through interaction, conversation and FGDs
- To ensure quality participation and effective decision making which will ensure Citizen Engagement Plan

### 1.6.5 Stakeholder's concerns

- •The host community may not own the remediation process due to lack of awareness.
- •Inadequate Waste Management process leads to poor public health, health risks due to environmental problems (air and water pollution)
- •Lack of community engagement

### 1.6.6 Public disclosure

Information dissemination on Project details - Aim, objectives, issues, strategies, and mitigation measures, project cost, time line through different IEC tools, disclosure of helpline number and ULB website etc.

### 1.6.7 Activities proposed

- Information dissemination about the project through public announcements
- Community/citizen Awareness
- Mass media (Bit notice, print media, radio, audio-visual including social media)
- Mid media (Posters, street play, flashmob, hoardings etc)
- Interpersonal communication

### 1.6.8 Awareness to service providers

- Capacity Building
- Training programmes
- Experience sharing of successful projects.
- Exposure visits to successful project sites

### 1.6.9 Citizen Engagement Plan

The below table 7.15 shows the Citizen Engagement Plan,

*Table 1.15 Citizen Engagement Plan*

| S. No | Engagement Challenge | Impacts on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| 1 | Lack of Awareness on Project activities | Public protests | Awareness generation through SBCC (to selected community people in the ward regarding the necessity of remediation, process, cost etc.)<br>IEC Activities (Specific to remediation activities)<br>Interpersonal communication<br>Mid media<br>Print materials (Leaflet, Brochure, dangler etc.)<br>Inter/intra group communication | PIU/TSC |
| 2 | Socio political issues | Community unrest, Non-cooperation, lack of credibility and ownership | Citizen engagement<br>Discussion/ FGD by opinion seekers, adequate propaganda, policy/ advocacy programmes with the citizens.<br>Liaison activities with those who intervene such issues.<br>Discussion meeting with political/community/religious leaders/labour department officials.<br>Media advocacy/ support programs | Contractor/TSC |

### 1.6.10 Budget

Budget for Sensitization, SBCC and IEC activities are provided in below table,

*Table 1.16 Budget*

| S. No | Activity | Specification | Quantity | Cost (₹) |
|---|---|---|---|---|
| 1 | Sensitization program | Waste generators (Residents) | 3 x [redacted] | [redacted] |
| 2 | Sensitization program | Service providers (HKS) | 2 x [redacted] | [redacted] |
| 3 | Sensitization program | Labourers | 2 x [redacted] | [redacted] |
| 4 | SBCC and IEC activities | Awareness programme, distribution of leaflet, Pamphlet, Flash mob, Street play, Competitions etc. | 1 x [redacted] | [redacted] |
| Total | | | | [redacted]/- |

*The total budget worked out for Social Management measures are* [redacted]

**Summary of SMP budget**

| S.No | SMP Activity | Cost |
|---|---|---|
| 1 | Labour Management Plan | [redacted] |
| 2 | Labour Influx Management Plan | [redacted] |
| 3 | Preventive GBV action plan | [redacted] |
| 4 | Citizen Engagement Plan | [redacted] |
| **Total** | | [redacted] |

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

# MUVATTUPUZHA DUMPSITE

**SUBMITTED BY**

**KERALA SOLID WASTE MANAGEMENT PROJECT (KSWMP)**

# Part A

# Environmental Impact Assessment

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# SUMMARY

**INTRODUCTION:** Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio mining of multiple Legacy Waste Dumpsites in various districts. Bio mining and bioremediation of Valakkuzhi dumpsite figures in Cluster 1. The selected dumpsite is Valakkuzhi which is falling under this cluster 1 and is located near Ward no 25 Muvattupuzha municipality, Ernakulum District.

**RATIONALE FOR THE PROPOSED SUB-PROJECT:** Muvattupuzha ULB proposes bio mining and bioremediation of the Valakkuzhi legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

**PROPOSED SUB-PROJECT DETAILS:** Muvattupuzha dumpsite is located at a distance of 2.5 km from the centre of Muvattupuzha town in western side and encompasses a total area of 5.47 acres of land. The geographical coordinates of the dumpsite are 9.993701° N, 76.560974° E. The volume of legacy waste to be remediated in the dumpsite is 55,712 Cu.m. The legacy waste is presented about 2.47 m above and 5.5 m below the ground level respectively. Hence bioremediation of the dumpsite is essential to mitigate the environmental impacts.

**APPLICABLE NATIONAL, STATE LEGISLATIONS AND TECHNICAL GUIDELINES:** To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed and followed.

**THE WORLD BANK SAFEGUARDS POLICIES, AND KSWMP ESMF**: The World Bank policies and directives on environmental and social safeguards have been adhered to the proposed dump site remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are ensured.

**SUB-PROJECT SCREENING AND ITS CATEGORIZATION:** As per indicative categorization for dumpsite bio mining and bioremediation, this subproject is categorized as E1.

Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (5.47 acres) and waste spread (3.20 acres) and absence of environmentally sensitive features around, this subproject is individually considered as E2 and EIA is prepared accordingly.

**ENVIRONMENTAL BASELINE:** Physiographically, Muvattupuzha in and around topographical features, is flat terrain zone. The favourable time for remediation is between October-2023 to March-2024 non-monsoon period. As per Wind rose diagram, the predominant wind directions are blowing from West and WSW direction throughout the year. As per the geotechnical investigation, the subgrade soil was encountered at 5.5 m below the waste depth of the dumpsite and the predominant soil is gravelly clay. The dumpsite is surrounded by predominantly of Dry cultivation land use and the same will act as odour attenuation during remediation. The cultural heritage zone near dumpsites is Muvattupuzha Old Bridge at a distance of 2.0 Km in East direction. Hence, no significant physical impact to the heritages sites is envisaged during remediation. As per the district disaster management plan-2015 and flood vulnerability map the dumpsite is under flood prone zone.

**DESCRIPTION OF ENVIRONMENTAL PARAMETERS:** The analysed air pollution data indicates that the levels are within acceptable limits of NAAQs, except the $PM_{10}$ of 136 $\mu g/m_3$. The ambient Noise Levels are well within the National Ambient Noise standards for Residential Area for night time however during the night time noise equivalent (45.9 dB (A) was found to be marginally higher than the standards. The ground water quality results indicate that the dumpsite has not caused any major increase of the parameters and the quality parameters are within the IS10500:2011, except the coliforms which are found to be higher than the above said standard. Similarly, the surface water sample shows that it is not largely influenced by the dumpsite as the quality is within the limits of IS 2296, except for BOD which shows a marginal increase in value of about 4.6 mg/l and COD of 14 mg/l. The leachate monitoring data indicates, the TDS is about 143 mg/l, while the suspended solids is about 12 mg/l. The chlorides are 24.1 mg/l, while the COD, BOD are 150 mg/l and 16.4 mg/l respectively.

**SOCIO-ECONOMIC BASELINE:** Muvattupuzha Municipality has population of 30,397, literacy rate of 96.11%, Density of population of 9as per Census 2011. The dump site is situated in the land owned by the Municipality. They have full authority to plan and implement the remediation process in this land. The remediation process will be conducted by an experienced

agency decided by the Municipality with the supervision of a ULB level project implementation unit.

**SOCIO-ECONOMIC ENVIRONMENT:** The dumpsite remains in close proximity to 27 houses 200 metre distance and the remediation process will not affect the socio economic environment in and around the dump site in any way. Within a 200-meter radius of the dumpsite, there are houses, shops and workshops. The site is covered with a compound wall and gate.

**ANALYSIS OF ALTERNATIVES:** After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

**ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS:** Environment: During operational phase (bio-remediation), the main potential nuisances caused by a dump site are fugitive dust, odour, foul gases, smoke from the site (in case of fire), and leachate generation. Birds, vermin, and rodents, littering, noises both from machineries operating at the site and waste collection vehicles. Social: No specific social risk is identified for initiating the remediation process except the occupational hazards to the workers engaged in the remediation process. It can be overcome by using adequate protective measures properly. In

**ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN:** The management plan proposed are for pre-remediation as well as during remediation stage and post remediation. The mitigation measures are recommended for impacts from air, noise, water, leachate, health and safety, OH&S aspects. The proposed monitoring plan includes leachate, surface and ground water monitoring for a period of once in three months. The cost of [redacted] is required for implementation and supervision of EMP.

**SOCIAL MANAGEMENT AND MONITORING PLAN:** The social management plan proposed are for pre-remediation as well as during remediation stage. The mitigative measures proposed addressing concern of local community about remediation work, labour management issues, health and safety risks of labours, gender discrimination.

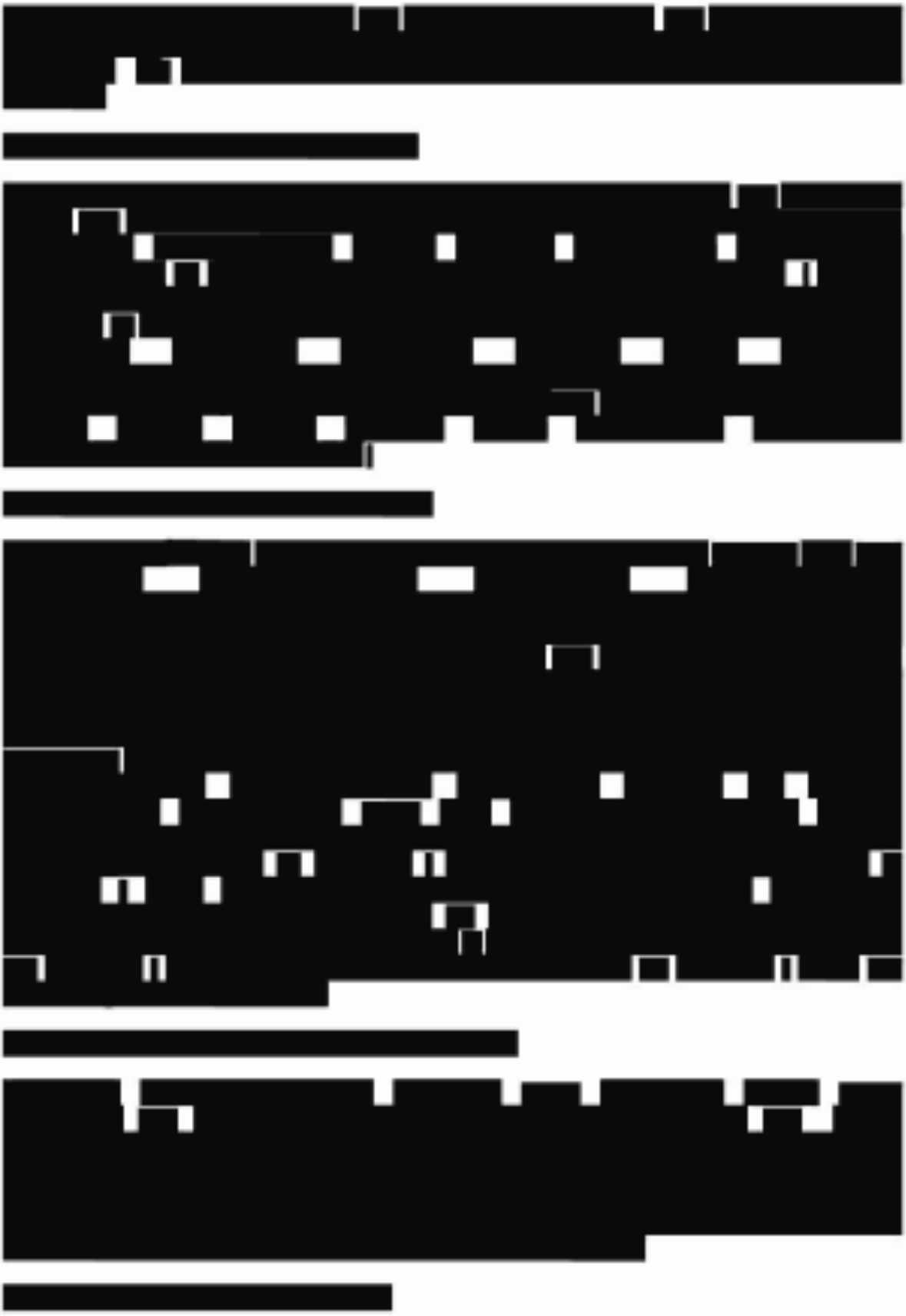
**EMERGENCY PREPAREDNESS PLAN:** The identified emergency situations which may arise from remediation activities are fire risk in summer, occupational health and safety related risks. The Muvattupuzha police station at 3.7 km, General hospital at 3.5 km, Muvattupuzha Fire and Rescue station at 3.0 km are the nearest emergency services.

**SUPERVISION AND MONITORING:** Periodic Compliance monitoring system will be done by the contractor during remediation.

**PUBLIC CONSULTATION AND INFORMATION DISCLOSURE: A** Transect walk was carried out on 31.05.2023 covering the surrounding area of the dump site. Effective IEC drive to be initiated to engage with the community to build support as the activity will create positive impact. Warning sign boards and project information boards with full details of grievance redressal mechanism along with all related contact details will be installed at site during the process at the site. Site control measures should be enforced to prevent unauthorized personnel into the work site.

***Note: All the references to Social Impact Assessment and Social Management Plan may be referred to Part B- Social Impact Assessment which is a separate document attached along with this document.***

# സംഗ്രഹം





[redacted]

# CHAPTER 1. INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-Financing Framework agreement and as agreed Project Co-Lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio mining of multiple Legacy Waste Dumpsites in various districts. There are 19 dumpsites identified for remediation under the Kerala Solid Waste Management Project. Several others have been taken up for remediation directly by the ULBs. Currently, 7 dumpsites considered within the three districts, which are (Ernakulum, Alappuzha and Idukki) falling under Package B are selected by Kerala Solid Waste Management Project (KSWMP) for remediation under the project. One of the selected dumpsite is Valakkuzhi which is located near Ward no 25 Muvattupuzha municipality, Ernakulum District.

## 1.2 The rationale for the Proposed Sub-Project:

Valakkuzhi dumpsite in Muvattupuzha ULB at ward no. 25 has a total waste quantity of 55,712 Cu.m, spreading over 3.20 acres. The site is located between Latitude 9.993701° N and Longitude 76.560974° E and has an elevation of MSL +20 (m), with a gentle slope towards the south-eastern part. During monsoon season, due to the geography of the site, Leachate from waste flows downhill towards residential areas located at southern side of the site. Muvattupuzha ULB proposes bio mining and bioremediation of the Valakkuzhi legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

## 1.3 Proposed Sub-Project Details:

Valakkuzhi dumpsite is located at a distance of 2.5 km from the centre of Muvattupuzha town in western side and encompasses a total area of approximately 5.47 acres of land. Out of this, 3.20 acres of land is covered with solid waste. The geographical coordinates of the dumpsite are 9.993701° N & 76.560974° E. It is located in ward no. 25 of the municipality. Muvattupuzha municipality holds the ownership of the dumpsite. The access road to the dumpsite is Valakkuzhi road which is at a distance of 35 m in the Northern direction. The nearest state highway (SH-41) connecting (Ernakulam-Thekkady Road) is in northern direction at a distance of 540 m and nearest national highway (NH-85) connecting (Kochi-Madurai Road) is in Southern direction at 1

km from the dumpsite. The south and west direction of the dumpsite is vacant land. Muvattupuzha river is in SE direction from the distance of 1.2 Km.

Currently, the quantity of waste dumped at this site is about 55,712 Cu.m. As of now 60 % of the area is covered with solid waste. The legacy waste is presented about 2.47 m above and 5.5 m below from the existing ground level as per the geotechnical investigation studies conducted. Hence bioremediation of the dumpsite is essential to mitigate the environmental impacts. Dumpsite reclamation involves excavation, screening, and separation of material from dumpsites into various components such as soil, recyclable materials, and residues.

### 1.4 Objectives and Scope of the EIA & SIA:

As per indicative categorization for dumpsite bio mining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (5.47 acres) and waste spread (3.20 acres) and absence of environmentally sensitive features around, this subproject is individually considered as E2 and EIA is prepared accordingly.

The EIA & SIA process involves the identification of the potential environmental and social issues in the project and during design interventions. The EIA & SIA further carries out impact prediction and evaluation of residual environmental and social issues of a Project. It then goes on to outline the proposed mitigation measures for residual impacts and enhancement measures for positive impacts which the Project will implement.

### 1.5 Structure of the Report:

The Consolidated EIA & SIA report has been structured into the following Chapters:

- Introduction and Project Description.
- Policy, Legal and Administrative Framework presents a review of the existing Institutions and legislation relevant to the project at the National and the State levels;
- Environmental Assessment Methodology discusses sequence of tasks carried Out in preparing EIA;
- Existing Environmental Scenario presents a consolidated picture of the existing Environmental setting of the project;
- Assessment of Potential Impacts identifies and quantifies the potential impacts on each of the environmental components due to the proposed project development;
- Analysis of Alternatives discusses the criteria for analysis of alternatives of technology for remediation.
- Mitigation Measures presents an elaborate listing of the nature of impacts on each of the environmental components and the avoidance and mitigation measures suggested.
- Public Consultation details the stages and types of public consultations carried out during the project preparation stage and people's perceptions of the project benefits and the Potential impacts.

# CHAPTER 2. POLICY AND REGULATORY FRAMEWORK

## 2.1 Applicable National, State Legislations and Technical Guidelines

**National Environmental Rules and Regulations: -**

To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed. A summary of environmental legislation/regulations relevant to the project is furnished in the following **Table-2.1**.

**TABLE: 2.1 SUMMARY OF ENVIRONMENTAL LEGISLATION/REGULATIONS**

| SR. NO | ACT / RULES | PURPOSE | APPLICABLE (YES / NO) | REASON FOR APPLICABILITY | AUTHORITY |
|---|---|---|---|---|---|
| 1 | Environment Protection Act, 1986 | To protect and improve the overall environment. This is an umbrella Act. | Yes | As all environmental notifications, rules and schedules are issued under this act. | MoEF&CC, CPCB, SPCB |
| 2 | Solid Waste Management Rules, 2016 | To manage collection, transportation, Segregation, Treatment, and disposal of solid wastes (other than Hazardous water, Plastic Waste, Bio Medical waste) | Yes | Dumpsite remediation/bio mining | MoEF&CC, CPCB, SPCB |
| 3 | Air (Prevention and Control of Pollution) Act, 1981 | To control air pollution by controlling emission of air pollutants as per the prescribed standards. | No | No, Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 21 of Air (Prevention and control of Pollution) Act 1981. | State Pollution Control Board, Kerala |
| 4 | Water Prevention and Control of Pollution) Act, 1974 | To control water pollution by controlling discharge of pollutants as per the prescribed standards | No | No, Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 25 of this Act. | State Pollution Control Board, Kerala |
| 5 | The Noise Pollution (Regulation and Control) | The standards for noise for day and night have been promulgated by | Yes | This act will be applicable for all construction equipment | State Pollution |

| | | | | | |
|---|---|---|---|---|---|
| | Rules, 2000 & amendments | the MoEF&CC for various activities. | | deployed at worksite and in operation. | Control Board, Kerala |
| 6 | Public Liability and Insurance Act, 1991 | Protection from accidents. | Yes | This act will be applicable for providing immediate relief to the persons affected by accident occurring during work | State Pollution Control Board, Kerala |
| 7 | Central Motor Vehicle Act 1988 | To check vehicular air and noise pollution. | Yes | This rule will be applicable to vehicles deployed for construction activities and construction Machinery. | Motor Vehicle Department |
| 8 | The Plastic Waste Management Rules, 2016 | For the storage and disposal of plastic wastes through authorized vendors. | Yes | This act will be applicable for the storage and disposal of all the plastic wastes. | State Pollution Control Board, Kerala |
| **Other Applicable Rules** | | | | | |
| 9 | Construction & Demolition, Waste Management Rules, 2016 | | | | |
| 10 | Batteries (Management and Handling) Rules, 2001 | | | | |
| 11 | E-Waste (Management) Rules, 2016 | | | | |
| 12 | Kerala Municipality Act, 1994 & Rules | | | | |
| 13 | Hazardous & Other Wastes (Management And Transboundary Movement) Rules, 2016 | | | | |
| 14 | Bio-medical Waste (Management & Handling) Rules, 1998 | | | | |

## Applicable Social and Other Legislation:

**Other Legislations applicable to Sub-Project activities under the project**

- Workmen's Compensation Act 1923 (the Act provides for compensation in case of injury by accident arising out of and during the course of employment);
- Payment of Gratuity Act, 1972 (gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years);
- Employees PF and Miscellaneous Provision Act 1952 (the Act provides for monthly contributions by the employer plus workers);
- Maternity Benefit Act, 1951 (the Act provides for leave and some other benefits to women employees in case of confinement or miscarriage, etc.);
- The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 is introduced to prevent and provide redressal of complaints of sexual harassment.
- The Protection of Women from Domestic Violence Act, 2005 defines domestic violence, describes the powers and duties of protection officers, service providers and lists the procedures for obtaining reliefs.

- Contract Labor (Regulation and Abolition) Act, 1970 (the Act provides for certain welfare measures to be provided by the contractor to contract labour);
- Minimum Wages Act, 1948 (the employer is supposed to pay not less than the Minimum Wages fixed by the Government as per provisions of the Act);
- Payment of Wages Act, 1936 (it lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers);
- Equal Remuneration Act, 1979 (the Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees);
- Payment of Bonus Act, 1965 (the Act provides for payments of annual bonus subject to a minimum of 83.3% of wages and maximum of 20% of wages);
- Industrial Disputes Act, 1947 (the Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment);
- Industrial Employment (Standing Orders) Act; 1946 (the Act provides for laying down rules governing the conditions of employment);
- Trade Unions Act, 1926 (the Act lays down the procedure for registration of trade unions of workers and employers. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities);
- Child Labour (Prohibition and Regulation) Act, 1986 (the Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labour is prohibited in Building and Construction Industry);
- Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979 (the inter-state migrant workers, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home to the establishment and back, etc.);
- The Building and Other Construction Workers Act (BOCW), 1996 is a social welfare legislation that aims to benefit workers engaged in building and Other Constructions Works.

**2.2 The World Bank Safeguards Policies, and KSWMP ESMF**

The World Bank policies and directives on environmental and social safeguards have been adhered to the proposed dump site remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are summarized in the following table.

**Environmental Codes of Practices (ECoP):** The ECoPs provide guidelines for environmental management of bio-mining and bio-remediation activities which are seen to be of limited extent of impacts/risk, temporary and reversible, and readily managed with good practices during the implementation. The following key points should be considered.

**Key Points of ECop to be considered:**

- The bio-mining activities and preparatory activities shall follow the "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" published by CPCB in February 2019.

- Bio-mining methods include Tractor Tiller, Trench method, Cone Method, windrow, Thin Layer Method, etc. More appropriate may be the Cone method for legacy waste and window for relatively fresh waste.

- Leachate channelization and treatment facility shall be set up before starting the bio-mining works. Works shall take place only during the non-monsoon period; and there shall be suitable precautions to prevent any rainwater disturbing the operations (like seasonal unexpected rains, storm water, runoffs from other sources).

- Ballistic separator and trommel may be used for screening. Screened fractions into which waste is segregated include RDF, inert, Compost, and C&D wastes.

**Applicable World Bank Operational Policies:**

OP 4.01 Environmental Assessment Help to ensure the environmental and social soundness and sustainability of investment projects. Support integration of environmental and social aspects of projects in the decision-making process

OP 4.04 Natural Habitats Promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions.

OP 4.09 Pest Management includes training to prevent risk to human beings or animals from Bio-culture, enzymes, insecticides and such formulations used for remediation.

OP 4.11 Physical Cultural Resources (PCR) includes resources of archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites), aesthetic, or other cultural significance. Assist in preserving PCR and in avoiding their destruction or damage.

WB General EHS Guidelines Recommendations of these guidelines would be incorporated in EMP & SMP and Bidding document for this sub-project.

The Environmental Management Framework (EMF) has been prepared to assist in the screening, assessment, and management of environmental risks of all solid waste management projects at an early stage during the planning and integration, mitigation hierarchy during the subproject design, implementation, and operation. The framework helps provide specific guidance on the policies and procedures to be followed for environmental assessment along with the roles and responsibilities of the implementing agencies.

# CHAPTER 3. BASELINE ENVIRONMENTAL SCENARIO

## 3.1 Project Location of the site

Muvattupuzha dumpsite is located at a distance of 2.5 km from the centre of Muvattupuzha town in western side and encompasses a total area of approximately 5.47 acres of land. Out of this, 3.20 acres of land is covered with solid waste. The coordinates of the dumpsite are 9.993701° N and 76.560974° E. It is located in ward no. 25 of the municipality. The access road to the dumpsite is Valakkuzhi road which is at a distance of 35 metre in the Northern direction. In the surrounding area of the dumpsite around 3 - 5 Households are residing within 100m radius. St. George Orthodox Syrian Church 660 m away, ST. Thomas Public School 760 m away, Kurishu Palli (St. Peter & St. Pauls) 700 m away from the project location. The google map image showing the location of Muvattupuzha dumpsite is shown below in **Figure: 3.1**.

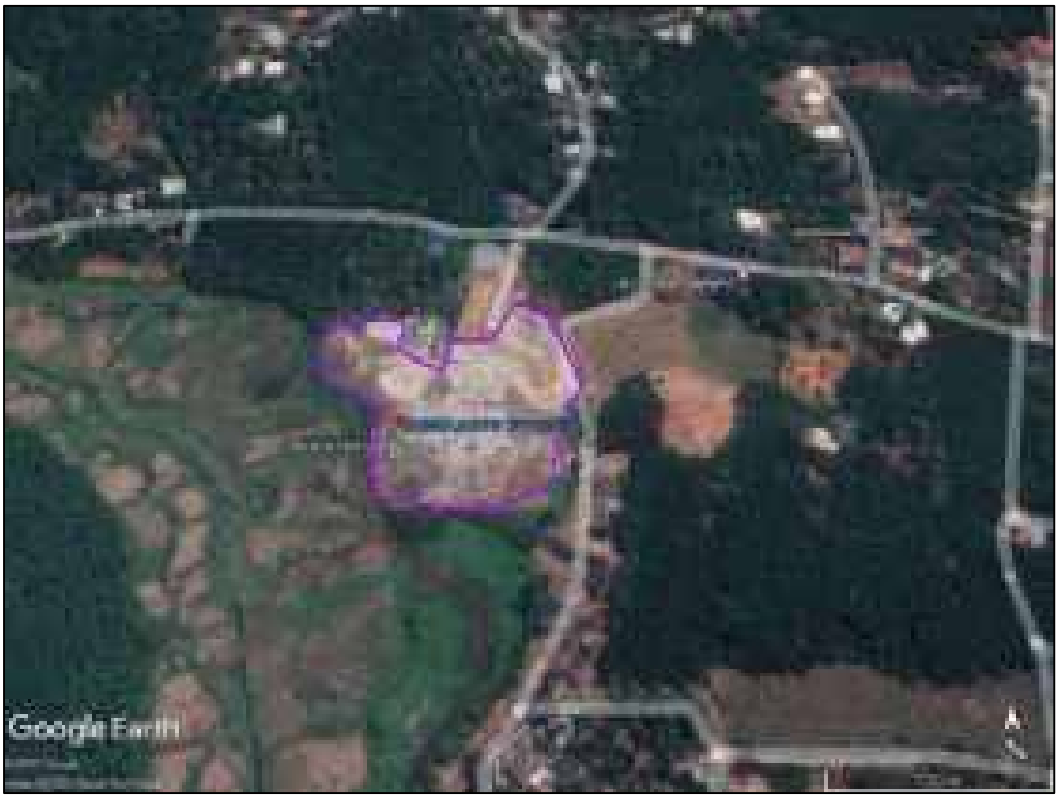



**FIGURE: 3.1 GOOGLE IMAGE SHOWING THE LOCATION OF THE EXISTING DUMPSITE AT MUVATTUPUZHA**

## 3.2. Methodology for Environmental Baseline Studies

The baseline appraisal should consider all aspects of the environment that may be altered by the proposed project. These can be categorized as physical, biological or socioeconomic attributes. The baseline should be based upon the findings of the screening and scoping studies. Surface water and sediments, groundwater, air quality, noise, soils and land use Biodiversity Socio-economic (social), cultural heritage, traffic and transport Physical Biological Socio-economic. The scope of the baseline study, including attributes that will be appraised, and the geographical extent of the analysis, will typically have been agreed with the relevant decision makers as an outcome of the scoping phase. It is important to re-emphasize that the scope (and detail) of the baseline study should be commensurate with the size and scale of the project and hence the

potential changes that the project may have upon the environment and society. The baseline study will typically be developed in three stages:

**Desktop study:** Office-based exercise during which readily available existing information (i.e. that can be used to describe the existing environment) is collected and reviewed to ensure its appropriateness for use within the EIA & SIA;
**Field study:** The stage within which additional data is captured in the field, with the intent of addressing any gaps that have been identified in the existing knowledge base; and
**Reporting stage**: Collation of the captured information into the baseline report.

The below table indicates the environmental attributes and location of monitoring.

**TABLE : 3.1 ENVIRONMENTAL ATTRIBUTES**

| S.NO | DESCRIPTION | PARAMETERS TESTED | SAMPLING LOCATION | JUSTIFICATION |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | Upwind direction in North East boundary of the dumpsite. Distance 10 m from the boundary of dumpsite. | The AAQ locations were chosen based on the Wind rose data obtained for Muvattupuzha. The most predominant wind direction are from West and WSW. |
| | | | Downwind direction in West South West (WSW) boundary of the dumpsite | |
| 2 | Noise (1 Location) | Ambient Noise level [Eq] for 24 hours | Entrance of the dumpsite. Distance 10 m from the boundary of dumpsite. | Most vulnerable point in the site in regards of Noise quality is due to entry and exit of the waste loading and unloading vehicle. Please note that the site is devoid of proximity to any sensitive receptors within a 200 m radial circle . |
| 3 | Surface water (1 Location) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, E.coli and Total coliforms (IS 10500-2012). | Surface water sampling location at 300 m distance in North West direction. | Surface water sample points are selected based on the water flow from upwards to downwards and for this site, it is North-West to South-west. |
| 4 | Ground water (2 Locations) | Pb, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, E.coli and Total coliform (IS 10500-2012). | Groundwater sampling location at 169 m distance in South East direction. | |
| | | | Groundwater sampling location at 103 m distance in South East direction. | |
| 5 | Bore Hole(1 location) | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard | Centre of the dumpsite | Volume of legacy wastes were found to be higher in |

| TABLE : 3.1 ENVIRONMENTAL ATTRIBUTES | | | | |
|---|---|---|---|---|
| **S.NO** | **DESCRIPTION** | **PARAMETERS TESTED** | **SAMPLING LOCATION** | **JUSTIFICATION** |
| | | penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, Strength compressibility (vertically-3 samples per borehole). | | the center part of the dumpsite during investigation. So the bore hole test was performed in the center. |
| 6 | Waste & Environmental Analysis | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammonical nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cynide, Chloride, Fluoride, Phenolic compounds. | South East boundary direction within the dumpsite - one point | |
| | | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | Within the dumpsite at 2 locations, one at East direction and at one at West direction. | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. So the two locations were considered for sampling. |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Poatassium (N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor | 1 | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. |

### 3.3 Environmental Audit of the Existing Facilities

Inside the dumping yard, there is a Bio waste composting unit, MCF, RRF, Black Soldier Fly Unit and the resting room for the workers assigned for the collection and segregation process. There MCF and RRF are functional for dry waste management in the Valakkuzhi dumpsite, but not supported under KSWMP project. However, an environmental audit of the facility is important since is situated at the same site and might be impacted during the bio-mining activities.

| TABLE: 3.2 ENVIRONMENTAL AUDIT OF EXISTING FACILITIES | | |
|---|---|---|
| **S. NO** | **ASPECTS** | **REMARKS** |
| 1 | Structural Characteristics | **1. MCF**<br>Area - approx. 310 (in Sq. m)<br>Buffer/setback around the MCF – 3 ft<br>Distance from waste pile of dumpsite- 20 m.<br>Roof: (GI Sheet Roof, Good condition)<br>Floor (Cement Floor, Good Condition)<br>Walls: (Concrete, Good Condition) |

| | | |
|---|---|---|
| | | Doors & windows: Doors Available and no window openings, Lack of dust emission and odor can impact the MCF facility.<br><br>**2. Black Soldier Fly (BSF) Unit**<br>Area - approx. 627.74 (in Sq. m)<br>Buffer/setback around the MCF – 3 ft<br>Distance from waste pile of dumpsite- 10 m.<br>Roof: (GI Sheet Roof, Good condition)<br>Floor (Cement Floor, Good Condition)<br>Walls: (Concrete, Good Condition)<br>Doors & windows: Door Available and only window openings are available, dust emission and odor can impact the BSF facility. |
| 2 | Functional Characteristics (MCF & BSF Units) | Activities in the MCF: Functional<br>Materials and condition of stacking: Yes<br>Activities spilling out onto the dumpsite: Yes<br>Activities in the BSF: Non functional<br>Access to the MCF & BSF (Common access for MCF/BSF & Dumpsite. Both are in the same premises.)<br>Total No: of workers – 40 |
| 3 | Facilities (MCF & BSF Units) | Parking area-NIL<br>Loading/unloading Area- NIL<br>Storage room & area: Yes<br>Worker snack/rest areas: Yes<br>Worker / other washrooms & sewerage: NIL<br>Water supply for Cleaning, Washroom: Yes<br>Greenbelt: NIL |

### 3.4 Physiography and Climate

**Physiography**

Physiographically, Muvattupuzha falls under Midland category with flat terrain zone.

**Climate**

Muvattupuzha has a tropical climate. Rainfall is significant in most months of the year, and the short dry season has little effect. As per Climate-Data.org, the average annual temperature is 27.6 °C. Precipitation here averages 3,570 mm. Most of the precipitation here falls in June-July with an average of 568 mm. The warmest month of the year is March with an average temperature of 29.4 °C. So, the favorable time for remediation is between October-2023 to March-2024 non-monsoon period. As per wind rose diagram, the most predominant wind directions are blowing from WSW and West direction. The wind rose diagram for Ernakulam is shown in **Figure: 3.2**.



**Source:** meteoblue

**FIGURE: 3.2 WINDROSE DIAGRAM FOR ERNAKULAM**

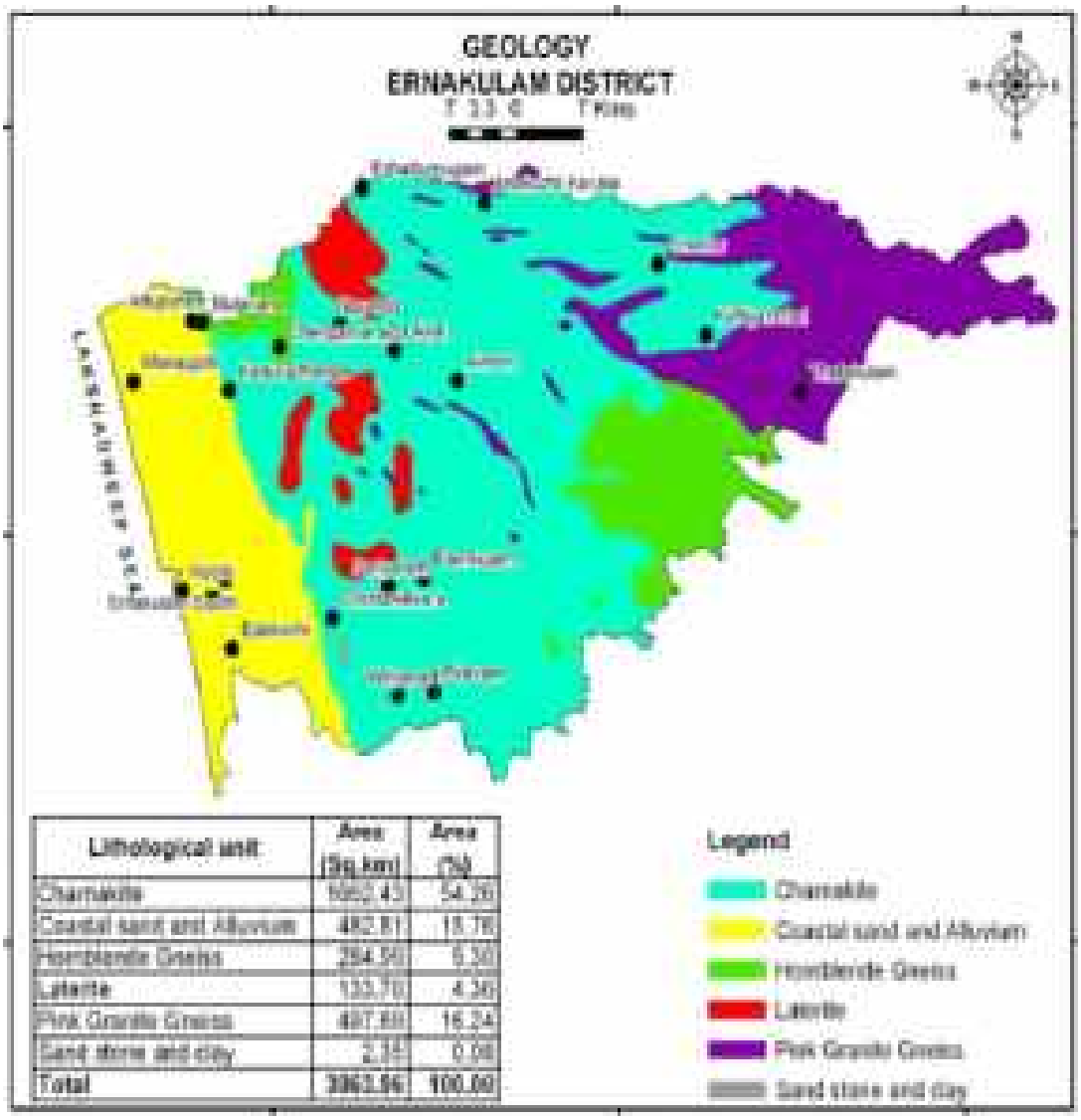
### 3.5 Hydrology, Hydrogeology, and Soil

**Hydrogeology**

The occurrence and movement of groundwater is mainly controlled by factors like physiography, geological setting, etc. The aquifer type is phreatic aquifer and groundwater table level ranging from 3.5 to 6.5 m during most of the year.

**Geology**

The geology of Muvattupuzha is predominantly of Charnockite group. The geology map of Ernakulam District is shown in **Figure: 3.3**.

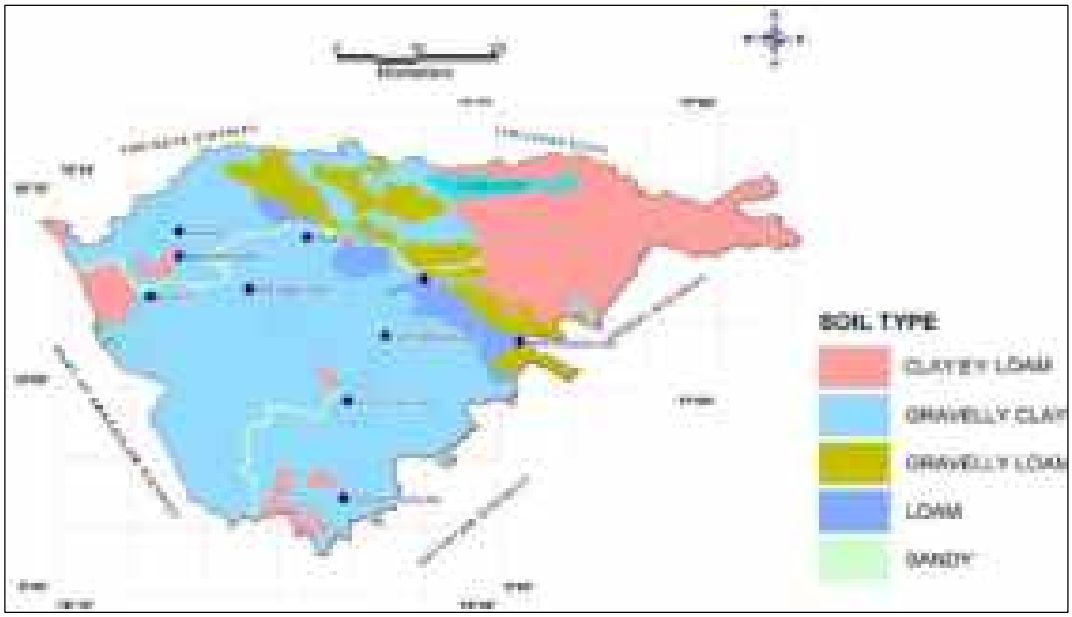



| Lithological unit | Area (Sq.km) | Area (%) |
|---|---|---|
| Charnakite | 1662.43 | 54.26 |
| Coastal sand and Alluvium | 482.81 | 15.76 |
| Hornblende Gneiss | 284.56 | 9.30 |
| Laterite | 133.70 | 4.36 |
| Pink Granite Gneiss | 497.88 | 16.24 |
| Sand stone and clay | 2.34 | 0.08 |
| Total | 3063.86 | 100.00 |

**FIGURE: 3.3 GEOLOGICAL MAP OF ERNAKULAM DISTRICT**

**Soil**

As per the geotechnical investigation, the soil was encountered at 5.5 m below the waste depth of the dumpsite and the predominant soil is gravelly clay. The detailed geotechnical investigation report is enclosed in the FR. The map with different soil type of Ernakulum is shown in **Figure: 3.4**.




**Source:** CGWB, Ernakulum

**FIGURE: 3.4 MAP SHOWING SOIL TYPE OF ERNAKULAM DISTRICT**

### 3.6 Land Use & Land Cover

The highest percentage of land use and land cover falls under residential of (61%), dry cultivation (15%), commercial (2.21%), industrial (0.37%), water bodies (7.2%), and Paddy plantation (4.06%), and the remaining areas are under traffic and transport. The dumpsite is surrounded predominantly by Dry cultivation land use and the same will act as odour attenuation during remediation. The land use & land cover map of Ernakulum District is shown in **Figure: 3.5**.



**Source:** Development Plan for Muvattupuzha Town

**FIGURE: 3.5 LANDUSE & LANDCOVER MAP OF MUVATTUPUZHA MUNICIPALITY**

### 3.7 Cultural Heritage

The cultural heritage site near the dump site is Muvattupuzha Old Bridge at a distance of 2 km (The first concrete bridge in Asia). Hence, no significant physical impact to the heritages sites will be envisaged during remediation.

### 3.8 Ecology and Biodiversity

The wild faunal species present are, mainly dogs, rodents and flies are seen near the dumpsite. Also, crow, egrets, and other birds are seen feeding on the wastes. The flora mostly covers shrubs, tubers, and trees.

### 3.9 Site Connectivity

The nearest state highway (SH-41) connecting (Ernakulam-Thekkady Road) is in northern direction at a distance of 540 metre from the dumpsite. The site has an access road (Valakkuzhi Road) with a width of 3 m.

### 3.10 Natural Disasters

As per the district disaster management plan-2015 and flood vulnerability map, the dumpsite is under the most vulnerable zones.

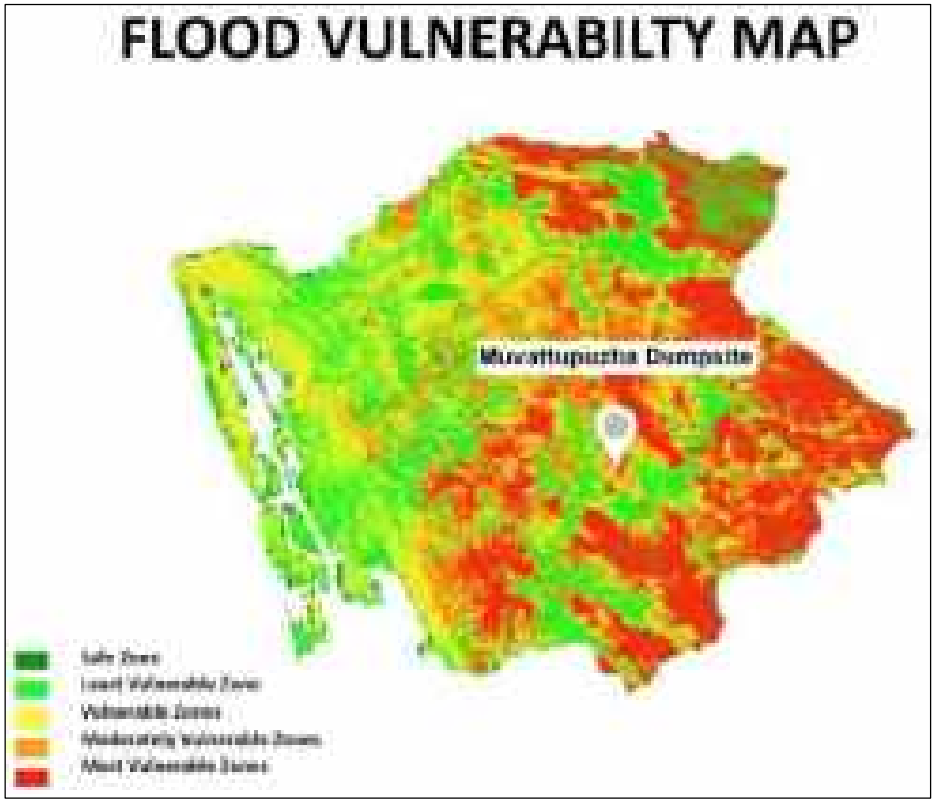



**FIGURE: 3.6 MAP SHOWING FLOOD VULNERABLITY MAP OF ERNAKULAM DISTRICT**

### 3.11 Description of Environmental Parameters

| TABLE- 3.3 DESCRIPTION OF ENVIRONMENTAL BASELINE PARAMETERS | | | |
|---|---|---|---|
| **S NO** | **ENVIRONMENTAL ASPECT** | **DISCUSSION ON BASELINE SCENARIO** | **REMARKS ON DEMAND SUPPLY GAPS (AVAILABILITY, QUALITY) & ASPECTS TO BE ADDRESSED IN THE SUBPROJECT** |
| 1 | Water Supply<br>a) Surface water<br>b) Ground Water | A) Surface water: Kadathy canal is 300 m from the site in NW direction and Surface water sample was collected and the test results showed – all parameters are well within limits except BoD.<br>B) Ground Water collected from 2 different locations (Residences within 200m radius)– all parameters are well within limits except for pH. | Site Drainage & leachate Impacts due to bio mining activity (especially during any seasonal rain) is important as far as the nearby soil & water environment are concerned. |
| 2 | Leachate | The data indicates very low concentrations of tested parameters. The heavy metals are also found to be low, hence the soil is unlikely to be contaminated by heavy metals from the waste. | |
| 3 | Air Quality | Air samples were collected from 2 locations at 20 metre from the dumpsite and results found to be well within the permissible limits | The Particulate matter $PM_{10}$ (136 $\mu g/m^3$) was found to be higher than the NAAQ standards emission. The vehicular movement of machinery and recovered material during dump site remediation will be the additional source of Air Pollution. |
| 4 | Noise Level | Noise Level monitoring samples collected at a distance of 10 m from the boundary of the dumpsite. Noise levels are well with the National Ambient Noise standards for Residential Area limit during daytime Leq. However, during night time the Noise (45.9 dB (A)) was found to be marginally higher than the standards. | Proper remedial measures for increased noise level shall be ensured by the contractor while bio mining activity. |

# CHAPTER 4. ANALYSIS OF ALTERNATIVES

## 4.1 Alternative 1: No Project Alternative (without Dumpsite Remediation)

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevent further contamination of the site.
If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows.
1. Foul Odor Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.
2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.
3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.
4. Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the surrounding environment, disrupting natural habitats and causing long-term ecological imbalances.
5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

## 4.2 Alternative 2: Mode of Execution / Management Alternative

Muvattupuzha Municipality intends to complete the remediation project as earlier. However, considering the time required for mobilization, installation, sieving and handling recoverable etc., a time frame of about six months will be considered. The broad timeline chart for the execution of this project is given below Table – 4.1.

**TABLE – 4.1 TIMELINE CHART FOR EXECUTION**

| S. No. | Task Name | M 1 | M 2 | M 3 | M 4 | M 5 | M 6 |
|---|---|---|---|---|---|---|---|
| 1 | Planning & Mobilization | ■ | | | | | |
| 2 | Foundation & Civil Works (Cover Shed installation) for machineries , Hiring & Installation of Machineries, Electrical Works | ■ | | | | | |
| 3 | Excavation of Legacy Waste | | ■ | ■ | | | |
| 4 | Site Development for Windrows & Leachate Collection | | | ■ | ■ | | |
| 5 | Windrow Formation & Spraying of Bio culture | | | | ■ | ■ | |
| 6 | Sieving Operations | | | | | ■ | ■ |
| 7 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | | | | ■ | ■ |
| 8 | Project Closure Activities:<br>• Levelling of Reclaimed Land using Bio-soil<br>• Handover the available infrastructure at site to the ULB<br>• Closure Report Submission to ULB, | | | | | | ■ |
| 9 | Buffer Period (Rainy Season) | | | | | | |

### 4.3 Alternative 3: Technology Alternatives

The selection of the appropriate method or technique for remediation is determined by considering several parameters. These include the significant aspects and suitability of remediation types such as,

1. Capping without land recovery,
2. Bio-mining – reclamation/recovery of 100% land
3. Capping with partial land recovery.

Additionally, factors like available resources such as manpower, machinery, finances, and physical site conditions, including the quantity and characteristics of legacy waste, Environmental baseline, social concerns, regulatory compliance (KSPCB/NGT), the need for complete land recovery, and opportunities for utilization of processed aggregates/by-products are taken into account.

After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

# CHAPTER 5. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

Bio mining and bioremediation of existing legacy dumpsites brings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more man-days at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, bio-mining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration) are important in this case. In addition to the below mentioned,

(i) Drainage and leachate flow into regional waterbodies (& esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies,
(ii) Pollution on land/soil, dust and odour nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks,
(iii) Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and
(iv) Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at this stage, while some would be known only based on the project details that would be known from the work plan of the contactor once on board.

## 5.1 Impact Assessment Methodology

Impacts are assessed based on Magnitude, Duration, and Significance of the impacts and sensitivity of the receptors present within the 500 m aerial distance of Valakkuzhi dumpsite.

### 5.1.1 Magnitude and Duration of Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Bio-mining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;
- The spatial extent of the potential impact;
- Reversibility of the Impact;
- Legal standards and established criteria.
- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table Aspects for Determining the Magnitude of Impacts. Magnitude is assessed as medium, considering shorter duration of the activity. However, magnitude of cumulative impacts of various dumpsite remediation might be High.

| TABLE: 5.1 ASPECTS FOR DETERMINING THE MAGNITUDE OF IMPACTS | | | | |
|---|---|---|---|---|
| **Aspects** | **Large** | **Medium** | **Small** | **Negligible** |
| **Duration of the potential impact** | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or Less than the lifespan of the program | Temporary with no detectable potential impact |
| **Spatial extent of the potential impact** | Regional – much beyond project boundaries | Beyond immediate Program components, site boundaries or local area | Within program boundary (but cumulative impact of various dumpsite bio mining activities will be on larger extent) | A specific location within program component or site boundaries with no detectable potential impact |
| **Reversibility of potential impacts** | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months | Baseline remains constant |
| **Legal standards and established professional criteria** | Against national/approved standards and or international guidelines/obligations | Complies with limits given in national standards but not confirming to international lender guidelines in one or more parameters | Meets minimum national standard limits or international guidelines | Not applicable |
| Likelihood of potential impacts occurring | Commonly occurs under typical operating or construction conditions (Certain) | Usually seen occurring under most situations (Likely) | Occurs under abnormal, exceptional or emergency conditions (Occasional) | Unlikely to occur |

NOTE: Anticipated Project Duration - 5 to 6 months

### 5.1.2 Sensitivity of Receptor

The dumpsite is surrounded by residential buildings and dry cultivation. During the time of site assessment, some sensitive receptors within 200m from the site identified were only households. The project site lies near to residences, within a 200-meter radius, and it may cause potential impacts on air, noise, surface water, and ground water that will directly or indirectly affect over 27 families for a duration of 5 to 6 months. The sensitivity of these receptors is Medium. In addition, there is a canal which flows at a distance of 300m from the dumpsite, there is chance

of runoff and leachate towards the canal during rainy season. Hence, the sensitivity of this receptor is estimated as high.

### 5.1.3 Significance of the impact

The significance of the Sub-project impact is tabulated below: -

| TABLE: 5.2 SIGNIFICANCE OF THE PROJECT | | | |
|---|---|---|---|
| **PROJECT DETAILS** | **SENSITIVITY** | **VULNERABILITY OF RESOURCE** | **IMPORTANCE OF RESOURCE** |
| No project Impacts | High | Medium | Medium |
| Project with Bio Remediation (Bio-mining) | Low | Low | Low |

Overall, Bio mining will have a low to medium impact, with more of a positive Impact on the Environment and Human health in the longer term.

**Source-Pathway-Receptor Analysis**

A) **Source:** The source of contamination is the legacy waste remaining and being deposited at the Valakkuzhi closed dumpsite, more specifically the landfill gas and leachate generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. In this case the waste is 63 years old, as dumping had started in year 1960 and still functional. The total waste volume is 55,712 cu. m with the dumpsite spread over 3.20 acres and the legacy waste is presented about 2.47 m above and 5.5 m below from the existing ground level. In addition to the landfill gas and leachate, windblown dust and litter are also considered as sources of contamination.

B) **Pathways:** The following pathways for migration of contaminants have been identified: Wind- The main pathway for litter and dust dispersion is the wind. As long as the waste is kept uncovered, the dust and litter will continue to be blown off the dumpsite to the surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. Rainwater runoff through the dumpsite acts as a pathway for transport of leachate to the soil and groundwater. The rainwater flowing off the dumpsite along the slope towards South East direction acts as a pathway for the uncovered waste to flow into the canal along the boundary to south eastern side, which runs through the residential areas and joins at Muvattupuzha river at 1.3 Km.

   The leachate flows with groundwater and acts as the pathway. Surface water contaminants like run-off from the dumpsite, leachate and windblown dust and litter that reach nearby surface water bodies like canals and rivers are further transported by surface waters and in this case the surface water acts as the pathway.

C) **Receptors:** Receptors are air, surface water (drain passing through residential areas) and ground water. For drinking purpose, they mainly use municipal water supply (27 nearby Households within 200 m and 5 households at 10m distance), soil, flora, fauna and humans. In the case of remediated dumpsite, the most prominent group of receptors are the nearby residences. As the dump is not contaminated by hazardous wastes, remediation would improve the pollution scenario provided the bio-earth used is pollution free and of good quality. However, other impacts are expected on the final destinations of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF/MRFs in the region. Depending on

the locations of end use of fractions retrieved from bio-mining, the contractor shall assess the impacts on communities and workers on site & nearby; and near locations of end-use. Key impacts may result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after bio-mining activity, activities in bio-mined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post bio mining activity.

**5.2 Impacts on Air Environment**

Key impacts on air include:

- Emission of Methane and other Greenhouse gases; and its impacts on scavengers, workers on site/other facilities on site (MCF & RRF in this case), nearby communities of Ward 25.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odour, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.
- When the legacy site is opened, existing gases would get emitted. Further, any delay /unexpected stoppage of bio mining activity, might further aggravate the process of gas formation depending on waste composition, leading to odour and fire risks.

***5.3. Impacts on Water Environment***

**Ground water:**

- Borehole data indicates waste upto depth of 3.5 m to 6.5 m with hard lateritic strata after that. Hence it is expected that the ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. Oozing & pooling of leachate & it draining to nearby areas during rains would be an important aspect to be managed during bio mining to prevent ground water contamination
- Leachate samples: BOD and COD values may impact the ground water quality in nearby residences, wells, and long term soil pollution.
- Borehole data: Dump below water table may impact water resources and wells nearby.
- Ground beneath the dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. There are no parameters exceeding the permissible limits for heavy metals.

**Surface water:**

- The dumpsite experienced flooding during 2018 floods and the site is highly vulnerable to flooding. The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas. Kadathy Canal is at a distance of 300 m from the dumpsite.
- Predominant slope is in the South East Direction. At Southeast direction, (end direction) there are residential households and dry vegetation. During rainy season leachate from the site flows to canal which flows through residential areas, and ends at Muvattupuzha. It is important to contain and treat leachate from the proposed bio mining activities on site. Treated leachate may be recirculated or used for other purposes.

**5.4 Impact due to Odour**

Dumpsite of organic, or partly organic waste, always results in anaerobic degradation of the waste and consequently, the production of landfill gas, consisting mainly of methane, $H_2S$, Ammonia,

and carbon dioxide. If not properly managed the gas can cause odor problems in the neighborhood and since landfill gas is a highly potent greenhouse gas it will also contribute to the increased level of greenhouse gases (GHG) in the atmosphere. Dumpsite gas may also increase the risk of fires or explosions at the landfill site and surroundings.

**5.5 Impact on Noise**

A potential nuisance is a noise from transport of vehicle and machinery operating during remediation phase of the Dumpsite and transports of waste to the Dumpsite. The topography is favorable to attenuate noise to the surroundings. The distance to nearby residential areas is at 10 m with 5 households. Hence, the impact will be higher during remediation to the residents.

**5.6 Impacts on Soil**

- Historic land use assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it shall be excluded from the site as bio mining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.

- Spillover of activities to nearby road and land would result in pollution of all types on these areas. Hence it is important to restrict all activities to the site for legacy waste bio mining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.

- Ground beneath dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. In Valakkuzhi, all heavy- metals are falling within the limit as per Fertilizers Control Order 1985 and its amendments. Valakkuzhi does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste (including legacy asbestos), e-waste or biomedical waste is found while bio mining, same shall be retrieved, transported, treated and disposed as per specific waste guideline of the Central Pollution Control Board, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste), Feb 2019 and World Bank EHS Guidelines. A plan shall be prepared to auditing of all wastes, management, eliminating pollution & OHS risks; and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.

**5.7 Other impacts on Biodiversity - Fauna/Flora**

- There are no sensitive biodiversity areas within 10 km of the site. However, since the project involves transport of wastes, it is important to consider the impact beyond the project boundaries. Within 25 Km from the site, there is a Neryamangalam Reserve Forest.
- Fauna: impacted by direct consumption of the solid wastes, sharps, entanglement, or by consumption of plants and/or animals contaminated by wastes, or as a result of leachate effects on groundwater and surface water.
- Flora: Plants near open dumpsites can be impacted directly by the waste, dust or smoke from burning. Disturbance to vegetation due to machinery, trampling by foot, vehicle or animals, or contamination by waste or leachate, the migration of landfill gas, or as a result of burning or smoke.
- Disturbance to other fauna and flora on site: onsite activities including those related to MCF and RRF may also impact fauna/flora through high noise levels of pre-construction / construction activities.
- Biodiversity of existing site: Only naturally occurring plants and animals were noticed, no threatened or endangered. There is no key species identified which are listed by IUCN.

**5.8 Other Impacts on existing or proposed activities on site/s**

- There may be approvals from various agencies for bio mining activities and associated facilities; depending on utilities and uses on site & associated activities. These permits shall be obtained prior to initiating activities on site.
- Impacts of bio mining on existing facilities on site such as RRF, MCF, Black Soldier Fly Unit, composting yard etc. (disturbance to activities & people due to dust, leachate, noise, odour; additional load of wastes to these facilities, vibration impacts & structural damage, etc.).
- Post bio mining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped, or if this is dumped elsewhere or not processed, it will lead to health and environmental issues. This alternate location, being associated facility need mitigation measures to avoid/minimize pollution, Health & Safety impacts on workers, communities. Also, forward linkages are considered as associated facilities/linked activities. Impacts of transportation of these fractions (traffic increase, odor, leachate, dust), impacts during rains & emergencies, handling, storage at the identified locations, reuse etc. shall be mitigated.

## Chapter 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN

### 6.1 Proposed Environmental Management Plan

The detailed anticipated impacts and corresponding mitigation measures/management of the impacts are given below.

**TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN**

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| *A* | **Planning and Pre-Construction Stage** | | | |
| *1* | ***Planning for bio mining facility*** | | | |
| 1 | Bio mining & Bioremediation Plan & Capacities | • Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / biomined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these biomined material in line wit the agreements with such facility owners and National, State regulations and WB EHS<br>• Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate management Plan.<br>• The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers.<br>• Contractor to get all required licenses & permits before start of any activity on site | Contractor | SPMU/DPMU/ULB |
| 2 | Site Access Closure | • The total cessation of dumping in the site will be implemented before any works.<br>• All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public.<br>• The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance to indicate that the waste dump has been closed from the operation.<br>• To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br>• Grading shall be performed where necessary to provide a neat appearance | ULB or Contractor as per Bidding mechanism | SPMU/DPMU/ULB |
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the | • Carry out site assessments as per Guidelines for Biomining of Legacy waste Dumpsites of CPCB<br>• Consider safe biomining & gas / leachate generation from existing capped portion of the site<br>• Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means | TSC, ULB, Contractor | SPMU/DPMU/ULB |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| | waste – *impact on air quality, odor, water contamination due to leachate, health and safety impacts of the people working in the site assessment* | ▪ Provision of appropriate PPE's to the team undertaking the site assessments<br>▪ Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>▪ Plan for machinery operated which will be operated by skilled operators at all times.<br>▪ Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures.<br>▪ Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | | |
| 4 | Absence / Delay in Permissions for Developing the biomining facility and associated works as per National regulations | ▪ Required permissions for undertaking biomining at the existing dumpsite and assessments conducted for undertaking biomining as per existing Laws, Regulations; including for associated infrastructure, DG Sets, Consent to Establish; and other licenses including those as per Labor Laws, before the start of works on site | Contractor, ULB | SPMU/DPMU/ULB |
| 5 | Dust impacts due to Site works, screening & stacking of retrieved wastes<br>*(Air Pollution) and Visual Blight due to excavation* | ▪ Plan to Provide temporary high screen, buffers around the site before the start of work to curtail dust emissions<br>▪ Arrange a green belt as early as possible on the area of the site with no / less dump. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers)<br>▪ PPEs to be used by workers<br>▪ Awareness to communities & suggest to use PPEs | Contractor and or ULB depending on agreement on bidding mechanism/DPR | SPMU/DPMU/ULB |
| 6 | Material sourcing, transport, and stacking of construction materials *(Occupational Health and Safety issues and Air noise pollution)* | ▪ Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism<br>▪ Prior intimation to nearby Primary Health Centre on work activities need for medical support, emergency support needs, type of laborers on-site and labor camp if any<br>▪ Materials shall be sourced only from approved quarries<br>▪ Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions.<br>▪ The driver should be with required license and follow speed regulations | Contractor | SPMU/DPMU/ULB |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| | | ▪ Materials shall be transported preferably through well-surfaced roads. If road it kuchcha, water sprinkling shall be done to prevent dust emission before and after truck passes<br>▪ Material transport and unloading activities should not result in noise disturbance to locals and should be during daytime<br>▪ Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors.<br>▪ Provide vehicle wheel wash area on site<br>▪ Workers to be provided with Personnel Protection Equipment (PPE) including safety boots, jackets, ear muffs, gloves.<br>▪ Proper rest area on site shall be provided with water, first aid, toilets | | |
| 7 | The layout of Labour camp *(Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)* | ▪ Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp<br>▪ Nearby health center shall be informed about the labor camp & appropriate medical checkup shall be arranged periodically<br>▪ Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters)<br>▪ It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with landowners wherever the labour is accommodated<br>▪ Camp must not be provided in an area prone to Hazards<br>▪ Camp should be adequately at higher plinth levels to prevent water intrusion<br>▪ Rooms shall be of appropriate sizes with adequate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG)<br>▪ Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female labourers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc.<br>▪ The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security<br>(Refer ECOP section 06 and section 11 of EMF for KSWMP) | Contractor | Site engineer of SPMU, Labour Commissioner, PCB |
| 8 | Nearness/disturbance to sensitive areas such as forests, wildlife habitations, etc. | ▪ Ensure site selection for any support facilities or activities (such as vehicle storage etc. if no in bio mining site) based on the screening checklist and the master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate, Reduce. Obtain requisite permissions from respective authorities such as Pollution Control Board, ULB etc. | Contractor | SPMU/DPMU/ULB |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| | especially in case of providing support facilities *(Impacts on Fauna / Flora)* | ▪ Identify appropriate government site to avoid land acquisition and resettlement impacts<br>▪ Covered and well-marked storage area with cut off drains & odour/fly/dust/ fire prevention shall be ensured for excavated wastes and washing, segregation of the same are to be arranged with due consideration to nearby residences, slope and other landuses | | |
| 9 | Contamination of groundwater due to leaching. Leachate parameters; BOD, COD, TDS, Ecoli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution | ▪ During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant<br>▪ Depending on the contractors plan for biomining of the site, adopt plans to manage leachate | Contractor | SPMU/DPMU/ULB |
| 10 | Impacts on flora, fauna" consumption of wastes, leachate impacts, dust smoke burning, trampling/machinery | ▪ Movement routes of vehicles to be planned to avoid key fauna/flora on site<br>▪ Leachate collection & storage/treatment and recirculation shall be planned to avoid impacts on flora, fauna | Contractor | SPMU/DPMU/ULB |
| 11 | Nuisance hazards to neighboring areas | ▪ Ensure proper design and adequate compound wall; high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements<br>▪ In case of waste mound and site edges are sliding or unsafe; provide engineered retention walls. | Contractor | SPMU/DPMU/ULB |
| 12 | Treatment & Disposal of wastes and rejects | ▪ Contractor to Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & intert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventorised and quantified, including Bioearth, rejects, inerts. These shall be tested and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertiliser Control Order 1985 and their amendments. Asbestos Management Plan shall be prepared for management if Asbestos wastes retrieved if any | | |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| | | • Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period. | | |
| **B** | **Implementation or Biomining & Bioremediation stage and Construction of ancillary facilities such as access road improvements, compound walls, greenbelts, drainage etc.** | | | |
| | | **Implementation of bio mining of the dumpsite** | | |
| 1 | Impact due to the vehicular movement *(Air and noise environment & Vehicular - Vehicular & Vehicular - Pedestrian Conflicts)* | • Vehicles and machinery are to be maintained so that emission conforms to National Ambient air quality standards.<br>• All vehicles and machinery should obtain Pollution Under Control Certificates<br>• HORN PROHIBITION signpost to be erected.<br>• Rumble strips/speed breaker to be provided on access roads.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed.<br>• Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle<br>• Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements.<br>• Avoid heavy vehicle movement through Valaikuzhi road roads during peak hours 7 a.m to 10 a.m mention: school hrs / peak hrs; and during important period / festivals when people use the road to access temple<br>• Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents. | Contractor, ULB | SPMIU/DPMIU/ULB |
| 2 | Impact due to the use of heavy vehicle and equipment *(Air and Noise environment)* | • Mixing equipment (in case of construction of ancillary facilities) should be well sealed and be equipped with a dust-removal device.<br>• Equipment Operators & labourers should wear dust masks, ear protection, and hard hats.<br>• Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load.<br>• Labor to be provided masks / PPEs.<br>• Construction / Biomining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spreading into neighboring sensitive land uses<br>• Noise standards at operation machines are to be strictly monitored to prevent exceeding of CCII noise standards. | Contractor | SPMIU/DPMIU/ULB |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| | | ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines.<br>▪ Using modern, well-maintained and regularly serviced vehicles.<br>▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>▪ Provision of earmuffs and ear protection to workers and employees in high noise areas.<br>▪ Workers in the vicinity of strong noise to wear protectors and their working time should be limited as a safety measure.<br>▪ As Muvattupuzha dumpsite has sensitive receptors and settlement areas within 150m of it, noisy works shall be stopped from 22:00 to 06:00.<br>▪ Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum.<br>▪ Avoid noisy activities/machines near South side of the site where settlement exist within 50m. Noise barrier shall be provided at all noise-sensitive locations / for noise generating equipment such as DG sets, mixers (for ancillary facilities) especially near South side of the dumpsite<br>▪ Adopt required measures as per CPCB guidelines, and site & work specific safety requirements | | |
| 3 | Impact during the construction activities *(water environment)* | ▪ Labour camps if any (depending on Contractors work plan & arrangements) are to be located away from water bodies.<br>▪ Vehicle washing or maintenance near water bodies are to be avoided.<br>▪ Contaminated water from construction / biomining activities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated on site. | Contractor | SPMU/DPMU/ULB |
| 4 | Leachate and Runoff from biomining activities *(Soil contamination and groundwater contamination)* | ▪ Provide site cut off drain around the site to divert off stormwater from entering the site, and to prevent contaminating downstream resources with run off from the dumpsite<br>▪ Depending on the contractors plan for biomining of the capped area on site, implement leachate management to cause no harm to communities & environment<br>▪ Ensure stormwater drains will lead to drain outlets<br>▪ Provide leachate drains lined from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area<br>▪ Provide proper treatment of leachate and stormwater that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by biomining activities like excavation and waste segregation and stabilization | Contractor | SPMU/DPMU/ULB |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| | | ▪ The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB.<br>▪ The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata<br>▪ Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff and hence reduce infiltration<br>▪ Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism<br>▪ Plan the works on-site only during non-rainy seasons and to complete the works before rains<br>▪ Store leachate preferably in aboveground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide for emergency containment additionally | | |
| 5 | Soil decontamination from accumulated waste levels<br>*(Impact on leachate, odor)* | ▪ Decontaminate the soil / stabilized layers remaining after sieving out wastes using windrow and bioculture of appropriate quality in line with standards / regulations or appropriate means as per CPCB Guidelines<br>▪ Vegetative layer using contaminant absorptive root varieties like Vetiver may be tried on soil and along the edge of the green belt or floating wetlands may be deployed in water channels nearby to maximize absorption of leachate in the soil by root-zone phytoremediation<br>▪ Soil and water testing shall be done and changes in contamination shall be noted. | Contractor | SPMU/DPMU/ULB |
| 6 | Excavation of waste from the waste mound<br>*(Health and safety impacts)* | ▪ The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound.<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided<br>▪ Machinery operated for excavation should be operated by skilled operators at all times.<br>▪ Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on wastes. | Contractor | SPMU/DPMU/ULB |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| | | ▪ Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound<br>▪ In case of the waste mound and site edges are sliding or unsafe; provide engineered retention walls or string boundaries.<br>▪ When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection & treatment mechanism. | | |
| 7 | Transportation of wastes or retrieved or other material in overloaded and open vehicles *(Air, Odour nuisances; spills and littering impacts on Air, Water, Land)* | ▪ All vehicles shall carry only approved load of weight<br>▪ Regular cleaning of roads & drains and removal of spills if any.<br>▪ All waste transport vehicles shall be covered and movement shall be during non-peak hours.<br>▪ Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities.<br>▪ Adopt required measures as per CPCB guidelines, and site specific safety requirements. | Contractor | SPMU/DPMU/ULB |
| 8 | Occupational health and safety impacts of the workers during the biomining & construction of support facilities:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage of chemicals/other materials, biocultures or wastes etc; by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects | ▪ Avoid direct & double handling of wastes through avoidance measures(suitable planning & equipments), engineering controls & use PPEs<br>▪ Work area & Labour camps shall be provided with First Aid and other related activities.<br>▪ Emergency Preparedness plans shall be prepared and implemented for all manpower working centers and its field extension centers.<br>▪ An Environment Health & Safety policy shall be prepared and implemented<br>▪ Adequate manpower shall be provided & manager & staff shall listen and act upon the manpower related grievances.<br>▪ Workers will be provided with PPE such as face mask, gloves, shoes, nose masks & goggles<br>▪ Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed with out slip, trip, fall especially on waste, leachate or trenches<br>▪ Proper training will be provided regarding the maintenance of health<br>▪ Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks & water supply), food, and water in a hygienic environment (with proper handwash). Provide clean eating areas where workers are not exposed to contaminated, hazardous or noxious substances.<br>▪ First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus<br>▪ Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker | Contractor, ULB | SPMU/DPMU/ULB |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| | • Allergies from pathogen and airborne dust *(Air environment, Health impacts)* | to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health checkups. Arrange daily health checkup for workers working on waste heaps<br>▪ Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals.<br>▪ Measures such as deferred timings and stretch break to be adopted<br>▪ Secure all installations from unauthorized intrusion and accident risks;<br>▪ Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every days start of works / activities. Key hazards would be (but not limited to) are flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and leachate from existing capped area on site, electric shocks, works with heavy machines & equipments, slips of men & material (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc.<br>▪ EHS specialist with adequate experience & third party supervision are important for biomining activity<br>▪ Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites<br>▪ Provide visitor orientation if visitors to the site need to gain access to areas where hazardous conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible<br>▪ Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;<br>▪ Ensure moving equipment is outfitted with audible back -up alarms & flag men with whistles or speakers;<br>▪ Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit.<br>▪ Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenance to be marked well & | | |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| | | safe kept before activity start near thoseIn close proximity to this location, there is a transformer. Disallow worker exposure to noise level greater than 85 dBA for more than 8 hours a day without hearing protection<br>▪ All workers shall be registered as per prevalent labor laws (including a workforce of subcontractors) and provided insurance cover & others as per existing acts/laws<br>▪ Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractors person/insurance agent<br>▪ While using heavy machinery like JCB, cranes, etc, inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle.<br>▪ While using heavy machinery like JCB, cranes, etc, inform communities to prevent children and others from going near operating / movement areas including roads.<br>▪ Flagmen shall be arranged if work is near schools, hospitals, major roads, and traffic control is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if possible<br>▪ A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs;<br>▪ No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor<br>▪ All works related to working at heights will be undertaken only during the daytime when sufficient sunlight is available;<br>▪ Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done;<br>▪ All excavation activities to be conducted in supervision of the site contractor;<br>▪ Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured.<br>▪ All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans prepared and implemented, as per Banks Incident Reporting Tool | | |

**TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN**

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 9 | Risk of fire due to conditions leading to spontaneous combustion *(Air environment, disturbance to communities and workers, health impacts, safety issues)* | ▪ Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for Implementation of SWM Rules 2016 – regdg Fire Incidents at MSW Dumpsites (https://cpcb.nic.in/openpdffile.php?id=UHVibGljYXRpb25GaWxlLzQyNDRfMTY1NDE2Mzk3N19tZWRpYXBob3RvNzYxMi5wZGY= ), LSGD Kerala Government GO on Fire Safety of MRF, MCFs (for the MRF on site if used for storage of wastes)and other Regulations, guidelines applicable<br>▪ Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3; and National/State regulations & WB EHS<br>▪ Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes<br>▪ Avoid conditions that can lead to spontaneous combustion such as:<br>o Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard<br>o Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.<br>▪ Design the facility for access by firefighting equipment, including clear aisles among waste heaps or work areas and access to adequate water supply.<br>▪ Ensure workers are briefed of fire hazard & its management<br>▪ No unauthorized entry shall be permitted to the site; including of workers during holidays, nighttime, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating “trespassers not allowed”<br>▪ The following activities should be implemented to prevent fires from occurring at the facility<br>o adequate fire-fighting equipment should be made available on-site and stored in an accessible manner,<br>o all operating staff should be trained and able to manage fire outbreaks at any part of the facility.<br>o clear signage should be established to inform workers and the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area.<br>o Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows.<br>o all fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the biomining, storage, and processing areas. | Contractor, ULB | SPMU/DPMU |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| | | ○ all flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating stormwater.<br>▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the biomining activity in line with National State regulations, guidelines and international good practices<br>▪ Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.<br>▪ Contain all local smokes/small fires inside the dump asap. Fire brigade help shall be sought on all smokes/fires outside the dump<br>▪ Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured.<br>▪ Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers | | |
| 10 | Construction of new facilities in retrieved land | ▪ The excavated site shall be protected from any dumping during or after the biomining activity and shall be reserved for SWM activities in line with SWM Rules 2016<br>▪ Any new facility under KSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations | ULB | SPMU/DPMU |
| 11 | Pest / Vermin Control & Visual impacts (Odour, flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center<br>▪ Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups<br>▪ Biopesticides / biological control shall be followed. However, biopesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used<br>▪ Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate management | Contractor, ULB | DPMU, SPMU |
| 12 | Odour nuisance | ▪ Waste with a strong odor to be covered immediately they are emptied from vehicles.<br>▪ Control and manage leachate treatment to minimize odor.<br>▪ Provide buffers screens to curtail odor from reaching surrounding communities especially to North side of site. | Contractor, ULB | DPMU, SPMU |

**TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN**

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor. | | |
| 13 | Storage, Collection, Transport, Treatment & Disposal of wastes and rejects | • Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste<br>• Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters<br>• Waste handling shall be inline with existing regulations & guidelines & avoid health & safety impacts<br>• No material is allowed to remain on site after the contract period<br>• Adequate fire safety arrangements & awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported<br>• Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/inerts in designated or agreed area & are in line with schedule; using GPS.<br>• Given that the access road is used by the public, it is imperative to implement the required safety precautions and environmental protection measures when transporting the waste. | Contractor, ULB | DPMU, SPMU |
| 14 | Other activities | • No activity other than biomining shall take place on site & any activity shall cause no adverse impacts on the environment or people<br>• If existing MCF shall be used for soring biomining wastes, its safety shall be ensured in terms of fire & structural safety before starting to use the facility. Further usage of the MCF after biomining works shall be after proper cleaning / washing & disposal of all rejects/inerts & tools to ensure good housekeeping & no H&S impacts<br>• If existing MCF shall be used by the ULB for storing dry wastes from Town, during biomining period, alternate access shall be arranged & workers shall be adequately protected against any health & safety impacts | | |
| 15 | Energy Efficiency & Water Use efficiency | • All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & biomining / construction techniques<br>• Landscaping & green belts to use local / indigenous plants & trees<br>• Waste water and Leachate to be treated & recycled/reused | Contractor | ULB |
| **C** | **Future Site Usage (EMP shall be updated in line with EMF & used if future site usage is proposed under KSWMP). This section is not the responsibility of the Contractor for Biomining, but of the future facility operator & ULB** | | | |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| 1 | Future use of the biomined site: Green Park, MCF, MRF, RRF, Treatment plants, landfill cell or any other, preferably for SWM | ▪ ULB to ensure that the site will not be used for future dumping.<br>▪ Activities at existing MCF to be upgraded to ensure that no waste (even dry wastes) gets dumped around.<br>▪ ULB shall plan the future use of the site shall be in consultation with the communities.<br>▪ Phase 1 Environmental Assessment to be caried out, EA for existing facilities & EIA for proposed development in line with EMF in case this is proposed to be developed under KSWMP<br>▪ All applicable clearances, permits shall be arranged in line with applicable regulations for the proposed new use of the site, and appropriate designs/plans to be prepared & implemented | Future Facility Developer/ Operator & ULB | ULB (SPMU in case it is under KSWMP) |
| 2 | Vehicle movement for new activities: MCF/MRF, RRFs, Treatment plants, landfill cell<br><br>*(Air, water environment, a nuisance to biodibersity, communities, Health impacts)* | ▪ The movement route shall be scheduled for each vehicle.<br>▪ Enforce speed limits applicable and make drivers aware of this<br>▪ Vehicles movement shall be tracked by Health Supervisors to ensure keeping up to schedule; preferably using GPS<br>▪ Any adulterated fuel shall be avoided. There shall be periodic emission tests for vehicles<br>▪ Provision of Personal Protective Equipment such as face mask, gloves, nose masks & goggles to all workers in C&T vehicles, Maintenance yards<br>▪ Proper lubrication shall be provided to minimize squeaking noise due to friction<br>▪ Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br>▪ The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public<br>▪ Traffic will be managed at the site by providing adequate space for parking of vehicles<br>▪ Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design<br>▪ No waste or material shall be disposed in any place other than the designated area; including water bodies, coasts/forests, or sensitive areas. | Future Facility operator | ULB |
| 3 | Exhaust emissions *(Air impacts)* | ▪ No idling of vehicles on site.<br>▪ Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed | Future Facility operator | ULB |
| 4 | Plying of vehicles through kutcha / unsurfaced roads and idling *(Air pollution: SPM, CO, CO2)* | ▪ Vehicle movement shall be well planned – through topped roads. In case of necessity to move through Kutcha roads, ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Future Facility operator | ULB |

| TABLE: 6.1 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN | | | | |
|---|---|---|---|---|
| **S No** | **Probable Negative Impacts** | **Mitigation Measures** | **Implementation Responsibility** | **Monitoring Responsibility** |
| 5 | Impact on the ambient noise quality during the operations<br>*(Noise, nuisance to sensitive receptors, health impacts)* | ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines;<br>▪ Using modern, well-maintained and regularly serviced vehicles;<br>▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>▪ Provision of earmuffs and ear protection to workers and employees in high noise areas | Future Facility operator | ULB |
| 6 | Occupational health and safety impacts of the workers:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust | ▪ All OHS and CHS measures to be followed in line with applicable regulations, guidance<br>▪ Workers & communities shall be made aware of OHS, CHS risks and impacts & mitigation measures adopted<br>▪ Emergency management plan to be prepared & followed<br>▪ Workers shall be appropriately trained or OHS during construction & Operation of all future facilities | Future Facility operator | ULB |
| 7 | Pest / Vermin Control (Odour, flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted<br>▪ Biopesticides / biological control shall be followed.<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used | Future Facility operator | ULB |
| 8 | Fire Safety | ▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented in line with National State regulations, guidelines and international good practices | Future Facility Operator | ULB |
| 9 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees<br>▪ Waste water to be treated & recycled/reused | Future Facility Operator | ULB |

**Disposal phase of By-products from Bio-mining process:**

The bio-earth and coarse fraction soil recovered from dumpsite will be used for filling low lying areas. The RDF material recovered from dumpsite will be transported to nearby cement factory and recyclable material will be handed over to the authorized recycling agency. If the by-products are not removed from the site within a three-month period, penalties will be imposed on the contractor.

## 6.2 Disaster Management and Emergency Preparedness

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care, and other necessities of life. In the case of Dumpsite remediation, Disaster Management Plan is aimed to ensure the safety of life, protection of the Environment, protection of installation, restoration of the remediation process, and salvage operations in this order of priorities.

For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel training is to be provided through rehearsals/drills. The disaster management Plan consists of Onsite Emergency Plan and an offsite Site Emergency plan, which is outlined here for Emergency Preparedness. The list of emergency helpline services is mentioned in the Table below.

**TABLE: 6.2 LIST OF EMERGENCY HELPLINE SERVICES**

| Sl. No. | Emergency Services | Distance from the dumpsite |
|---|---|---|
| 1 | Muvattupuzha Police Station | 3.7 Km |
| 2 | Muvattupuzha Fire Station | 3 Km |
| 3 | General Hospital | 3.5 Km |

### 6.2.1 Approach to DMP

The objective and approach of the Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effect the rescue and medical treatment of casualties;
- Safeguard other people;
- Minimize damage to property and the environment;
- Initially contain and ultimately bring the incident under control;
- Identify any dead;
- Provide for the needs of relatives;
- Provide authoritative information to the news media;
- Secure the safe rehabilitation of the affected area;
- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency.

In effect, it is to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy. Disaster Management Plan should include Emergency Preparedness Plan, Emergency Response Team, Emergency Communication, Emergency Responsibilities, Emergency Facilities, and Emergency Actions.

**Identified Emergency Situations**

Major disasters which can affect the remediation process are as follows:

- Floods due to heavy rainfall
- Fire risk in summer
- Occupational and health risks during the remediation process
- Safety-related accidents during the remediation process

**Proposed Organizational Structure for Disaster Management Plan**

**Response team:** Setup an Emergency Organization. Emergency Organization includes the senior executive (head of EO as a Site controller), Manager Safety (Incident controller), Shift in charge, and Emergency Coordinators.

- All Incident control would be reported to the Site Controller. Each Incident Controller organizes a team responsible for controlling the incident with the personnel under his control.
- **Shift In-charge** would be the reporting officer, who would bring the incident to the notice of the Incidence Controller and Site Controller.
- **Emergency Coordinators** would be appointed who would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential and support services. For this purpose, security in-charge, personnel department, essential services personnel would be engaged. All these personnel would be designated as key personnel.
- In each shift, the electrical supervisor, in charge, and other maintenance staff would be drafted for emergency operations. In the event of power or communication system failure, some of the staff members in the office/facility would be drafted and their services would be utilized as messengers for quick passing of communications.

### 6.3 Proposed Monitoring Plan

The proposed monitoring plan is presented in table below,

**TABLE -6.3 PROPOSED MONITORING PLAN AND FREQUENCY**

| Monitoring media/parameters | Items and parameters | Frequency | Location |
|---|---|---|---|
| **Ambient Air Quality** | PM10, PM2.5, NOx, CH4, CO, Ammonia | Quarterly (1 sample) | 2 point |
| **Noise** | Leq Day and Night | Monthly | 2 point |
| **Health safety Hazards** | Medical records, documentation of injuries and accidents, Health and safety assessments | As and when accident/injury occurs | Incident reports |
| **Leachate** | • pH<br>• Biological Oxygen Demand- BOD<br>• Chemical Oxygen Demand-COD<br>• Nitrogen (Ammonia, Nitrate, Nitrite)<br>• Oxidation-Reduction Potential- ORP<br>• Electrical Conductivity-EC<br>• Total Organic Carbon (TOC) Dioxins | Quarterly | 2 point |
| **Groundwater quality** | | Quarterly | 8 points |

| | | | |
|---|---|---|---|
| **Surface water quality** | Parameters will be defined and sampling, preservation, and analysis of water will be carried out following those stipulated in the subsections below and Standards Methods for Testing Water and wastewater, 21st edition, published by American Public Health Association (2005). | Quarterly | 6 points. 2 upstream and 4 downstream |

### 6.4 Estimated Budget for Implementation and Supervision of EMP

The estimated capital cost of [redacted] is required for budget provision for implementation and supervision of EMP. The remediation will be only during shorter time duration and hence the recurring cost won't be incurred. The estimated cost particulars for EMP is mentioned below.

| TABLE -6.4 ESTIMATED BUDGET FOR EMP | |
|---|---|
| **Particulars** | **Capital Cost (In Lakhs)** |
| Dust Mitigation Measures Including site barricading, water sprinkling and Wheel Washing, leachate management | [redacted] |
| Mobile Toilet, Pest Control, Disinfectant | [redacted] |
| Medical cum First Aid facility | [redacted] |
| PPE for workers & welfare, Fire Fighting Equipment | [redacted] |
| Monitoring / testing (air, noise, water, soil, leachate) | [redacted] |
| **Total** | [redacted] |

# CHAPTER 7 INSTITUTIONAL ARRANGEMENTS

## 7.1 Proposed Institutional Arrangements

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of ToR for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation. The Support Organisation will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments. Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level. The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances. The PIU will submit the compliance reports on clearances, permits, and environmental and social safeguards to D-ESDU.

## 7.2 Capacity Building

- Sensitize and orient different stakeholders of the project with adequate communication of benchmark standards on various project components. Ensure up gradation of awareness generation at different levels. Special focus: Health Hygiene and sanitation Sub Activity
- Training program for HKS (Health & Hygiene, source level waste segregation and source level treatment, Fire and Safety)
- Training program for ULB Councilors and Ward convener (Proposed SWM project plan of KSWMP)
- Training program for Political and trade union leaders (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for Residence Association leaders (Health, Hygiene different composting methods and source level waste segregation, littering of waste, Public Health, Fire and Safety)

- Training program for workers of Municipal Sanitary workers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for school / college students (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for ULB officials (Proposed SWM project plan of KSWMP, proposed policies, existing policies etc... to improve the existing pattern into zero waste concept of the municipality)
- Training program for School children, Parents and Teachers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Massive awareness campaign on 5R (Reuse, Recycle, Repurpose, Reduce and Refuse)

**Importance of Capacity Building**

Capacity building is defined as the "process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in the fast- changing world. It is the development of knowledge, skills and attitudes in individuals and groups of people relevant in the design, development and maintenance of institutional and operational infrastructures and processes that are locally meaningful. It is generally defined 'capacity building' as the creation of an enabling environment with appropriate policy and legal frameworks, institutional development, including community participation, human resources development and strengthening of managerial systems. It is a long-term, continuing process, in which all stakeholders participate. The main aim of capacity building under solid waste management is to build a basic understanding regarding the solid waste management project at each step of value chain (waste generation, segregation & storage at source, primary collection, secondary collection, transportation, processing and disposal) and importance of their work and develop a sense of belonging towards the work.

## 7.3 Grievance Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizen can lodge complaint either directly to ULBs, toll free number or through digital platforms (website/email – grmkswmp@gmail.com / Toll free number-18004250238). The complaint will automatically be recorded in login of ward level official of ULB and an escalation system is constituted according to the category of each complaint to close the complaint in time. The complainer can close the complaint through a feedback form according to their satisfaction.

# CHAPTER 8. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

## 8.1 Approach to Public Consultation

**KSWMP** have developed a detailed strategy and installed various inclusive mechanisms in the different stages of the remediation process considering the project affected persons, families, and commercial establishments.

As the initial step, a **Transect walk** was carried out on **31.05.2023** covering the surrounding area of the dump site. The aim of the transect walk was to assess the site and gather information about its location, potential social risks, existing infrastructure and the impact on surrounding communities. The group exercise that entails walking between two points to intentionally cross or transect a community. The group explores environmental and social resources, conditions and systems by observing, asking, listening, looking and producing a transect diagram. Information collected can be used to reveal land use practices, hazards and vulnerabilities to inform disaster mitigation and water management.

Ward level Consultation Meetings will be conducted before the commencement of remediation in the leadership of ward councilors by engaging the representatives from different resident's associations, commercial establishments and other institutions in the ward for explaining about the remediation process and thereby to gain public support and cooperation. This shall be conducted 30 days prior to the commencement of the work. Effective IEC drive to be initiated to engage with the community to build support as the activity will create positive impact.

## 8.2 Information Disclosure

Warning sign boards and project information boards with full details of grievance Redressal mechanism along with all related contact details will be installed at site during the remediation process at the site. Site control measures should be enforced to prevent unauthorized personnel from entering the work site. Work zones should be delineated around specific bore holes, excavations and other areas that may pose the risk of potential exposure to the hazards.

## 8.3 Information Education and Communication (IEC Plan)

| Target Audience | Activity | Topic | Responsibility | Monitoring |
|---|---|---|---|---|
| 1.Inhabitants near by the Dumpsite (27 Families)<br><br>2.Shops | 1 One to one interaction<br><br>2. Group meetings<br><br>3.Video presentation of dumpsite remediation process through whatsapp. | 1.Process of dumpsite remediation<br><br>2.Risks involved in the process<br><br>3. Possible mitigation measures<br><br>4. Listen their concerns & discussion on its remedies<br><br>5. Awareness creation for the community support and participation for smooth implementation of the Bio | Contractor | PIU/TSC/DPMU/DPMC |

| | | | | |
|---|---|---|---|---|
| | | mining process and timely completion of bio mining activity.<br><br>6.Discussion on traffic arrangement | | |
| HKS, Sanitation workers, Workers in MCF & Windrow compost Plant | 1.Interactive sessions<br>2. Distribution of pamphlets<br>3. Video presentation of dumpsite remediation process through whatsapp groups of the affected persons . | 1. Process of dumpsite remediation<br>2.Risks involved in the process<br>3.Possible mitigation measures<br>4. Discussion on traffic arrangements<br>5. Listen their concerns & discussion on its remedies<br>6. Health and safety measures | Contractor | PIU/TSC/DPMU/DPMC |

# ANNEXURE -I

**INITIAL ENVIRONMENTAL EXAMINATION**

**(To be prepared for each subproject)**

Checklist to be followed for Environmental Screening during the Initial Environmental Assessment Stage has been provided below:

**Subproject Details**

| | |
|---|---|
| **Name of Subproject:** | Valakkuzhi Solid Waste Dumpsite (Muvattupuzha) Remediation by Biomining |
| **Subproject Components:** | Dumpsite Remediation by Bio-mining |
| **Subproject Location (City / Town/ Village with ward numbers):** | Valakuzhi Paipra Panchayath, Ward 25, Muvattupuzha |

**Stage 1: Exclusion List**

**Is the Project Excluded from Consideration due to the following:**

| ***Sl No:*** | ***Non-permissible Activities*** |
|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i) any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides |

*(This space can be used to add details on the above, reason for exclusion from the Project etc.)*

*This dumpsite remediation project involves 1. (i) no construction in demarcated Forest areas or protected areas or their buffers, (ii) no construction of landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) no treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). 2. NO activities which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas, 3. No activities with (i) any impact on or due to Dams or embankments (ii) and projects will not purchase, store and use Banned Pesticides.*

*Hence, not excluded*

*Proceeding to Stage 2 Screening*

**Stage 2: Environmental Screening Checklist**

| Project Details | | |
|---|---|---|
| **Sl.No** | **Components** | **Details** |
| 1 | Project components | Dumpsite Remediation by Bio-mining |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste management, centralized non-biodegradable waste management facilities, centralized biodegradable waste management facilities, sanitary landfills, biomining of dumpsites, including for Linked activities / associated facilities) | Bioremediation of Valakuzhi Dumpsite: - A total station survey was conducted to determine the quantity of legacy waste, revealing a total of 55,712 cubic meters. |
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project; including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination) Site Survey No:/s (attach map) with ownership details, Geographical co-ordinates of the site location [including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | Location: Valakuzhy Paipra Panchayath, Ward 25<br>Survey No: (902/15A/2,902/11B/2,902/11A/5,545/3,545/6/2,545/6/1)<br>Ownership – Muvattupuzha Municipality<br>Land use – Solid Waste Management facility<br>Geographical Coordinates: Latitude: 9.99414 $^{0}$ N<br>Longitude: 76.561345 $^{0}$ E<br>Earthquake zone: III<br>Cyclone: Moderate<br>Access road of width 3 m (Valakkuzhi Road)<br>Dumpsites have existed since the year 1950. |
| **4** | Land Area proposed to be used: Location wise (in sq km / sq m) | Current total land area of 3.20 acres will be fully remediated through bio-mining. |
| **5** | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | For domestic usage 2 KLD will be met from a private supplier. |
| **6** | Power Required and Source of Power | No DG set requirement for this sub-project. Electricity connection is available within the site.<br>Source: KSEB |

***Baseline Environmental Conditions***

| *Sl. No* | *Environmental Aspects* | *Yes* | *No* | *Details (include distance in Km, info on its importance)* |
|---|---|---|---|---|
| 1 | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers) | | | |
| *(i)* | Critically Vulnerable Coastal Areas (CVCAs), Eco-sensitive Areas (ESAs) | | ✓ | No Critically Vulnerable Coastal Areas and Eco sensitive Areas in the study area |
| *(ii)* | Cultural Heritage site, Protected monuments - listed by ASI/State | ✓ | | Old Muvattupuzha bridge– 2 Km away |
| *(iii)* | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensitive area, with any schedule 1 species? If Yes, which is the area? | | ✓ | No Eco-Sensitive Areas in the study area |
| *(iv)* | Other Wetlands/ Mangrove/ Estuarine Region | | ✓ | There is no Wetlands/ Mangrove/ Estuarine Region in the study area |
| *(v)* | Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves | | ✓ | There is no Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves in the study area |
| *(vi)* | Other Sensitive Environmental Components listed in EMF | | ✓ | There is no other Sensitive Environmental Components in the study area as listed in EMF |
| *(vii)* | Drinking water source, upstream and downstream uses of rivers, etc | ✓ | | Muvattupuzha River – 1.2 Km, SE direction from the dumpsite. |
| *(viii)* | Low-lying areas/areas of Tidal Influence (provide CRZ details) | | ✓ | The location is not in a low lying area and not in a CRZ region. |
| *(ix)* | Sensitive Receptors – a) Habitations / Households / Hostels, other special areas, etc. b) School c) Religious Places d) Tourist Areas | ✓ | | 27 houses within 200 m of the dumpsite. |
| *2* | Is the site in Critical / Overexploited Groundwater Block. Provide the level of the groundwater table | | ✓ | asper the ground water booklet of ernakulam district general Water level ranges from 3.5 to 6.5 metres. |
| *3* | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other (specify) | ✓ | | Fire accident occurred twice in the dumpsite. Bio-mining will be carried out by considering the fire control and safety measures.<br>The site is highly vulnerable to Flooding. |
| *4* | Describe the type of soil and vegetation on site | ✓ | | Gravelly Clayey soil is the most predominant soil type, presence of vegetation ( shrubs ) |

| *Sl. No* | *Environmental Aspects* | *Yes* | *No* | *Details (include distance in Km, info on its importance)* |
|---|---|---|---|---|
| *5* | Is the site present in the flood plains as recorded in the last 100 years? Provide the HFL level of the site/region | | ✓ | Site is located in a flood prone area. |
| *6* | Existing pollution/contamination or degradation on site | ✓ | | Dumpsites have existed since the year 1950. |
| *7* | Any other remark on baseline condition | ✓ | | Based on the baseline study data for AAQ, except Particulate matter all other parameters are within the permissible standards, surface and groundwater, indicating that the respective results are well within permissible limits. The noise analysis indicates, during night time the Noise was found to be marginally higher than the standards |

***Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology, and Soils***

| *Sl. No* | *Impacts on Land / Soil Environment* | *Yes* | *No* | *Remarks* |
|---|---|---|---|---|
| *8* | Total extend of land to be covered/built | ✓ | | The existing dumpsite area of 3.20 acres will be remediated by bio-mining. |
| *9* | Total extend of land where the waste will be dumped openly / or expected to get contaminated by waste or leachate/material storage | | ✓ | The existing dumpsite area of 3.20 acres will be remediated by bio-mining. |
| *10* | Extend of Land to be remediated | ✓ | | The existing dumpsite area of 3.20 acres will be remediated by bio-mining. |
| *11* | Extend of land expected to be under green belt | | ✓ | Currently the dumpsite has no greenbelt. The Area of 3.20 acres will be fully remediated and utilized for further use by ULB. |
| *12* | Will the proposed project cause the following on Land / Soil: | | | After bio-mining the land will be remediated and will have a positive impact on the land and soil. |
| *(i)* | Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains | | ✓ | No Impact on Surrounding Environmental Conditions due to the proposed sub-project. |
| *(ii)* | Substantial removal of Top Soil (mention area in sq.m) | ✓ | | The dumpsite has legacy wastes of 5.5 m below and 2.47 m above existing ground level. However, the legacy waste combined with soil will be remediated till the depth of 5.5 m below ground level. |
| *(iii)* | Any degradation of land / eco-systems expected due to the project? | | ✓ | No land use change or ecosystem change due to implementation of this project |

| Sl. No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| | | | | since the land will be reclaimed. |
| (iv) | Loss or impacts on Cultural/heritage areas/properties | | ✓ | No impacts or loss of cultural/ heritage areas/properties due the implementation of the project |
| (v) | Does the project activity involve cutting and filling/ blasting etc? | | ✓ | The project activity does not involve any cutting, filling or blasting. The bio-mining sub-project involves only excavation of wastes which are to be remediated. |
| (vi) | Will the project cause physical changes in the project area (e.g., changes to the topography) due to excavation, earthwork, or any other activity? | ✓ | | Waste is about 5.5 m below Ground Level which is to be excavated and remediated. So there is a change in topography. |
| (vii) | Will the project involve any quarrying/ mining etc? | | ✓ | The project does not involve quarrying/ mining |
| (viii) | Will the project / any of its components contaminate or pollute the Land? | | ✓ | The existing dumpsite will be remediated and utilized for further use, henceforth there won't be any contamination to the land. |
| (ix) | Will the project contribute to any long term significant adverse (negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | ✓ | Due to the proposed bioremediation, the site will be remediated and biodiversity of the surroundings will be enhanced and it will have a positive impact in the longer term. |
| (x) | Will the Project or related activities cause negative impacts on the land in combination with other anticipated / existing projects in the region? | | ✓ | The proposed subproject involves only remediation through bio-mining. Hence no negative impact to the land. |

| Sl. No | Impacts on Air and Noise Environment | Yes | No | Details/Remarks |
|---|---|---|---|---|
| 13 | Will the project cause or increase air pollution due to dust and / or vehicle emissions? | ✓ | | The process of bioremediation may cause dust emission from process and vehicle movement which shall be managed using effective mitigative measures |
| 14 | Will the project cause or increase pollution due to GHG emissions? | ✓ | | Chances of GHG emissions due to un-stabilized waste. |
| 15 | Will the project cause or increase odor nuisance? | ✓ | | The process of bioremediation may cause odour during remediation for the shorter time duration, which shall be managed by effective mitigative measures |
| 16 | Is there a potential for release of toxic gases or accident risks (eg: potential fire outbreaks) | ✓ | | Fire accident occurred once in the dumpsite. |
| 17 | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | | ✓ | Project activity stage (during the process of bioremediation, the noise may arise due to |

| Sl. No | Impacts on Air and Noise Environment | Yes | No | Details/Remarks |
|---|---|---|---|---|
| | | | | vehicular movements & working of machineries). The proposed mitigation measures will ensure the ambient noise within the permissible limits. The duration of work will be 8 hours/day. |

| Sl. No | Impacts on Water Environment | Yes | No | Details/Remarks |
|---|---|---|---|---|
| 18 | Will the activities proposed at the site(s) impact water quality (surface or ground) – leachate, runoff, wastes deposition, erosion? | | ✓ | The proposed remediation will only enhance the groundwater/surface water quality in the long term. |
| 19 | Will the activities proposed at the site(s) impact water resource availability and use - leachate, runoff, wastes deposition, erosion? | | ✓ | The proposed remediation will only enhance the groundwater/surface water quality in the long term. |
| 20 | Chances of Pollution of Water bodies/groundwater wells, nearby or downstream | | ✓ | The proposed remediation will only enhance the groundwater/surface water quality in the long term. |
| 21 | Will the activities proposed at the site(s) hinder natural drainage | | ✓ | No, the proposed remediation activity does not hinder natural drainage. |
| 22 | Will the activities proposed at the site(s) decrease permeability/rainwater percolation | | ✓ | The proposed remediation will clear the legacy wastes and the land will be remediated. After remediation the permeability/rainwater percolation of the soil will be increased. |

| Sl. No | Impacts on Biodiversity and Host Communities | Yes | No | Details/Remarks |
|---|---|---|---|---|
| 23 | Will the project necessitates cutting of Trees / Loss of Vegetation | | ✓ | Cutting of trees is not required for the proposed remediation activity. |
| 24 | Will the project necessitate substantial removal of Top Soil (mention area in sqm) | ✓ | | The dumpsite has legacy wastes of 5.5 m below ground level and 2.47 m above ground level. However, the legacy waste combined with soil will be remediated till the depth of 5.5 m below ground level. |
| 25 | Any degradation of land / eco-systems expected due to the project? | | ✓ | The proposed process of bio-mining ensures that there will be no degradation of the land. |
| 26 | Will the project result in Health & Safety Risks in the neighborhood including the release of toxic gases, leachate, accident risks | | ✓ | There are 27 households 200 m from the dumpsite. Hence, bioremediation should be conducted considering proper mitigation measures and |

| *Sl. No* | *Impacts on Biodiversity and Host Communities* | *Yes* | *No* | *Details/Remarks* |
|---|---|---|---|---|
| | | | | occupational health and safety conditions to the labourers and neighborhood will be ensured. |
| *28* | Potential Noise, Light Pollution/movements causing disturbance to nearby habitats/communities | | ✓ | There is a habitable area at a distance of 200 m from the dumpsite. The noise pollution will be minimal outside of the premises during remediation. |
| *29* | Potential disruption to common property, accessibility, traffic disruptions, conflicts, or disruption to the local community within the subproject area? | | ✓ | No disruption, there will be a marginal increase in traffic of medium sized vehicle (trucks) due to the forward linking of recovered products from dump site (i.e. For compost, plastic and other recyclable waste). |

Enclosures:

| Access road | Site entrance |
| --- | --- |
|  |  |
| **General view of waste deposit** | **Constructions** |
|  |  |

| Map (from google) |
| --- |
|  |

*Project Categorization and Need for Safeguards Instruments, Oversight*

| *Project Category* | □ ✓*E2* |
|---|---|
| **Key Reasons (for categorisation)** | During screening, it has found that the proposed subproject is moderately causing impact to the base line environment, land/ soil / water /noise environment, biodiversity or to the community. Site is not close to any Environmental Sensitive Receptor. Moreover, Project results positive impacts on Environment. The Environmental Baseline analysis reveals that dumpsite not having any Heavy metal contamination. Hence it is categorized as E2. |
| **Safeguards Instruments Required** | a) E2: Project-specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities) |
| **Additional Responsibilities Expected** (such as i) Specialists to be hired for Physical/Cultural resources, Natural Habitats/others, etc for EIA preparation, and/or supervision), ii) Consultations, iii) any other aspect | |

| *Status* | *Agency / Official* | *Name, Signature with Date and Seal* |
|---|---|---|
| **Prepared by** | PIU or ULB (project in-charge) | |
| | Environmental Engineer | |
| **Checked, Categorised as ___ (E1, E2, E3) & ToR issued by:** | DESDU / SESDU | |
| | Environmental Specialist | |

# ANNEXURE II: FIRE RISK ASSESSMENT

**Objectives:**

The important elements of fire risk Management planning can be classified as:

- Identifying the disaster potential scenarios and advance planning to combat and minimize the damage.
- Vulnerable zone delineation.
- Assessment of loss probability and its severity.
- To deal with such emergencies expeditiously.
- Warning, protective actions like evacuation of personnel.
- To contain the disaster by isolating the area, firefighting etc.
- To make efforts to return to normal condition when the situation is controlled.

*Causes of fire and Risk:*

| Ignition (heat) sources | Fuel Sources | Oxygen Sources |
|---|---|---|
| Lit cigarettes/ butts, matches, lighters<br>Improperly stored batteries<br>Bushfire<br>Self-heating piles<br>Hot loads/contaminated waste<br>Hot work operations<br>Arson<br>Lightning<br>Fires from neighbouring activities<br>Faulty electrical wires | Flammable liquids, gases and solids<br>Combustible goods and waste (e.g. CRWM[3])<br>Contamination in CRWM storage<br>Dry and unmanaged vegetation | Oxidising chemicals such as oxy-acetylene sets, bleach, hydrogen peroxide, nitrates<br>Physical introduction of oxygen through unbaling or turning of loose piles |

**Fire Prevention & Management Plan**

It is a strategy well evolved, organized and rehearsed to contain the adverse effects of a possible disaster. It aims to mobilize the internal resources and use these with minimal dependence on external agencies for the following purposes:

- To control and contain incidents.
- To safeguard employees and people in the vicinity.
- To inform employees, the general public and the authorities about the hazards/risks assessed, safeguards provided, residual risk, if any, and the role to be played by them in the event of disaster.
- To effect rescue and treatment of casualties.
- To prevent recurrence of such a disaster.
- To establish machinery for review, rectification/modification of the emergency

- To ensure safety of workers before personnel re-enter and resume work.
- To work out a plan with all provisions to handle and to provide for emergency preparedness and the periodic rehearsal of the plan.

**Pre-Disaster Stage**

The prevention of disaster is of vital importance and is the moral responsibility of each and every individual employed in the dumpsite site. It can be prevented by observance of precautionary and preventive measures. During pre-disaster stage following points will be followed to avert the occurrence of disaster:

The emergency operation procedures of the dumpsite site will be written down, so that no confusion is caused in the event of an emergency taking place.

- To reduce the probabilities of accidental leakage of methane.
- Smoking will be prohibited in the areas where handling of dumpsite will be done. “NO SMOKING” boards will be prominently displayed in Local Language ie., Malayalam and English languages.
- All electrical wiring, fittings, cables, equipment will be checked periodically. Temporary wiring will not be permitted to be installed inside the dumpsite area. No inflammable material including papers, Oils, wooden racks will be stored within 1 meter of any electrical fittings. No unauthorized person will be allowed to tamper with electrical fittings.
- Welding, Burning, cutting, Chipping, soldering work, etc. will only be carried out by authorized persons.
- Necessary compliance with various Statutory Guidelines and other relevant instructions as issued from time to time will be done by the contractor.
- The Safety Department will arrange to educate all concerned regarding operational hazards of non-compliance of the safety guidelines. They will also provide necessary guidance and support in proper implementation of the program. They will also arrange mock exercises periodically.
- The Safety Department will display important telephone numbers and instructions in Mizo & English languages. The Security Control Room located at the dumpsite site will be equipped with the following:
- Sufficient number of copies of On-Site Disaster/Emergency Management Plan.
- Master plan of the dumpsite site indicating vital locations and possible sources of disaster.
- Important Telephone numbers
- Emergency lights (portable) and Wireless sets if required and possible).
- First Aid boxes

**Disaster Stage**

The most probable disaster which may occur at the dumpsite site is because of accidental leakage and fire. To control leakage and fire the following measures/precautions will be taken at the dumpsite site:

The guidelines as given below for the protection of fire will be followed:

• The dumpsite’s fire protection will consist of structural solutions, fire extinguishing systems and fire alarm systems. The fire extinguishing system will consist of the fire system with fire pumps, distribution pipelines, hydrants and fire hoses and the portable extinguishers.

• The fire alarm system will be a part of the primary systems and take care of the places which are unmanned or will not have any fixed fire extinguishing system.

• The major operation areas shall be equipped with fixed smoke detectors, $CO_2$ extinguishers near the door in the control room.

• All the rooms in the office shall be equipped with fixed smoke detectors.

• The ventilation rooms shall be equipped with fixed smoke detectors. One $CO_2$ extinguisher will be located near the door to the ventilation room.

• The fire alarm and detection system shall be designed, installed, maintained and tested according to relevant standards.

• The water for firefighting shall be stored in the fire water tank (water reservoir).

• CO2 fire extinguishers contain extinguishing carbon dioxide which either by it or under expected conditions of use gives off CO2 to prevent fire.

• Dry fire extinguishers contain an extinguishing medium which either by itself or under expected conditions of use will give fine powder to prevent fire to get oxygen.

• As soon as a fire takes place inside the premises of dumpsite, action to be taken by various persons/officials

**Post Disaster Stage**

After the incident a report will be prepared regarding occurrence of event/losses incurred and recommendations thereof for restoration of normalcy

**Reporting of Accidents**

Situation in totality will be studied thoroughly, investigated with respect to the cause of the incident, extent of loss of life and property and a detailed report prepared by the individual/team nominated by dumpsite site authorities for this purpose. Based on the investigation report, rescue team would finalize time bound programmes for implementation of corrective measures proposed and regularly monitor the progress thereafter. Rescue, medical and welfare operations would be continued by the concerned agencies.

**Fire Standards and Facilities:**

Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.

Below equipment and their required quantities should be strategically positioned according to the site's specifications.

- Fire extinguisher (A, B, C powder): It will be used to immediately put off fire caused by wood, Paper and textiles, flammable liquids and flammable gases. Commonly can be placed anywhere inside the site
- Fire extinguisher (Foam spray): Mainly used to put off the fire caused by flammable liquids. It should be placed in diesel storage area, lubricant storage area and DG sets.
- Fire extinguisher ($Co_2$): Mainly used to put off the fire caused by Electrical short circuit. It should be placed near the control panel room/operation room.
- Fire bucket filled with sand: It should be placed near the diesel storage area

To ensure rapid response in case of a fire, it's essential to have a water tanker filled with water, equipped with a fire-fighting hose, readily accessible along with the portable motor. The presence of this equipped

water tanker ensures timely and effective action during fire emergencies. All requirements in line with National / State regulations and as advised y the Local Brigade shall be arranged & followed

The following points to be considered for assessing the fire risk and procedure to mitigate it.

1. Identification of Fire Hazards: The first step involves identifying potential fire hazards in the premises. These hazards could include sources of ignition (e.g., electrical equipment), combustible materials (e.g., flammable liquids, paper, cardboard), and other factors that could contribute to the outbreak of a fire.
2. Assessment of Risk: Once the hazards are identified, the next step is to assess the level of risk associated with each hazard. This involves evaluating the likelihood of a fire occurring and the potential consequences if a fire were to break out.
3. Escape Routes: Since operational phase occurs in an open environment, the need for conventional escape routes in the event of a fire emergency may not be required.
4. Fire Safety Measures: The assessment reviews existing fire safety measures in place, such as fire alarms, firefighting equipment, and fire suppression systems. Proper assembly point is required in case of fire break out
5. Emergency Procedures: The assessment evaluates the effectiveness of emergency procedures and evacuation plans in the event of a fire, ensuring that workers can safely evacuate the premises.
6. Fire Training and Awareness: The assessment considers the level of fire safety training provided to workers and the awareness of fire hazards and evacuation procedures.
7. Record-Keeping: Detailed records of the assessment process, findings, and recommended actions are maintained for future reference and regulatory compliance.
8. Recommendations: Based on the assessment, the fire risk assessor provides recommendations for improving fire safety, which may include installing additional fire safety equipment, conducting training programmes, or implementing any changes to reduce fire risks.
9. Review and Updates: Fire and risk assessments should be regularly reviewed and updated to account for any changes in the premises or regulations.

Fire and risk assessments play a crucial role in preventing fires and minimizing their impact if they occur. They are particularly important for dumpsites and other places with a higher risk of fire hazards to ensure the safety and well-being of workers.

## ANNEXURE- III MAP SHOWING BASELINE MONITORING LOCATIONS OF





**GOOGLE IMAGE DEPICTING THE NOISE MONITORING LOCATIONS AT MUVATTUPUZHA DUMP SITE**




**GOOGLE IMAGE DEPICTING THE SURFACE WATER, GROUND WATER AND LEACHATE MONITORING LOCATIONS AT MUVATTUPUZHA DUMP SITE**

KSWMP

FEASIBILITY REPORT

# DUMPSITE BIOMINING AND BIOREMEDIATION, VALAKUZHI, MUVATTUPUZHA MUNICIPALITY




November 2023

KSWMP | LSGD | LSGD

State Project Management Unit
Kerala Solid Waste Management Project (KSWMP)

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## Executive Summary

The Solid Waste Management Rules of 2016 directed Urban Local Bodies to clear legacy waste dumps as well as existing operational dumpsite down to pre-existing ground level through a process called bioremediation or bio mining, which refers to an environment-friendly technique to separate soil and recyclables from legacy waste.

The Muvattupuzha dumpsite is located at a distance of 2.5 km from the centre of Muvattupuzha town in western side and encompasses a total area of 5.47 acres of land. The geographical coordinates of the dumpsite are 9.993701° N, 76.560974° E. The volume of legacy waste to be remediated in the dumpsite is 55,736.66 Cu.m. The legacy waste is present about 2.47 m above and 5.5 m below the ground level. Hence, bioremediation of the dumpsite is essential to mitigate the environmental impacts. Dumpsite reclamation involves excavation, screening, and separation of material from dumpsites into various components such as soil, recyclable materials, and residues.

The subproject site has been screened for potential impacts due to proposed activity of dumsite remediation. Based on Environmental screening report and baseline consideration, potential odour nuisance and air borne microbial contamination, the activity may have moderate environment impacts to the surroundings during remediation period. Considering all the above factors, also the time extent of the impact during remediation stage and the mitigation measures proposed, the sub-project has been considered as E2 category.

The favourable time for remediation is non-monsoon period. As per the geotechnical investigation, the subgrade soil was encountered at 5.5 m below the waste depth of the dumpsite and the predominant soil is clayey. The dumpsite is surrounded by predominantly of dry cultivation land use and the same will act as odour attenuation during remediation. The cultural heritage zone near dumpsites is Muvattupuzha Old Bridge at a distance of 2 km in East direction. Hence, no significant physical impact to the heritages sites is envisaged during remediation. The total number of vehicles that will be operational at the dumpsite is 5 numbers per day which increase the traffic load by only 0.1% per hour and reducing the impacts to negligible. As per the district disaster management plan-2015 and flood vulnerability map the dumpsite is under flood prone zone.

Muvattupuzha Municipality has population of 30,397, literacy rate of 96.65%. The dump site is situated in the land owned by the Municipality. The remediation process will be conducted by an experienced agency decided by the KSWMP with the supervision of a ULB level project implementation unit. The entire process will be monitored by the KSWMP district level unit with the technical assistance of the TSC. The dumpsite remains in close proximity to 5-7 houses within 200 metre distance and the remediation process will not affect the socio-economic environment in and around the dump site in any way. The site is covered with a compound wall and gate.

After a comprehensive assessment, it has been determined that Bio-mining – reclamation/recovery of land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite. The cost of Bio-mining is [redacted] per $m^3$ as per the estimate.

During operational phase (bioremediation), the main potential nuisances caused by a dump site are fugitive dust, odour, foul gases, smoke from the site (in case of fire), and leachate generation. Birds, vermin, and rodents, littering, noises both from machineries operating at the site and waste collection vehicles. No specific social risk is identified for initiating the remediation process except the occupational hazards to the workers engaged in the remediation process. It can be overcome by using adequate protective measures.

The mitigation measures are recommended for impacts from air, noise, water, leachate, health and safety, OH&S aspects. The proposed monitoring plan includes leachate, surface and ground water monitoring for a period of once in three months. The cost of [redacted] is required for implementation and supervision of EMP and SMP. The social management plan proposed are for pre-remediation as well as during remediation stage. The mitigative measures proposed addressing concern of local community about remediation work, labour management issues, health and safety risks of labours, gender discrimination.

Periodic Compliance monitoring system will be done by the contractor during remediation. A Transect walk was carried out on 31.05.2023 covering the surrounding area of the dump site. Effective IEC drive to be initiated to engage with the community to build support as the activity will create positive impact. Warning sign boards and project information boards with full details of grievance redressal mechanism along with all related contact details will be installed at site during the process at the site. Site control measures should be enforced to prevent unauthorized personnel into the work site.

## 1.0 Introduction

The issue of municipal solid waste management in Urban India has become one of the foremost concerns during last couple of decades. Kerala state has 93 ULBs including six Corporations.

The primary environmental issue currently faced by the municipal authorities in Kerala revolves around a longstanding existing legacy waste dumpsite. The state has a long history of more than three decades of continuous dumping of both bio- and non- biodegradable wastes. Though the waste dumping activity has been stopped, the dumpsite remains as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Improper management of such sites pose significant environmental, social, and economic challenges for the communities and ecosystems in the vicinity.

In view of the environmental and social issues connected with dumpsites, the SWM Rules 2016, directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the remediation projects of legacy waste dumpsites in the ULBs. As part of the project, in phase -1, the existing dumpsite of Muvattupuzha ULB was proposed for remediation.

For arriving at a methodology for remediating the legacy waste in the dumpsites, as per the Project Implementation Manual, a feasibility study outlining the technical, economic, and socio- environmental factors has been carried out. As a result of the feasibility study that involved detailed field investigations & assessment, and market sounding, the method proposed for remediation of legacy waste dumpsite is biomining, which will ensure long-term sustainability and environmentally sound treatment, which is found technically feasible, economically viable, and socially acceptable. The details of various steps involved in the feasibility study are described in the following sections.

## 2.0 General Description about the Project

Muvattupuzha, Ernakulam in the State of Kerala is experiencing the issues of treatment and disposal of MSW. The common solid waste management facility of the Muvattupuzha Municipality is located within 5.47 acres of land in Valakuzhi (9.993701"N, 76.560974"E). The legacy dumpsite is also located at this common solid waste management facility. This is the only dumpsite present in the ULB.

This waste dumpsite at Muvattupuzha needs to be remediated scientifically and the land is to be reclaimed for productive use. This feasibility report outlines the status including the environmental and social aspects. The feasibility report also examines various remediation options and suggests the most feasible option for the given context for the purpose of availing for the closure of the dumpsite by Muvattupuzha Municipality.

## 3.0 Profile of ULB- Muvattupuzha Municipality

### 3.1 Location

Muvattupuzha Municipality is located at latitude 9.993701°N and longitude 76.560974°E and is located on the central part of the district as shown in **Figure 3.1**. Total geographical area of Muvattupuzha municipality is 13.18 Sq. Km.the Municipality is divided into 28 administrative ward.



**Figure 3.1 Location Map of Muvattupuzha ULB**

### 3.2 Demographic & Socio-Economic Status

The municipality has a total population of 30,397 of which 15,010 are males while 15,387 are females as per Census 2011 indicating a Sex Ratio of 1,025 against state average of 1,084. The overall literacy rate of Muvattupuzha town is 96.65% which is higher than state average of 94.00 %. *(Source: Census Data 2011)*

**Table 3.1 Workforce Participation Details, Muvattupuzha**

| Category | Total | Male | Female |
|---|---|---|---|
| Main Workers | 9,916 | 7,588 | 2,328 |
| Cultivators | 207 | 189 | 18 |
| Agriculture Labourer | 219 | 176 | 43 |
| Household Industries | 211 | 160 | 51 |
| Other Workers | 9,279 | 7,063 | 2,216 |

| Category | Total | Male | Female |
|---|---|---|---|
| Marginal Workers | 840 | 492 | 348 |
| Non-Working | 19,641 | 6,930 | 12,711 |

*Source: Census of India 2011*

### 3.3 Connectivity

Muvattupuzha town is well connected to neighboring local bodies and towns through National Highways, State Highways, and other Major and minor road networks. National Highway 85 passes through the municipality, about 7.36 kms of NH 85 is occupied within the municipality. The Main Central Road (MC Road) section of about 6.45 kms is also passing through the municipality.

Muvattupuzha is connected by National Highway No. 85 to Ernakulam and Kothamangalam and by State Highway 8. Muvattupuzha connects Thodupuzha Muvattupuzha – Theni Highway SH—45.

The nearest major railway station, Aluva is located 32 kms from the town center, which is second largest railway station in Ernakulam. And nearest airport is Kochi International airport located 34 kms away from the town. The town is well connected by water way network which brings a wide opportunity of inland navigation.




**Figure 3.2 Road Map of Ernakulam Showing Major Connectivity of Muvattupuzha Town**

### 3.4 Climatic Condition

Muvattupuzha has a tropical climate. The average annual temperature is 27.6 °C in Muvattupuzha. Precipitation here averages 3,579 mm.

Summer season beings from March and ends in May. The climate in Muvattupuzha during the season is moderately hot and humid. Like all other places in Kerala, Muvattupuzha experiences heavy showers during the monsoon season. The catchment area has very high humidity of more than 80%. The data is presented in **Table 3.2.**

**Table 3.2 Meteorological data for Muvattupuzha**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Avg. Temp °C | 25.6 | 26.7 | 27.6 | 27.1 | 26.1 | 24.7 | 24.3 | 24.3 | 24.7 | 24.7 | 24.7 | 24.9 |
| Min. Temp °C | 20.6 | 21.7 | 23.1 | 23.7 | 23.7 | 22.9 | 22.4 | 22.3 | 22.2 | 21.9 | 21.3 | 20.6 |
| Max. Temp °C | 31.7 | 33.1 | 33.4 | 31.7 | 30 | 27.9 | 27.5 | 27.6 | 28.3 | 28.6 | 29 | 29.9 |
| Rainfall mm | 12 | 13 | 37 | 123 | 296 | 524 | 470 | 358 | 267 | 295 | 166 | 50 |
| Humidity (%) | 71% | 67% | 70% | 81% | 87% | 92% | 92% | 90% | 89% | 89% | 87% | 79% |
| Rainy days (d) | 1 | 2 | 6 | 14 | 19 | 21 | 21 | 21 | 19 | 19 | 13 | 5 |

*(Source: en.climate-data.org/asia/india/kerala/muvattupuzha-24593/)*

## 3.5 Ground Water Level

The vicinity of the project area has a few households. The site is surrounded by paddy field and the water table is high. According to information published by the CGWB, the Government of India, the water level in Muvattupuzha fluctuates from 3.53 to 6.54 MBGL.

## 3.6 Land use

Land use survey record revealed that the predominant land use of Muvattupuzha Municipality is residential. 60.43% of the total area is under residential use. Existing land use analysis shows following breakups as shown in table below:

**Table 3.3 Land use Pattern of Muvattupuzha Municipality**

| S. No | Land use | Area Ha | % |
|---|---|---|---|
| 1 | Residential | 796.45 | 60.43 |
| 2 | Commercial | 29.18 | 2.21 |
| 3 | Industrial | 4.91 | 0.37 |
| 4 | Public and semi public | 67.14 | 5.09 |
| 5 | Traffic and transport | 66.54 | 5.05 |

| | | | |
|---|---|---|---|
| 6 | Green and open space | 11.95 | 0.91 |
| 7 | Dry cultivation | 193.37 | 14.67 |
| 8 | Paddy | 53.52 | 4.06 |
| 9 | Water bodies | 94.94 | 7.2 |
| | Total | 1318 | 100 |

*Source: CSP, Muvattupuzha, 2009*

The details of analysis of land use survey and the resultant findings of existing land use are given hereunder.

- About 60.43 percent of the total geographical region is residential.
- Substantial coverage of water bodies and agricultural land.
- Agricultural land consists of dry as well as wet land. Rubber is the principal crop followed by paddy, coconut and tapioca.

## 4.0 Detailed Description of the Dumpsite

### 4.1 Physical Feature of the Site

The dumpsite is located approximately 2.5 km west of the centre of Muvattupuzha town, in ward no 25 and has an area of approximately 5.47 acres of land. The dumps site is not very far from human settlement. The coordinates of the dumpsite are 9°59’ 29" N & 76°43’ 42” E. Muvattupuzha municipality owns the dumpsite land. The Dumpsite is surrounded by residential dwellings (5 nos.) on eastern direction. South and west direction from the dumpsite is vacant land. Muvattupuzha River flows south-eastern side of the dumpsite at the distance of 1.2 km.

The exact date of start of the dumpsite is not available with the municipality; however, it is learnt during field visit that it started in the year 1960. Presently, the quantity of waste dumped at this site is about 55,736.66 cum as per records available with the ULB. As of now 3.2 acres of the area of the 5.47 acres is covered with waste. The legacy waste is present till about 5.5m below and 2.47 m above the ground level. There are high chances of water being contaminated in this area due to leachate percolation.



**Figure 4.1 Photographs of Muvattupuzha Dumpsite**

**Table 4.1 Salient Features of Muvattupuzha Dumpsite during Site Visit**

| Particulars | Details |
|---|---|
| Name of Dumpsite | Valakkuzhi dumpsite |
| Location of Dumpsite | Ward No. 25 of the municipality |
| Co-ordinates of Dumpsite | Latitude:- 9.993628 N<br>Longitude:- 76.561114 E |
| Distance from the central part of the town | 2.5 km |
| Area of dumpsite | 5.47 Acres |
| Waste of the dumpsite | 5.5 m below and 2.47m above |
| Ownership of dumpsite land | Municipality |
| Distance from nearby features- residential, school, offices, temples, institutions, industry etc.) | Residential and other structures within 100 m from the site |
| Start date of dumpsite | 1960 |
| Utilities on site | Electricity connection is available |
| Details of manpower and vehicles available in dumpsite | 45 persons and 6 Vehicle |
| Site demarcated | Site is currently demarcated with a boundary wall. |
| Details of weighbridge available at dumpsite | No weighbridge at site |
| Plant adjacent to dumpsite details | Nil |
| Availability of electrical power | 440 LV grid available at 100m from site |
| Availability of water for process | Water available from nearby stream at 100m, drinking water to be supplied by tanker |

## 4.2 Surrounding Features of the Dumpsite

The immediate surrounding land use of the dumpsite is rubber plantation. Within 200 m radial vicinity a few households (5 to 7 numbers) exist. The LV line is available at dumpsite, hence

it is convenient for setting up the bio-mining facilities. Site has proper access through a 5 m wide road.

## 4.3 Information on Site Management

This section describes the current management of the dumpsite in terms of agency responsibility, profile of workers and numbers, nature of work the labour force in engaged in, Waste pickers and other category of workers at the site

**Agency responsible for current management of the dumpsite:** Dumpsite is present within the common solid waste management area of the Muvattupuzha Municipality. An MCF, RRF & BSF Larva composting are working near to the dumpsite. MCF is operated by Cris Global traders who are appointed as Haritha sahaya sthapanam.

**Profile of workers and numbers:** Total number of 36 HKS workers & 14 workers (Provided by the agency) have been appointed on a daily basis for the operation of MCF, RRF and waste collection.

**Nature of work the labour force in engaged:** HKS workers and workers appointed by the agency are involved in the collection, segregation, and forward linkage of the non-bio waste. And they are also involved in the collection of bio waste from the Market, institutions, and households.

## 4.4 Relevance in local or regional SWM plans

The 5.47 acres of land after reclamation may be productively used by the ULB as it deems fit. The ULB may consider its use as a waste recycling park in which case the non-biodegradable waste from the ULB shall be brought to this facility and materials collection facilities and processed for further use. The project may be funded under the KSWMP project.

## 4.5 Litigation status of the Site

There is no litigation against the site. Whereas there is letter from State Pollution control board dated on 06/05/2023 Regarding “Direction imposing Environmental compensation for Non-compliance Act, 1986.” (Ref: 1. Soild waste management Rule 2016; The Hon’ble NGT order dated 16.01.2019 in OA No.606/2018; 3. Hearing notice no. PCB/HO/RULES/SWM EKM/2018 (Vol 2) dated 16.03.2022, Hearing conducted on 25.03.2022.

## 5.0 Scope of Work

Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at Muvattupuzha includes the following steps.

- Conducting detailed field investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical, and Environmental Baseline Analysis by M/s Poluchem Laboratories.
- Assessment & Analysis of detailed investigation report submitted by the Laboratories.
- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.
- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the By-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation (100% land recovery – Biomining, capping, partially Biomining & Capping), Methods/Technologies (Stationary & Mobile- compact), Implementation mode, Forward linkages (Utilization/Management of By-products) and Environmental & Social categorization as per the ESMF developed for projects envisaged under KSWMP.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Delineation of baseline assessment, impact & risk assessment, mitigations measures, Environmental Management & monitoring plan, budget for EMP, EMOP, institutional responsibilities for implementing monitoring and reporting
- Social Safeguards - Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.
- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport,
- Environmental and social monitoring costs, Revenue from the project, Funding for project
- Project Implementation plan –contractual models and timelines.

## 5.1 Objectives:

- To remediate the dumpsite by 31st March 2024.
- To reclaim 100% area and by eliminating the chances of dump fires, leachate generation, and foul odor.

- To reduce greenhouse gas emissions, soil pollution, and groundwater contamination.
- To increase nearby social value and benefit the citizens.

## 6.0 Detailed Investigation Strategy

### 6.1 Investigation Strategy

To understand the nature and composition of the legacy waste and the existing baseline environmental conditions, samples from waste, surface and groundwater, leachate, soil, air, and noise were collected as per the requirements given in the Project Implementation Manual, considering the state and national guidelines. Samples were collected as mentioned below:

- Bore hole upto a depth of 10 m and collection of 3 (nos) samples from the soil at interval of 1.5 m depth.
- Waste analysis viz., leachate sample from 1 location and physical analysis from 2 (nos) location, and chemical analysis from 1 (nos) location.
- Environmental baseline analysis surface water 1 (nos) location and ground water samples from 2 (nos) location (Well Water Samples -1 up gradient, 1 down gradient) and Air sampling from 2 (nos) locations and noise sampling from 1 (nos) location.

### 6.2 Investigation Plan

The detailed investigations carried out for the legacy waste dumpsite is given in the table below:

**Table 6.1 Detailed Investigation Plan**

| S.No | Parameters | Sampling Nos |
|---|---|---|
| 1 | **Geotechnical investigation** | |
| A | Bore Holes up to 10m depth(1No./2Hectare) (as per CPHEEO) | 1 |
| B | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coeff of permeability, Strength compressibility (vertically-3 samples per borehole). | 1 |
| 2 | **Waste & Environmental Analysis** | |
| A | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammonical nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyside, Chloride, Fluoride, Phenolic compounds. | 3 |
| B | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | 2 |

| S.No | Parameters | Sampling Nos |
|---|---|---|
| C | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Poatassium(N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor. | 1 |
| D | Ground water (well water samples-1 up gradient, 2 down gradient)-(shallow and deep wells) Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total coliform (IS 10500-2012) | 3 |
| E | Surface water (pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, Ecoli and Total coliforms (IS 10500-2012). | 1 |
| F | Ambient Air Quality (Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | 2 |
| G | Ambient Noise level (E(P)) for 24 hours. | 1 |

## 6.3 Sampling Methodology

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat/Long) were considered. The following table shows the strategic location details of samples selected for the detailed investigation.

**Table 6.2 Detailed Investigation Plan Executed for Waste Dumpsite at Muvattupuzha**

| S.No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | Upwind direction in Northeast boundary of the dumpsite. Distance 10 m from the boundary of dumpsite.<br>Downwind direction in West Southwest (WSW) boundary of the dumpsite. | The AAQ locations were chosen based on the Windrose data obtained for Muvattupuzha. The most predominant wind direction is from West and West-Southwest. |
| 2 | Noise (1 Location) | Ambient Noise level (E(P)) for 24 hours | Entrance of the dumpsite. Distance 10 m from the boundary of dumpsite. | Most vulnerable point in the site in regards of Noise quality is due to entry and exit of the waste loading and unloading vehicle. Please note that the site is devoid of |

| S.No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| | | | | proximity to any sensitive receptors within a 200 m radial circle. |
| 3 | Surface water (1 Location) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, Ecoli and Total coliforms (IS 10500-2012). | Nearby surface water within 100m from the dumpsite. | No alternative surface water sources were identified during sampling. |
| 4 | Ground water (2 Locations) | Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total coliform (IS 10500-2012). | Wells within vicinity of the dumpsite | No alternative ground water sources were identified during sampling. |
| 5 | Bore Hole (1 location) | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coeff of permeability, Strength compressibility (vertically-3 samples per borehole). | Centre of the dumpsite | Volume of legacy wastes were found to be higher in the centre part of the dumpsite during investigation. So, the bore hole test was performed in the centre. |
| 6 | Waste & Environmental Analysis | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammonical nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cynide, Chloride, Fluoride, Phenolic compounds. | 3 | |

| S.No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| | | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | 2 | |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium(N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor | | |

For the borehole investigation, the samples were collected by rotary drilling a 150mm bore hole using a fast rig attached to a drag bit. The soil drillings are removed by a circulating bentonite slurry which also aids in keeping the side walls stable. An SPT sampler was driven in to collect the representative samples, which is carefully packed in double walled polythene bags, sealed, and sent to laboratory for testing. Standard penetration tests were conducted on soil at every 1.5m depth and the number of blows to achieve 300mm penetration were noted. Fractions recovered from the mining of legacy waste were tested, especially for the presence of toxic metals and organic contaminants.

The total quantity of waste present in the waste dump is calculated based on the topographic study executed by ULB (for calculating quantum of waste above ground level) and the results of borehole investigation (for calculating the quantum of waste below ground level).

### 6.4 Analysis and Interpretation of Exploratory Data

The baseline condition of the waste dumpsite at Muvattupuzha, has been assessed through the geotechnical investigation and Waste & Environmental baseline assessment executed through M/s Matter Material Testing & Research Laboratory (P) Ltd and M/s Polluchem Laboratories (P) Ltd respectively. The results of Topographical survey conducted by ULB in the year 2022 also considered for the analysis. Results of topographic survey conducted by ULB, Geotechnical investigation report, waste and Environmental analysis are enclosed as **Annexures 1 to 4.**

The initial site visit was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd on 29/05/2023 along with the experts of TSC and PIUs. Field Geotechnical investigation to collect the soil samples after drilling through the legacy waste was started on 01.06.2023 and was completed on 04.06.2023. Positioning of Air samplers & Noise monitoring equipment, sampling of surface/groundwater, leachate, and legacy waste were done on 03.06.2023 by M/s Polluchem Laboratories (P) Ltd.

### 6.4.1 Topographic Survey Results

Topographic survey was conducted by ULB itself in the year 22/05/2022 towards assessing the quantum of the waste present in the dumpsite above the ground level. The Topographical survey report is presented in **Annexure 1**. The inference of the Topographical survey is as follows;

- Topographical Survey Map shows Approximate 3.20 acres of land used for waste dumping.
- Maximum height of waste dump above soil is 2.47 m
- Estimated waste volume is 31,995.18 Cum. (Above ground level density of waste is 0.904 T/cum as per the characterization study results presented in subsequent sections)

### 6.4.2 Geotechnical Exploratory Details

The geotechnical investigation at the dumpsite at Kurianmala, Muvattupuzha, Ernakulam district was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was drilled through the waste into the ground using a rotary drilling method. The maximum depth of investigation was 10 m (5.5.00 in waste after that 4.5 m soil). SPT and collection of undisturbed soil samples were carried out at regular intervals within the ground. Various laboratory tests were carried out on the SPT and undisturbed soil samples. The full geotechnical report is appended as **Annexure 2**. The major inference of the geotechnical investigations is as follows;

- In the borehole investigation it was asserted that the depth of the waste column below ground level is 5.50.m.

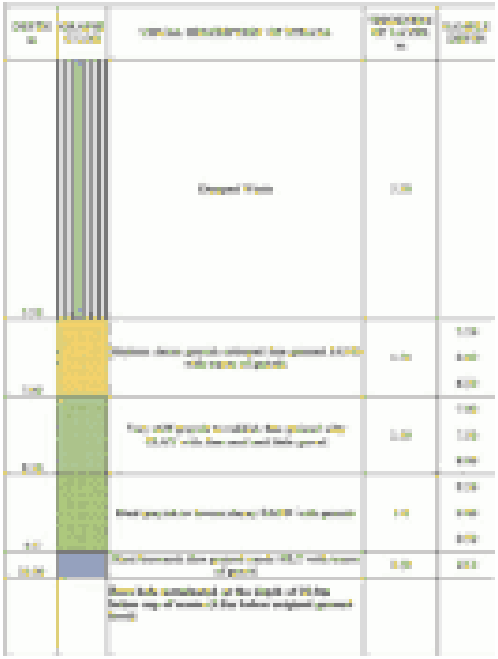


**Figure 6.1 Borehole Strata obtained for Muvattupuzha Dumpsite**

- The base soil has a plasticity index greater than 10 with clay and silt fractions account for more than 40%, which makes it suitable for the sub-base.
- The safe bearing capacity of the soil is 150 KPA, implying that the maximum height of fill may be about 15 m. During excavation, the side slopes should be maintained at 1:3.
- The Cation Exchange Capacity (CEC) of the soil is 11.03 meq/100gm.

### 6.4.3 Estimated Total Quantity of Waste

The total quantity of waste is estimated based on the contour/topography survey profile of the waste over the ground level and exploratory data of the bore log (Geotechnical investigations). As detailed under section 6.4.1 the estimated quantity of the waste above the ground level is 31,995.18 Cum.

Quantity of waste below the ground level is estimated as **23,741.48 Cum**. The quantity of waste below ground level may vary as per actual site conditions. We recommend taking 4 more bore holes for estimating exact quantity or the assessment of quantity below ground level may be included in the contractor's scope. Thus, the total legacy waste present in the Muvattupuzha dumpsite is calculated as below:

**Table 6.3 Total Waste Quantification for Muvattupuzha Dumpsite**

| Sl no | Name of Dumpsite | Quantity of Waste present above the Ground level | Quantity of Waste present below the Ground level | Total quantity of legacy waste to be managed |
|---|---|---|---|---|
| 1 | Muvattupuzha | 31,995.18 Cum | 23,741.48 Cum | 55,736.66 Cum |
| | | 28,923.64 T | 21,462.30 T | 50,385.94 T |

### 6.4.4 Legacy Waste Characterization

The characteristics of the legacy waste were assessed by collecting a 15kg sample. The legacy waste samples were collected on 09/08/2023 by M/s Matters lab (P) Ltd. The assessment of waste characteristics. was done based on the results of the analysis. The details of the physical characteristics are provided in the tables below. The detailed legacy waste characterisation reports are enclosed as **Annexure 3.**

**Table 6.3 Grain Size Analysis of Legacy Waste (total weight of sample taken 15 kg)**

| Sieve Size (mm) | Percentage Retained |
|---|---|
| 80 | 3.8 |
| 37.5 | 7.3 |
| 10 | 25.4 |
| 4 | 22.9 |
| Pan | 40.6 |

**Table 6.4 Characterisation of Waste Material Retained in Each Sieve**

| Test/ Parameters | Waste Material Retained on each sieve in % | | | |
|---|---|---|---|---|
| | 80mm | 37.5 mm | 10mm | 4mm |
| Plastic Waste | 16.9 | 7.7 | 3 | 5.9 |
| Cloth | 69.7 | 0.2 | 0.8 | Nil |
| Glass | Nil | 3.3 | 1.2 | 0.2 |
| Wood | Nil | 4 | 9.2 | Nil |
| C&D | Nil | Nil | Nil | Nil |
| Bio Fraction | Nil | Nil | Nil | Nil |
| Gravel | 13.4 | 84.6 | 83.2 | 93.4 |
| Metal | Nil | 0.3 | 2.6 | 0.5 |

**Table 6.5 By Product Composition**

| Particular | Percentage of Composition (%) |
|---|---|
| RDF | 8.81 |
| Recyclable | 0.80 |
| Inert | 49.80 |
| Compost Soil Enricher | 40.60 |

**Table 6.6 Physical Characteristics of Waste**

| Sl no | Parameter | Test Method | Unit | Value |
|---|---|---|---|---|
| 1 | Moisture@105°C | ASTM D 2216 | % | 12.4 |
| 2 | Bulk Density | USEPA | kg/m3 | 904 |
| 3 | Density | USEPA | g/cm3 | 0.8974 |

**Table 6.7 Chemical Analysis**

| SL No | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 8.02 |
| 02 | Biodegradable Factor | USEPA | % | 3.7 |
| 03 | Total carbon | USEPA 9060A | % | 4.6 |
| 04 | Phosphorus(P) | USEPA | % | 0.041 |
| 05 | Nitrogen(N) | USEPA | % | 0.31 |
| 07 | Potassium(K) | USEPA | % | 0.0630 |
| 08 | C/N Ratio | USEPA | .. | 14.8:1 |

*Note : The average Nitrogen, Phosphorus and Potassium (NPK) content in the legacy waste samples are far lower than 0.5, 0.4 and 0.5 as specified by the Fertilizer Control Order (FCO) 1985 for city compost and hence cannot be used as compost. The carbon: nitrogen ratio is 14.8:1 which is much lesser than the specified standard. This could be due to the materials being exposed to sun and air over the years or that the carbon content may have leached into the ground through leachate during the rainy season. Another possible contributor to the reduced carbon levels could be multiple fire incidents at the site. Although the material has very less carbon content, the NPK value can be enriched by adding additives like poultry litter. The enriched material can be given to farmers or used for horticulture purposes.*

### 6.4.5. Soil Conditions of the Dumpsite

As it is an unlined dumpsite, there is a probability of finding traces of contaminant from waste and leachate in the underlying soil. Since it is an uncontrolled disposal site, the mixed waste contains different types of pollutants which may eventually have an impact on the soil. Results

of soil analysis of the samples taken from the borehole in the Kurimala dumpsite is as shown below:

**Table 6.8: Chemical analysis of soil extracted from borehole at Muvattupuzha dumpsite**

| Sl. No | Parameter | Result | US (NY State-Codes, rules and regulations) Industrial Use |
|---|---|---|---|
| 1 | Cadmium (Cd) mg/Kg | <5.0 | 60 |
| 2 | Chromium (Cr) mg/Kg | 121.8 | 800 (Hexavalent) 6800 (Trivalent) |
| 3 | Copper (Cu) mg/Kg | 123.8 | 10000 |
| 4 | Nickel (Ni) mg/Kg | 82.9 | 10000 |
| 5 | Lead (Pb) mg/Kg | 59.9 | 3900 |
| 6 | Zinc (Zn) mg/Kg | 944.3 | 10000 |
| 7 | Mercury (Hg) mg/Kg | <0.1 | 5.7 |
| 8 | Arsenic (As) mg/Kg | 10.0 | 16 |

While comparing results of the report with the US Industrial Use benchmark, it is observed that the values are significantly low and within the benchmark values. Bioremediation may be carried out to reduce traces of heavy metals in soil and for site clearance. The location may be used as a site for Industrial use like setting-up SWM facilities. However, the solution may be considered after proper soil and groundwater investigation post dump-clearing stage.

### 6.4.6 Leachate Characterization and Quantification

There is no leachate collection/management system in the dumpsite. To address the concern of contamination of the groundwater and soil due to uncontrolled dumping, leachate samples are picked for analysis. The data is presented in **Annexure 4**. The data indicates that the TDS is about 143 mg/l while the suspended solids is about 12 mg/l. The chlorides are 12 mg/l, while the COD, BOD are 150mg/l and 16.4 mg/l respectively. The sample do not indicate any traces of contamination hence the soil is unlikely to be contaminated by heavy metals from waste.

**Table 6.9 Leachate characteristics at Muvattupuzha Dumpsite**

| Parameters tested | Test method | Results |
|---|---|---|
| Sampling Location | N-9 °59'23.582" E +76°33'51.031 | |
| pH | IS 3025 (P) 11 –1983RA2017 | 6.65 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 143 mg/l |

| Parameters tested | Test method | Results |
|---|---|---|
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 12 mg/l |
| Chloride as Cl- | IS 3025 (P) 32 – 1988RA2014 | 24.1 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 150 mg/l |
| B O D (3 days at 27O C) | IS 3025 (P) 44 – 1993 RA 2014 | 16.4 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 11.3 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 8.14 mg/l |
| Phenolic Compound asC6H5OH | IS 3025 (P) 43-1992 RA2014 | BDL(MDL- 0.01 mg/l) |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.54 mg/l |
| Cyanide as CN- | IS 3025(P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | BDL(MDL- 0.01 mg/l) |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

*BDL- Below Detection Level, MDL- Minimum Detection Level*

All the heavy metals are significantly low or below detectable limits. The ground water quality results (presented under ESIA Section indicate that the dumpsite has not caused any major increase in pollution levels and the quality parameters are within the IS10500:2012.

### 6.4.7 Environmental Baseline

The environmental baseline was assessed from the analytical results of air, surface &groundwater, noise and leachate. The samples by M/s Pollutchem Laboratories (P) Ltd. The Environmental baseline was analyzed with reference to the lab analysis reports. The details of analysis & inferences are provided in the ESIA Section in **Annexure 5.**

### 6.4.8 Risk Assessment

**Surface Water:** Dumpsites can release pollutants into nearby surface water bodies through leachate, which is generated when rainwater or other liquids come into contact with the waste. Leachate can contain various contaminants such as heavy metals, organic compounds, and pathogens. Proper containment and management of leachate are essential to prevent water pollution.

The analysis of surface water reveals that all the parameters are within the acceptable limit, except it is slightly acidic and the dissolved oxygen content is less than prescribed limit, so also the BoD is greater than the allowable limit, indicating that the water contains organic load.

**Table 6.10 Risk Assessment- Surface Water**

| Risk Assessment | |
|---|---|
| **source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite -BOD Higher than the acceptable limits |
| **Pathway** | Water/Run off |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | High BOD Indicates the water is highly polluted and it is harmful to ecosystem as fish and other aquatic life may suffocate in oxygen-depleted waters. Also it will contain more Pathogen and make the water unfit for human and animal |

**Ground Water**: Pollutants from dumpsite can infiltrate into underlying groundwater, particularly if the dumpsite is not adequately lined or if waste disposal practices have caused contamination of the soil. Once pollutants enter the groundwater, they can spread over a wide area, affecting drinking water sources. Remediation techniques often focus on preventing or minimizing further groundwater contamination.

The analysis of ground water samples taken at one location reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The pH of the sample analysis is 5.51, which is in a slightly acidic range which can make the water not fit for any industrial purpose as it is more corrosive.

**Table 6.11 Risk Assessment - Ground water**

| Risk Assessment | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite - pH is acidic in nature |
| **Pathway** | Water, Soil |
| **Receptor** | Human, Animals, Aquatic life, and flora fauna |
| **Risk** | Possible risk to human health are;<br>• Diarrhea<br>• Nausea and Vomiting<br>• Abdominal Pain<br>• Weakness<br>• Organ Damage<br>Possible risk to flora<br>It can decrease the availability of plant nutrients, such as phosphorus and molybdenum, and increases the availability of some elements to toxic levels, particularly aluminium and manganese. |

**Air**: Dumpsites may emit pollutants into the air through fire at dumpsites or the release of gases from decomposing organic materials. Airborne pollutants can include particulate matter, volatile organic compounds (VOCs), dioxins, and other hazardous substances. These pollutants can have adverse effects on air quality and human health. Measures to control and mitigate air pollution during dumpsite remediation include covering waste, implementing proper waste management practices viz., dust containment screens, etc. to be ensured.

**Table 6.12 Risk Assessment - Air**

| **Risk Assessment** | |
|---|---|
| **source** | Legacy waste Dumpsite |
| **Pollutant** | Within the limits |
| **Pathway** | Air |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | No Anticipated risk |

**Soil**: Dumpsites can contaminate the surrounding soil with a wide range of pollutants. Hazardous chemicals, heavy metals, and organic compounds can leach from the waste and accumulate in the soil, potentially posing risks to plants, animals, and humans.

**Table 6.13 Risk Assessment - Soil**

| **Risk Assessment** | |
|---|---|
| **source** | Legacy waste Dumpsite |
| **Pollutant** | Heavy metals |
| **Pathway** | soil |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | Possible risk to human health: Soil that contain substance such as heavy metals which may be toxic to human can pass those substances on to human through crop uptake leading to unsafe foods.<br>Possible risks to animals: when farm animals consume the plant grown from contaminated soil it affected the health of animal.<br>Possible risk to flora: Soil pollution may after plant metabolism and reduce crop yield, also the trees and plants that absorb the soil contaminants enter into the food chain. |

**Bioaccumulation in Biota**: Pollutants from dumpsites can enter the food chain and bioaccumulate in plants and animals. As pollutants move up the food chain, their concentrations can increase, leading to potential health risks for humans and wildlife. Remediation efforts include restoring the land and minimizing the exposure of organisms to contaminated environments

**Table 6.14 Risk Assessment - Bioaccumulation in Biota**

| Risk Assessment | |
|---|---|
| source | Legacy waste Dumpsite |
| Pollutant | Leachate and heavy metals |
| Pathway | Air, water and soil |
| Receptor | Human, Animals, flora and fauna |
| Risk | Possible risks to human health, animal flora and fauna<br>Accumulated of contaminants in plants and animals indirectly through food chain affects human health |

## 7.0. Evaluation of Remediation Techniques

Reclamation of existing unmanaged municipal waste dumpsites is becoming a key requirement for ULB's in India as unscientific and unplanned methods of waste disposal in non-engineered landfills have led to lot of environmental issues including soil and ground water contamination, uncontrolled landfill gas emissions into the atmosphere and exposure to disease vectors and scavengers. The Hon'ble NGT seized with these problems across the country has ordered that the respective authorities to remedy this at the earliest.

The dumpsites have emerged as pollution hubs, especially those situated in human settlements, as cities have grown over the decades. It has, therefore, become a necessity for the city authorities to remediate the existing dumpsites in an environmentally sound and economically viable manner.

Remediation of waste dumpsite is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

- Environment Enhancement - reduction in greenhouse gas emissions, soil pollution, ground water contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.
- Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in nearby real state value and rental values.
- Land - Dumpsite land becomes available for utilizing same for the establishment of other Waste Management Facilities.
- Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels.

For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- A total station survey for assessment of volumetric quantity of legacy waste above the ground level.
- Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- History of the site, Physical features of site, as –is/current situation and compositional analysis of waste.
- Baseline study of heavy metals; subsurface soils and water; rainfall; soil type; surface hydrology; topography; wind direction etc. Shall be studied prior to bioremediation.
- Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area.

The details of the remediation techniques for the remediation of the legacy waste dumpsite remediation are as follows:

## 7.1 Bio-Mining – Reclamation/Recovery of Land 100%

Bio- mining is the scientific technique to extract materials of economic interest from legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) and followed by sustainable management through recycling, co-processing, road construction etc for the end use of the recovered fractions.

**Phase 1: Stabilization**

The legacy waste is formed into equal-sized windrows, and which are turned frequently, bio-culture is added and de-odourizer (an odour-controlling agent) sprayed. This phase removes stench, reduces moisture, and eliminates pathogens

**Phase 2: Sorting & Segregation**

In this phase, stabilized legacy waste is sorted/ segregated into bio earth, recyclables, refused derived fuel (RDF) and C&D through series of various sizes of Trommels/ circular rotatory sieves and manpower

**Phase 3: Disposal & Utilization**

In this phase, the non-combustible fractions such as soil and stones are disposed of for further processing into finer aggregates or for earth filling. The combustible fractions are called refuse-derived fuel (RDF) are sent for co-processing in cement industries

| | |
|---|---|
| Salient Features | • 100% land recovery, increase in value of land and available for public use/habitation with immediate effect.<br>• Ensures long-term sustainability and environmentally sound treatment of legacy waste and present lucrative revenue-generating opportunities.<br>• Bio products/aggregates generated from the process can be used as alternative construction material, fuel and recyclables.<br>• Compliance to SWM Rules and NGT orders.<br>• Improvement in aesthetics and quality of life & health. |
| Applicability | • The ownership is well defined.<br>• Working space is available in the dumpsite.<br>• Linkage for utilization by-products is available |

## 7.2 Capping Without Land Recovery

Capping is a scientific process of profiling legacy waste and covering with barrier layers consisting of soil, high density polyethylene (HDPE) liner, gas collection system surface drainage system, and a vegetative cover to minimize the percolation of rainwater into the capped legacy waste.

| | |
|---|---|
| Salient Features | • The capped area becomes a green space and can be developed into parks/recreational areas post monitoring period.<br>• Capped area will be equipped with environmental monitoring systems for post-closure maintenance to monitor pollution levels in groundwater and surface-water sources and air (especially methane emissions) at least 15 years.<br>• Capped area needs to be inspected periodically for settlement due to physical, chemical, and biological transformation, leachate generation, erosion and naturally occurring invasion by deep-rooted vegetation.<br>• Recurring expenditure will be incurred for regular maintenance. On July 17, 2019 the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested bio- mining as environmentally safe and the most preferable approaches to dumpsite remediation.<br>• SWM rules do not permit habitation over it for at least 15 years because of the danger posed by toxic gases release by the waste. |
| Applicability | • Simple & robust, least expensive method among various available technologies |

## 7.3 Capping with Partial Land Recovery

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can be linked to relevant buyers and the inert material will be capped over lower footprints, with well-designed slopes to prevent further degradation of the environment.

The top layer of capped material may also be provided with gas collection wells and pipes to trap the methane and the collected gasses are typically passed through an oxidation layer of passive venting or flared. If the gas quantity is substantial then, power generation may be a possibility. The capped area should have drains to collect the surface water flow as well as any leachate that may be generated. Such leachate is collected and treated in leachate treatment plants.

The reclaimed land may be covered with loamy soil that has plants with high transpiration rates. The plants do not permit the ingress of water into the soil thereby reducing the possibility of leachate generation. The plants and soil microbes also behave as oxidation layer. The soil is compacted and maintained with gentle slopes with 1:3. Contour drains may be provided to divert the water away from the soil thereby preventing ponding of water. The reclaimed land may be covered with solar panels to generate renewable energy during the period of observation following the post closure.

| | |
|---|---|
| Salient Features | • The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.<br>• Ensures short -term sustainability and environmentally sound treatment of legacy waste.<br>• Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area |
| Applicability | • Legacy waste dumpsite area partial of steep terrain, inaccessible ravines and narrow valleys.<br>• Lack of linkage for disposal of inert<br>• Recovery land for public use is not a priority |

## 7.4 Selection of Remediation Option

Selection of the applicable method/type or technique is based on the factors like salient aspects & applicability of remediation types viz., Capping without land recovery, Bio-mining – reclamation/recovery of land 100% & capping with partial land recovery and also available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for 100% land recovery and forward linkages/utilization of processed aggregates/by-products.

Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. Moreover, as per Solid Waste Management Rules, 2016 and several National Green Tribunal (NGT) directives have mandated that urban local bodies opt for bio-mining over capping.

However, after the bioremediation municipality wants to use the land for setting up of Material Collection Facility and Resource Recovery Facility or to be used as deemed fit by ULB. Hence backfilling of the site with bio-earth and inert is planned.

For the execution of dumpsite bio-mining two strategies can be adopted.

- *In-situ biomining*: Here the biomining is carried out within the premises of the dumpsite after clearing the waste and reaching the original ground level or in level with the land adjoining the dumpsite. The advantage is that only the finished products are moved out of the premises, inerts may be used for gradation and filling up low lying areas within the site, or in a newly developed sanitary landfill. This is quite economical when legacy waste quantities are significant. The possibility of gaseous emissions, noise and odor and formation of leachate exist as the processing takes place at the site. The location would remain affected for the time till all waste are processed.
- *Ex Situ biomining:* In small dumpsites, or where the area is a constraint, the entire waste is excavated and taken away to an alternate location for processing. The work in the dumpsite can be completed quickly and the disturbance due to the excavation can be minimized. The cost of transportation of the whole waste adds to the cost of bio-mining. But since the process plant can serve multiple locations, economies of scale may be achieved and may also compensate for the added transport cost.

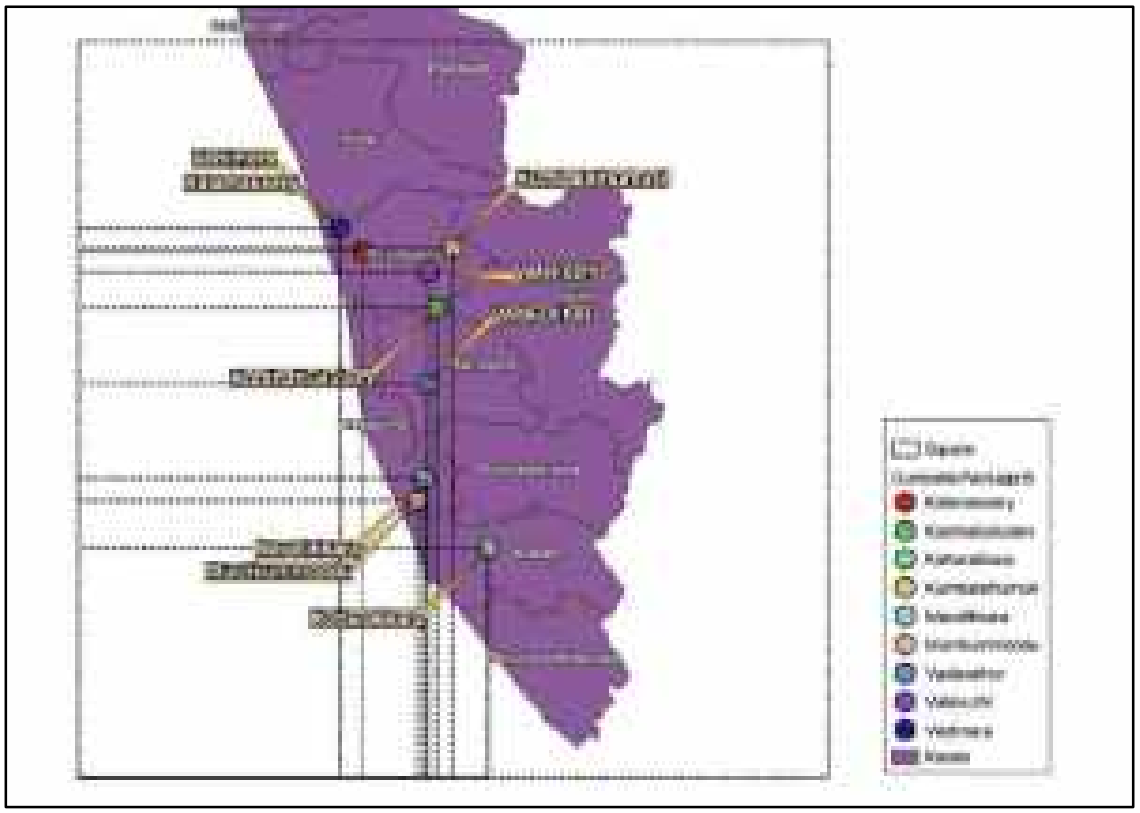


**Figure 7.1 Location of Other Dumpsites nearby**

## 8.0 Technical Description of the Selected Option

### 8.1 Methodology

The legacy waste dumpsite reclamation through bio-mining with recovery of land 100% involves

Phase 1: stabilization

Phase 2: sorting & segregation

Phase 3: disposal & utilization

Phase 4: Back filling of boulders and inerts

### 8.2 Selection of Machineries

The type of machinery, capacity, and type of screens to stabilize of the legacy waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) will depend

on the physical site conditions including quantity & characteristics of legacy waste and utilization of the aggregates/by-products/recovered material.

The type of machinery available for the bio mining are as follows:

- Stationary screening machinery and
- Mobile/compact machinery

### 8.2.1 Stationary Screening Machinery

A Stationary trommel is a specialized piece of equipment used in legacy waste bioremediation processes to separate and classify solid waste materials. It is designed to efficiently screen, and sort different components of the waste based on size and other characteristics. Technical description of a Stationary Trommel used in legacy waste bioremediation are as follows:

- Structure: The Stationary trommel consists of a frame made of steel or other durable materials. It is designed to withstand the harsh conditions of waste treatment facilities. The frame supports a cylindrical drum that is inclined at an angle for optimal material flow.
- Drum: The drum is the main component of the Stationary Trommel and is typically made of perforated metal or mesh. It is cylindrical in shape and rotates on its axis using a motorized drive system. The drum's 3- 5 mtr diameter and 10 mtr length can vary depending on the specific requirements of the waste treatment process.
- Motor and Drive System: The Stationary Trommel is equipped with a motor and drive system that powers the rotation of the drum. The motor is typically electrically powered and is connected to the drum through a gearbox or direct drive mechanism. The rotational speed of the drum can be adjusted to optimize the screening process
- Inlet and Outlet: The Stationary Trommel has an inlet where the legacy waste is fed into the drum for processing. The waste material enters the drum at one end, typically assisted by a conveyor or loader. The screened waste material is discharged from the opposite end of the drum through an outlet.
- Screening Mechanism: As the drum rotates, the legacy waste inside it is subjected to a combination of tumbling and rolling actions. The perforated drum allows smaller-sized particles and materials to pass through, while larger items such as bulky waste, debris, and contaminants are retained inside the drum. The drum's perforation size can be customized to achieve the desired separation efficiency.
- Waste Sorting: The Stationary Trommel facilitates the separation of different components within the legacy waste. It effectively segregates organic waste, inert materials, recyclables, and other categories based on their size and physical properties. This sorting process prepares the waste for further treatment or disposal.

### 8.2.2 Mobile/Compact Screening Machinery

The Mobile Trommel is a technical apparatus utilized in legacy waste bioremediation processes. Its primary function is to separate and sort various types of waste materials, such as solid waste and organic matter, for effective bioremediation

***Structure***: The trommel consists of a cylindrical drum, typically made of heavy-duty metal, which is inclined at a slight angle. The drum is supported by a framework and set in motion by a motor or engine, causing it to rotate slowly. The rotation of the drum allows the waste materials to be fed into the trommel at one end, while simultaneously moving the materials along its length. Large screening area (9.5 sq m). Helps in good quality segregation & high productivity

***Screening Mechanism***: The Mobile Trommel incorporates various mechanical features to facilitate waste separation. As the waste enters the drum, it encounters a series of screens or perforations arranged along the length of the drum. These screens have different mesh sizes, which allow for the separation of different-sized particles. The smaller particles, such as sand or fine soil, pass through the screens and fall through openings at the bottom of the trommel, while larger materials, such as plastics or larger debris, are retained and carried along by the rotation of the drum.

***Separation System***: Additionally, the Mobile Trommel may be equipped with paddles or lifters mounted inside the drum. These paddles help to agitate and tumble the waste materials, assisting in the separation process by ensuring proper contact between the waste and the screens. They also help to break up clumps or aggregates, aiding in the release of trapped organic matter. Four different screen inclination angles for operations between 20°-35° are available for selection provides flexibility.

***Treatment Process***: In the context of legacy waste bioremediation, the Mobile Trommel plays a crucial role in preparing the waste for subsequent treatment steps. By separating the waste into different fractions based on particle size, it allows for targeted bioremediation processes. For example, the fine fraction may be subjected to aerobic or anaerobic composting, while the larger fraction can undergo mechanical or physical treatments.

***Transport***: Quick and easy folding of conveyor helps in quick setup time.

***Discharge height***: Wider conveyor and higher discharge heights help in making bigger stockpile and eliminates the frequent loader usages

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land 100%) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of

stabilized legacy waste into aggregates/by- products as per the requirements of the utilization/forward linkage.

Based on the detailed assessment of the selection parameters listed above, the site conditions, legacy waste characteristics, statutory requirements etc, stationary trommel machine shall be the optimum screening machinery It may be noted that the contractor is required to propose and arrange for all necessary requirements to complete the works in the stipulated time and standards

## 8.3 System Requirements

The following are the infrastructural facilities required for setting up of machineries and equipment in biomining of a dumpsite: These are required irrespective of the option of in-situ or ex-situ processing.

- Fencing and secure entrance gate
- Security and reception office
- Weighing bridge
- Records room
- Laboratory
- Medical room
- Workers' area
- Parking for vehicles (heavy earth equipment, trucks, etc.) with tire washing facility.
- Administrative building
- Fire control unit
- Toilet–bath complex, with personnel protection equipment (PPE) storage room)
- Overhead water tank
- Leachate collection and treatment unit
- Environmental monitoring unit
- Segregation and processing area
- Temporary storage area for rejects, domestic hazardous waste and sanitary waste
- Material storage area
- Waste drying and windrow area.
- DG set

The total area required is about 900 sqm in an in-situ biomining plant. Temporary construction power at 440V needs to be obtained from KSEB. This can be easily availed as there is an existing electrical infrastructure passing through the site. A 440V, 125KVA electrical line

needs to be established for the project. Water storage tanks needs to be provided for the duration of the project. The water may be supplied by tankers. Labour will reside in Muvattupuzha and commute daily to the site, hence no labour sheds are envisaged during this project. The requirements are only indicative and the contractor is required to propose own design and capacity to complete the works in the stipulated time and standards.

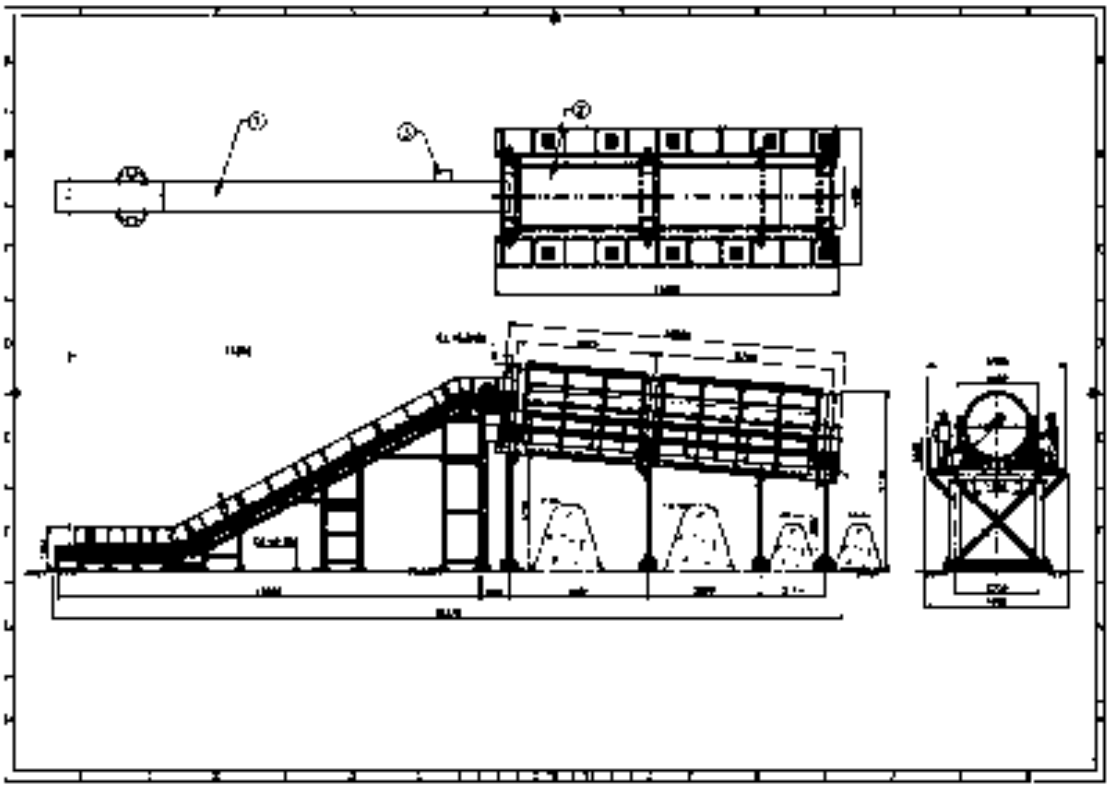


**Figure 8.1 Schematic of the Segregation System**

## 8.4 Site Reclamation Requirement

As detailed under section 6, the Muvattupuzha Dumpsite has waste spread of approx.3.2 acres of the 5.47 acres of land with a max of waste dump height 2.7m from the ground level. Estimated volume of waste above the ground level is: 31,995.18 cum which will be around 28,923.64 MT by taking density as 0.904 T/cum. *(Source: Topographical survey result for the Muvattupuzha Dumpsite conducted in the year 2022 by ULB)*

In the borehole investigation it was ascertained that the depth of waste column below ground level is 5.5.m and the quantity of waste below ground level is estimated 23,741.48 Cum as detailed under section 6. *(Source: Borehole investigation survey conducted by KSWMP through Matter Labs for the Muvattupuzha Dumpsite in June 2023)*

Since the ULB intends to use the land recovered after bioremediation, backfilling of the bio-earth and inert material obtained after the biomining is proposed. Land shall be reclaimed i.e.

all the legacy waste will be removed till it reaches the surface of the earth/ soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the bidder to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to bi-weekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site.

## 9.0 Scope of Disposal Including Location of Disposal for RDF, Bio Soils, Inert etc

### 9.1 Utilization of By Products

The details of the utilization of aggregates/by–products screened out by processing of the stabilized legacy waste are provided in the table below

**Table 9.1 By Product Composition**

| By–products | Percentage Composition | Quantity (Cum) | Utilization/Linkage/Usage |
|---|---|---|---|
| RDF | 8.81 | 4911.95 | RDF will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel. |
| Recyclable | 0.80 | 444.11 | Recyclables will be sold to authorized recyclers |
| Inert | 49.80 | 27755.69 | Can be utilized for filling at the site itself |
| Compost/ Soil Enricher | 40.60 | 22629.08 | Can be used as a soil enricher and given to farmers. The same cannot be sold as fertilizer unless it is enriched with carbon content to meet the standards suggested by FCO for city compost |

The **Table 9.1** details the expected recovered items in line with the investigation results present. However, during the execution stage, the bidder is required to analyse each recovered fraction at least every 15 days and report submitted to the concerned authority. It is to be noted that the RFB document should cover necessary clause in this regard.

The screened compost materials having size less than 4 mm shall be heaped to form windrows, the compost should be enriched to the FCO standards and its amendments from time to time. The materials shall be tested for carbon content and NPK values during execution of works, the materials may be sold to farmers depending on the test outcomes. If the compost materials

are not meeting with the standards, the same shall be used as bio-earth/ soil enricher for refilling within site itself.

Inert is coarse fraction (10mm to -35mm) received from the landfill mining of MSW. It is comprising stones, construction debris, ceramics, some decomposed organic matter. This is helpful in backfilling in the site or can be used as a subgrade material for highways, low land filling. It can also be used as cover for landfills.

RDF / SCF consists largely of combustible components of such wastes, as non-recyclable plastics (not including PVC), paper cardboard, cotton, labels, and other corrugative materials. These fractions are separated by different processing steps, such as screening, air classification, ballistic separation, separation of ferrous and non-ferrous materials, glass, stones and other foreign materials and sometimes shredding into a uniform size, in order to produce a homogeneous material which can be used as substitute for fossil fuels in e.g. cement plants, lime plants, coal fired power plants or as reduction agent in steel furnaces. The calorific value of the RDF should be higher than 1500kcal/kg for co-processing.

The RDF fraction from the site, once dried and shredded can be compacted and carried for disposal to RDF / SCF power plants or cement factories which can use this material in their kiln for burning if it meets the specification for SC/RDF.

The nearest cement Industry that can accept the RDF / SCF from Muvattupuzha City is located near Trichy, Tamil Nadu at a distance of 365 kms from the Dumpsite site. The other sites are at Karnataka between 740km to 1074km, while cements plants at Andhra are at 740km to 900kms.

**Table 9.2 Distance to potential RDF / SCF users**

| Name of the cement plant | Location | State | Distance from Kochi (KM) |
|---|---|---|---|
| Dalmia Bharath | Ariyalur | Tamilnadu | 458 |
| Dalmia Bharath | Dalmiapuram | Tamilnadu | 424 |
| ACC | Wadi | Karnataka | 1,075 |
| Chettinad | Karikazhi | Tamilnadu | 315 |
| Chettinad | Kallur | Tamilnadu | 386 |
| Dalmia Bharath | Belagavi | Karnataka | 956 |
| JK | Muddapur | Karnataka | 965 |
| Dalmia Bharath | Kadapa | Karnataka | 739 |
| Bharathi VICAT | Kalburgi | Karnataka | 1,074 |
| JSW | Kurnool | Andhra Pradesh | 901 |
| Bharathi VICAT | Kadapa | Andhra Pradesh | 739 |
| Ultratech | Tadipatri | Andhra Pradesh | 815 |
| Zuari | Yerraguntla | Andhra Pradesh | 877 |

## 10. 0 Estimated Project Cost

The details of the estimated cost for bio-mining the legacy waste dumpsite is provided in the table below:

**Table 10.1 Details of Estimated Project Cost**

| Sl. No. | Activity | Rate/ m3 | Quantity (m3) | Amount (INR) |
|---|---|---|---|---|
| 1 | **Bio-mining Operations** | | | |
| a | Processing the Waste | [redacted] | [redacted] | [redacted] |
| 2 | **Disposal Cost** | | | |
| a | Disposal of RDF | [redacted] | [redacted] | [redacted] |
| b | Disposal of Compost/ Soil enricher | [redacted] | [redacted] | [redacted] |
| c | Sale of recyclables | [redacted] | [redacted] | [redacted] |
| d | Disposal of Inert | [redacted] | [redacted] | [redacted] |
| | Total | | | [redacted] |
| | E& S Safeguards from ESIA | | | [redacted] |
| | Contractors Profit and Overheads at 15% | | | [redacted] |
| | Net Cost | | | [redacted] |
| | Average Cost Index for Kerala based on DSR 2018 is –1.35 at present. Considering the same, the Grand Total | | | [redacted] |
| | Cost per m3 | | | [redacted] |

*Note: It is to be noted that the total quantity of the waste is assessed based on the investigation test results and variation in the quantity of the same is expected during the execution stage. Hence RFB should include sufficient clauses to incorporate this expected quantity variation under the rate quoted by the contractor.*

## 10.1 Revenue from the Project

The anticipated sources of revenue from the processing of the legacy waste dumpsite are by sale Bio earth & C&D waste, organic compost, RDF and recyclables. But due to the following reasons mentioned below no revenue from the project is considered

- RDF is utilized as fuel (co – processing) in the cement industries, presently most cement industries are only accepting the RDF at free cost and transportation cost to be borne by the ULB/ contractor.
- The uncertainty of quantity and quality of the recyclables from legacy dumpsite due to burnt or crushed or disintegrated, rusted and additional money is required for cleaning of the recyclables for saleable.
- Paucity of time and limited storage space.

## 10.2 Funding for Project

The estimated cost of [redacted] for the project Dumpsite Remediation. The sources and funding pattern is given below:

**Table 10.2 Sources of funds in Crores**

| Sl no | Item wise funding pattern | | | |
|---|---|---|---|---|
| | Item | External (70%) (INR) | State Govt (30%) (INR) | Total Cost (INR) |
| 1 | Dumpsite remediation for the Muvattupuzha | [redacted] | [redacted] | [redacted] |

## 11.0 Project Implementation Plan

Muvattupuzha Municipality intends to complete this project as early as possible. However, considering the time required for mobilisation, installation, sieving and handling recoverable etc, a time frame of about 05- 06 months is considered.

## 11.1 Timeline

The broad timeline for the execution of this project is given below.

**Table 11.1 Project Timeline**

| TIMELINE CHART FOR EXECUTION | | | | | | | |
|---|---|---|---|---|---|---|---|
| S. No. | Task Name | M 1 | M 2 | M 3 | M 4 | M 5 | M 6 |
| 1 | Planning & Mobilization | ■ | | | | | |
| 2 | Foundation & Civil Works (Cover Shed installation) for machineries, Hiring & Installation of Machineries, Electrical Works | ■ | | | | | |
| 3 | Excavation of Legacy Waste | | ■ | ■ | | | |
| 4 | Site Development for Windrows & Leachate Collection | | | ■ | ■ | | |
| 5 | Windrow Formation & Spraying of Bio culture | | | | ■ | ■ | |
| 6 | Sieving Operations | | | | | ■ | ■ |
| 7 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | | | | ■ | ■ |
| 8 | Project Closure Activities:<br>Levelling of Reclaimed Land using Bio-soil<br>Handover the site to the ULB<br>Closure Report Submission to ULB, | | | | | | ■ |

**Timeline is indicative*

## 11.2 Contract Model

***Execution Method:***

Design, Build, Operate and disposal/Management of by-products/aggregates with -zero residues and 100% land recovery. The work shall be carried out in compliance with SWM Rules 2016 and CPCB Guidelines for the disposal of legacy waste 2019.

***Working Model***

- 100% work to outsourced to selected private contractor
- TSC will assess the quantity of waste and the ULB will hand over the land for setting up the facility to the Contractor.
- Electricity connection to be under contractor's scope.
- Electricity charges for the usage of the plant to be paid by contractor
- ULB may facilitate the disposal/Utilization of By-products and contractor is responsibility for disposal of RDF, recyclables, and aggregates.

*Note: The authority has put stringent selection criteria and it is expected that the onboarded contractor has sufficient experience and qualified technically to avoid contract failure. The client will have a proactive contract management and monitoring system in place to address any potential issues for successful completion of the contract*

## 12 Benefits of the Project

The project benefits of dumpsite remediation at Muvattupuzha are:

- Reclamation of Land: An area of 5.47 acres will be reclaimed which can be used for resetting SWM facilities or any other use deemed fit by the ULB.
- Environmental Protection: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By cleaning up contaminated sites, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity
- Health Improvement: Remediation projects reduce these risks, leading to improved public health outcomes and a reduction in waterborne and airborne diseases.
- Enhanced Water Quality: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to safe drinking water.
- Aesthetic and Social Benefits: Remediation of legacy waste dumpsite can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents. Uncontrolled waste dumping will be stopped.
- Operational & Life cycle Aspects - Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through a bio-mining process.

## 13. Conclusion

- The activities of the bio-mining will require 5-6 months. An area of **5.47 acres** will be reclaimed and will be used for setting up other solid waste management facilities in future.
- The land will be reclaimed and recovered through the biomining process, and this will be done by ensuring environmental safeguards.
- For the optimum screening of the **55,736.66 m3** of legacy waste, mobile / compact screening machinery shall be used.
- Favourable site conditions for bio-mining:
  - Optimum width of the road is available for movement of the vehicles.
  - Electrical power infrastructure viz., power lines & electrical transformer is available adjacent to the boundary of the dumpsite.
  - Piped water supply is available at the dumpsite.
- The project activity requires "Site Authorization, Consent to Establish and Consent to Operate" from KSPCB
- The implementation/execution of the project activities shall be conforming to SWM Rules 2016, CPCB 2018 guidelines for legacy waste management, NGT orders, KSPCB norms, World Bank guidelines and KSWMP ESMF and other regulatory rules & norms Environmental & Social safeguards:
  - The project attracts E2 Environmental category based on the project activities and status of the environment baseline.
  - Site specific Environmental Assessment and Environmental Management Plan has been developed.
  - The project attracts moderate risk social category based on the social mapping & transect walk to understand the settlements/habitations/establishments etc., and consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.
- Total cost of the project is [redacted]

# Annexures

| | |
|---|---|
| Annexure 1 | Topographical Survey Report |
| Annexure 2 | Geotechnical Survey Report |
| Annexure 3 | Waste Characterization Report |
| Annexure 4 | Waste & Environmental- baseline assessment reports |
| Annexure 5 | Environmental & Social Impact Assessment Report |
| Annexure 6 | Site Plan |
| Annexure 7 | Operation Plan |

| Box No. | Ground Elevations | Average Ground | Ground Box Area | Formation Elevations | Average Formation | Formation Box Area | Cutting Depth | Area | Volume | Filling Height | Area | Volume |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 94.105,94.106,94.103,94.105 | 94.106 | 0.005 | 94.778,94.789,94.776,94.778 | 94.780 | 0.005 | | | | 0.674 | 0.005 | 0.003 |
| 2 | 94.106,94.263,93.992,93.929,94.103,94.103 | 94.083 | 12.864 | 94.789,95.367,94.831,94.685,94.776,94.776 | 94.871 | 12.864 | | | | 0.788 | 12.864 | 10.137 |
| 3 | 94.263,94.418,94.294,94.293,93.992,93.992 | 94.209 | 15.658 | 95.367,95.809,95.261,95.262,94.831,94.831 | 95.227 | 15.658 | | | | 1.018 | 15.658 | 15.940 |
| 4 | 94.418,94.573,94.569,94.294,94.294 | 94.429 | 5.790 | 95.809,95.307,95.3,95.261,95.261 | 95.388 | 5.790 | | | | 0.959 | 5.790 | 5.553 |
| 5 | 94.573,94.578,94.569,94.569 | 94.572 | 0.007 | 95.307,95.31,95.3,95.3 | 95.304 | 0.007 | | | | 0.732 | 0.007 | 0.005 |
| 6 | 94.149,94.306,94.108,94.105,94.149 | 94.164 | 12.584 | 94.751,95.195,94.789,94.778,94.751 | 94.853 | 12.584 | | | | 0.689 | 12.584 | 8.670 |
| 7 | 94.306,94.465,94.263,94.108 | 94.286 | 25.000 | 95.195,95.645,95.367,94.789 | 95.249 | 25.000 | | | | 0.963 | 25.000 | 24.075 |
| 8 | 94.465,94.625,94.418,94.263 | 94.443 | 25.000 | 95.645,95.986,95.809,95.367 | 95.702 | 25.000 | | | | 1.259 | 25.000 | 31.475 |
| 9 | 94.625,94.773,94.573,94.418 | 94.597 | 25.000 | 95.986,95.94,95.307,95.809 | 95.761 | 25.000 | | | | 1.164 | 25.000 | 29.100 |
| 10 | 94.773,94.829,94.844,94.578,94.578,94.573 | 94.696 | 19.965 | 95.94,95.827,95.575,95.31,95.31,95.307 | 95.545 | 19.965 | | | | 0.849 | 19.965 | 16.950 |
| 11 | 94.829,94.885,94.893,94.921,94.844,94.844 | 94.869 | 8.884 | 95.827,95.663,95.66,95.687,95.575,95.575 | 95.665 | 8.884 | | | | 0.796 | 8.884 | 7.072 |
| 12 | 94.885,94.888,94.893,94.893 | 94.890 | 0.023 | 95.663,95.654,95.66,95.66 | 95.659 | 0.023 | | | | 0.769 | 0.023 | 0.018 |
| 13 | 94.17,94.316,94.149,94.15,94.17 | 94.191 | 11.310 | 94.931,94.977,94.751,94.764,94.931 | 94.871 | 11.310 | | | | 0.680 | 11.310 | 7.691 |
| 14 | 94.316,94.406,94.306,94.149,94.149,94.149 | 94.246 | 24.998 | 94.977,95.28,95.195,94.751,94.751,94.751 | 94.951 | 24.998 | | | | 0.705 | 24.998 | 17.624 |
| 15 | 94.406,94.462,94.465,94.306 | 94.410 | 25.000 | 95.28,95.73,95.645,95.195 | 95.462 | 25.000 | | | | 1.052 | 25.000 | 26.300 |
| 16 | 94.462,94.518,94.625,94.465 | 94.518 | 25.000 | 95.73,95.979,95.986,95.645 | 95.835 | 25.000 | | | | 1.317 | 25.000 | 32.925 |
| 17 | 94.518,94.575,94.773,94.625 | 94.623 | 25.000 | 95.979,95.933,95.94,95.986 | 95.960 | 25.000 | | | | 1.337 | 25.000 | 33.425 |
| 18 | 94.575,94.632,94.829,94.773 | 94.702 | 25.000 | 95.933,95.882,95.827,95.94 | 95.896 | 25.000 | | | | 1.194 | 25.000 | 29.850 |
| 19 | 94.632,94.71,94.885,94.829 | 94.764 | 25.000 | 95.882,95.779,95.663,95.827 | 95.788 | 25.000 | | | | 1.024 | 25.000 | 25.600 |
| 20 | 94.71,94.789,94.789,94.888,94.888,94.885 | 94.825 | 13.928 | 95.779,95.553,95.541,95.654,95.654,95.663 | 95.641 | 13.928 | | | | 0.816 | 13.928 | 11.365 |
| 21 | 94.789,94.794,94.789,94.789 | 94.790 | 0.071 | 95.553,95.539,95.541,95.541 | 95.543 | 0.071 | | | | 0.753 | 0.071 | 0.053 |
| 22 | 94.094,94.158,94.172,94.094 | 94.130 | 9.480 | 95.113,95.156,94.948,95.113 | 95.083 | 9.480 | | | | 0.953 | 9.480 | 9.034 |
| 23 | 94.158,94.236,94.316,94.17,94.172,94.172 | 94.204 | 24.899 | 95.156,95.207,94.977,94.931,94.948,94.948 | 95.028 | 24.899 | | | | 0.824 | 24.899 | 20.517 |
| 24 | 94.236,94.314,94.406,94.316 | 94.318 | 25.000 | 95.207,95.366,95.28,94.977 | 95.208 | 25.000 | | | | 0.890 | 25.000 | 22.250 |
| 25 | 94.314,94.392,94.462,94.406 | 94.394 | 25.000 | 95.366,95.816,95.73,95.28 | 95.548 | 25.000 | | | | 1.154 | 25.000 | 28.850 |
| 26 | 94.392,94.471,94.518,94.462 | 94.461 | 25.000 | 95.816,95.972,95.979,95.73 | 95.874 | 25.000 | | | | 1.413 | 25.000 | 35.325 |
| 27 | 94.471,94.549,94.575,94.518 | 94.528 | 25.000 | 95.972,95.924,95.933,95.979 | 95.952 | 25.000 | | | | 1.424 | 25.000 | 35.600 |
| 28 | 94.549,94.627,94.632,94.575 | 94.596 | 25.000 | 95.924,95.871,95.882,95.933 | 95.903 | 25.000 | | | | 1.307 | 25.000 | 32.675 |
| 29 | 94.627,94.705,94.71,94.632 | 94.669 | 25.000 | 95.871,95.819,95.779,95.882 | 95.838 | 25.000 | | | | 1.169 | 25.000 | 29.225 |
| 30 | 94.705,94.783,94.789,94.71 | 94.747 | 25.000 | 95.819,95.733,95.553,95.779 | 95.721 | 25.000 | | | | 0.974 | 25.000 | 24.350 |
| 31 | 94.783,94.846,94.798,94.794,94.794,94.789 | 94.801 | 11.314 | 95.733,95.587,95.539,95.539,95.539,95.553 | 95.582 | 11.314 | | | | 0.781 | 11.314 | 8.836 |
| 32 | 94.179,94.227,94.11,94.145,94.179 | 94.168 | 8.092 | 95.174,95.474,95.146,95.193,95.174 | 95.232 | 8.092 | | | | 1.064 | 8.092 | 8.610 |
| 33 | 94.227,94.287,94.158,94.094,94.11,94.11 | 94.165 | 24.638 | 95.474,95.385,95.156,95.113,95.146,95.146 | 95.237 | 24.638 | | | | 1.072 | 24.638 | 26.412 |
| 34 | 94.287,94.347,94.236,94.158 | 94.257 | 25.000 | 95.385,95.436,95.207,95.156 | 95.296 | 25.000 | | | | 1.039 | 25.000 | 25.975 |
| 35 | 94.347,94.407,94.314,94.236 | 94.326 | 25.000 | 95.436,95.487,95.366,95.207 | 95.374 | 25.000 | | | | 1.048 | 25.000 | 26.200 |
| 36 | 94.407,94.466,94.392,94.314 | 94.396 | 25.000 | 95.487,95.901,95.816,95.366 | 95.643 | 25.000 | | | | 1.248 | 25.000 | 31.200 |
| 37 | 94.466,94.526,94.471,94.392 | 94.464 | 25.000 | 95.901,95.965,95.972,95.816 | 95.914 | 25.000 | | | | 1.450 | 25.000 | 36.250 |
| 38 | 94.526,94.586,94.549,94.471 | 94.533 | 25.000 | 95.965,95.913,95.924,95.972 | 95.944 | 25.000 | | | | 1.411 | 25.000 | 35.275 |
| 39 | 94.586,94.646,94.627,94.549 | 94.602 | 25.000 | 95.913,95.903,95.871,95.924 | 95.903 | 25.000 | | | | 1.301 | 25.000 | 32.525 |
| 40 | 94.646,94.705,94.705,94.627 | 94.671 | 25.000 | 95.903,96.068,95.819,95.871 | 95.915 | 25.000 | | | | 1.244 | 25.000 | 31.100 |
| 41 | 94.705,94.777,94.783,94.705 | 94.742 | 25.000 | 96.068,95.842,95.733,95.819 | 95.865 | 25.000 | | | | 1.123 | 25.000 | 28.075 |
| 42 | 94.777,94.855,94.859,94.846,94.846,94.783 | 94.828 | 24.400 | 95.842,95.694,95.6,95.587,95.587,95.733 | 95.674 | 24.400 | | | | 0.846 | 24.400 | 20.642 |
| 43 | 94.855,94.897,94.859,94.859 | 94.868 | 4.968 | 95.694,95.637,95.6,95.6 | 95.633 | 4.968 | | | | 0.765 | 4.968 | 3.801 |
| 44 | 94.266,94.319,94.193,94.266 | 94.261 | 8.838 | 95.131,95.449,95.167,95.131 | 95.219 | 8.838 | | | | 0.958 | 8.838 | 8.467 |
| 45 | 94.319,94.381,94.227,94.179,94.193,94.193 | 94.249 | 24.581 | 95.449,95.818,95.474,95.174,95.167,95.167 | 95.375 | 24.581 | | | | 1.126 | 24.581 | 27.678 |
| 46 | 94.381,94.443,94.287,94.227 | 94.335 | 25.000 | 95.818,96.031,95.385,95.474 | 95.677 | 25.000 | | | | 1.342 | 25.000 | 33.550 |
| 47 | 94.443,94.505,94.347,94.287 | 94.395 | 25.000 | 96.031,95.728,95.436,95.385 | 95.645 | 25.000 | | | | 1.250 | 25.000 | 31.250 |
| 48 | 94.505,94.566,94.407,94.347 | 94.456 | 25.000 | 95.728,95.717,95.487,95.436 | 95.592 | 25.000 | | | | 1.136 | 25.000 | 28.400 |
| 49 | 94.566,94.609,94.466,94.407 | 94.512 | 25.000 | 95.717,95.987,95.901,95.487 | 95.773 | 25.000 | | | | 1.261 | 25.000 | 31.525 |
| 50 | 94.609,94.637,94.526,94.466 | 94.560 | 25.000 | 95.987,95.955,95.965,95.901 | 95.952 | 25.000 | | | | 1.392 | 25.000 | 34.800 |
| 51 | 94.637,94.666,94.586,94.526 | 94.604 | 25.000 | 95.955,96.039,95.913,95.965 | 95.968 | 25.000 | | | | 1.364 | 25.000 | 34.100 |
| 52 | 94.666,94.695,94.646,94.586 | 94.648 | 25.000 | 96.039,96.204,95.903,95.913 | 96.015 | 25.000 | | | | 1.367 | 25.000 | 34.175 |
| 53 | 94.695,94.724,94.705,94.646 | 94.692 | 25.000 | 96.204,96.229,96.068,95.903 | 96.101 | 25.000 | | | | 1.409 | 25.000 | 35.225 |
| 54 | 94.724,94.752,94.777,94.705 | 94.739 | 25.000 | 96.229,95.989,95.842,96.068 | 96.032 | 25.000 | | | | 1.293 | 25.000 | 32.325 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 55 | 94.752,94.781,94.855,94.777 | 94.791 | 25.000 | 95.989,95.749,95.694,95.842 | 95.819 | 25.000 | | | | 1.028 | 25.000 | 25.700 |
| 56 | 94.781,94.81,94.874,94.878,94.897,94.897,94.8 | 94.856 | 21.265 | 95.749,95.604,95.609,95.611,95.637,95.637,95 | 95.649 | 21.265 | | | | 0.793 | 21.265 | 16.863 |
| 57 | 94.81,94.818,94.874,94.874 | 94.844 | 1.308 | 95.604,95.553,95.609,95.609 | 95.593 | 1.308 | | | | 0.749 | 1.308 | 0.980 |
| 58 | 94.471,94.453,94.283,94.302,94.461,94.471 | 94.407 | 7.958 | 95.677,95.984,95.161,95.293,95.781,95.677 | 95.595 | 7.958 | | | | 1.188 | 7.958 | 9.454 |
| 59 | 94.453,94.416,94.319,94.266,94.283,94.283 | 94.337 | 24.770 | 95.984,96.039,95.449,95.131,95.161,95.161 | 95.488 | 24.770 | | | | 1.151 | 24.770 | 28.510 |
| 60 | 94.416,94.379,94.361,94.319 | 94.374 | 25.000 | 96.039,96.161,95.818,95.449 | 95.867 | 25.000 | | | | 1.493 | 25.000 | 37.325 |
| 61 | 94.379,94.342,94.443,94.381 | 94.386 | 25.000 | 96.161,96.53,96.031,95.818 | 96.135 | 25.000 | | | | 1.749 | 25.000 | 43.725 |
| 62 | 94.342,94.373,94.505,94.443 | 94.416 | 25.000 | 96.53,96.507,95.728,96.031 | 96.199 | 25.000 | | | | 1.783 | 25.000 | 44.575 |
| 63 | 94.373,94.401,94.566,94.505 | 94.461 | 25.000 | 96.507,96.204,95.717,95.728 | 96.039 | 25.000 | | | | 1.578 | 25.000 | 39.450 |
| 64 | 94.401,94.43,94.609,94.566 | 94.502 | 25.000 | 96.204,96.011,95.987,95.717 | 95.980 | 25.000 | | | | 1.478 | 25.000 | 36.950 |
| 65 | 94.43,94.459,94.637,94.609 | 94.534 | 25.000 | 96.011,96.175,95.955,95.987 | 96.032 | 25.000 | | | | 1.498 | 25.000 | 37.450 |
| 66 | 94.459,94.487,94.666,94.637 | 94.562 | 25.000 | 96.175,96.34,96.039,95.955 | 96.127 | 25.000 | | | | 1.565 | 25.000 | 39.125 |
| 67 | 94.487,94.516,94.695,94.666 | 94.591 | 25.000 | 96.34,96.504,96.204,96.039 | 96.272 | 25.000 | | | | 1.681 | 25.000 | 42.025 |
| 68 | 94.516,94.545,94.724,94.695 | 94.620 | 25.000 | 96.504,96.375,96.229,96.204 | 96.328 | 25.000 | | | | 1.708 | 25.000 | 42.700 |
| 69 | 94.545,94.573,94.752,94.724 | 94.648 | 25.000 | 96.375,96.136,95.989,96.229 | 96.182 | 25.000 | | | | 1.534 | 25.000 | 38.350 |
| 70 | 94.573,94.602,94.781,94.752 | 94.677 | 25.000 | 96.136,96.036,95.749,95.989 | 95.977 | 25.000 | | | | 1.300 | 25.000 | 32.500 |
| 71 | 94.602,94.631,94.81,94.781 | 94.706 | 25.000 | 96.036,95.715,95.604,95.749 | 95.776 | 25.000 | | | | 1.070 | 25.000 | 26.750 |
| 72 | 94.631,94.66,94.683,94.618,94.818,94.81 | 94.736 | 17.288 | 95.715,95.416,95.417,95.553,95.553,95.604 | 95.543 | 17.288 | | | | 0.807 | 17.288 | 13.951 |
| 73 | 94.66,94.663,94.683,94.683 | 94.672 | 0.169 | 95.416,95.397,95.417,95.417 | 95.412 | 0.169 | | | | 0.740 | 0.169 | 0.125 |
| 74 | 94.806,94.813,94.626,94.806 | 94.763 | 2.447 | 95.743,95.976,95.629,95.743 | 95.773 | 2.447 | | | | 1.010 | 2.447 | 2.471 |
| 75 | 94.813,94.83,94.492,94.574,94.626,94.626 | 94.660 | 19.356 | 95.976,95.589,95.647,95.677,95.629,95.629 | 95.841 | 19.356 | | | | 1.181 | 19.356 | 22.859 |
| 76 | 94.83,94.848,94.453,94.471,94.492,94.492 | 94.598 | 24.807 | 96.589,96.909,95.984,95.677,95.647,95.647 | 96.075 | 24.807 | | | | 1.477 | 24.807 | 36.640 |
| 77 | 94.848,94.82,94.416,94.453 | 94.634 | 25.000 | 96.909,96.979,96.039,95.984 | 96.478 | 25.000 | | | | 1.844 | 25.000 | 46.100 |
| 78 | 94.82,94.783,94.379,94.416 | 94.599 | 25.000 | 96.979,97.043,96.161,96.039 | 96.556 | 25.000 | | | | 1.957 | 25.000 | 48.925 |
| 79 | 94.783,94.746,94.342,94.379 | 94.562 | 25.000 | 97.043,97.099,96.53,96.161 | 96.708 | 25.000 | | | | 2.146 | 25.000 | 53.650 |
| 80 | 94.746,94.709,94.373,94.342 | 94.542 | 25.000 | 97.099,97.242,96.507,96.53 | 96.845 | 25.000 | | | | 2.303 | 25.000 | 57.575 |
| 81 | 94.709,94.672,94.401,94.373 | 94.539 | 25.000 | 97.242,96.995,96.204,96.507 | 96.737 | 25.000 | | | | 2.198 | 25.000 | 54.950 |
| 82 | 94.672,94.635,94.43,94.401 | 94.534 | 25.000 | 96.995,96.722,96.011,96.204 | 96.483 | 25.000 | | | | 1.949 | 25.000 | 48.725 |
| 83 | 94.635,94.598,94.459,94.43 | 94.530 | 25.000 | 96.722,96.476,96.175,96.011 | 96.346 | 25.000 | | | | 1.816 | 25.000 | 45.400 |
| 84 | 94.598,94.561,94.487,94.459 | 94.526 | 25.000 | 96.476,96.64,96.34,96.175 | 96.408 | 25.000 | | | | 1.882 | 25.000 | 47.050 |
| 85 | 94.561,94.524,94.516,94.487 | 94.522 | 25.000 | 96.64,96.762,96.504,96.34 | 96.562 | 25.000 | | | | 2.040 | 25.000 | 51.000 |
| 86 | 94.524,94.487,94.545,94.516 | 94.518 | 25.000 | 96.762,96.522,96.375,96.504 | 96.541 | 25.000 | | | | 2.023 | 25.000 | 50.575 |
| 87 | 94.487,94.45,94.573,94.545 | 94.514 | 25.000 | 96.522,96.556,96.136,96.375 | 96.397 | 25.000 | | | | 1.883 | 25.000 | 47.075 |
| 88 | 94.45,94.423,94.602,94.573 | 94.512 | 25.000 | 96.556,96.572,96.036,96.136 | 96.325 | 25.000 | | | | 1.813 | 25.000 | 45.325 |
| 89 | 94.423,94.452,94.631,94.602 | 94.527 | 25.000 | 96.572,96.131,95.715,96.036 | 96.113 | 25.000 | | | | 1.566 | 25.000 | 39.150 |
| 90 | 94.452,94.481,94.66,94.631 | 94.556 | 25.000 | 96.131,95.683,95.416,95.715 | 95.736 | 25.000 | | | | 1.180 | 25.000 | 29.500 |
| 91 | 94.481,94.507,94.663,94.663,94.66 | 94.595 | 12.787 | 95.683,95.242,95.397,95.397,95.416 | 95.427 | 12.787 | | | | 0.832 | 12.787 | 10.639 |
| 92 | 94.215,94.061,94.074,94.215 | 94.141 | 0.885 | 95.561,95.686,95.534,95.561 | 95.586 | 0.885 | | | | 1.445 | 0.885 | 1.279 |
| 93 | 94.061,94.717,94.683,94.635,94.074,94.074 | 94.374 | 7.207 | 95.686,95.937,95.478,95.489,95.534,95.534 | 95.610 | 7.207 | | | | 1.236 | 7.207 | 8.908 |
| 94 | 94.717,95.067,94.813,94.806,94.829,94.683,94 | 94.800 | 20.470 | 95.937,96.551,95.976,95.743,96.776,95.478,96 | 96.849 | 20.470 | | | | 1.049 | 20.470 | 21.473 |
| 95 | 95.067,95.194,94.83,94.813 | 94.976 | 25.000 | 96.551,97.106,96.589,95.976 | 96.556 | 25.000 | | | | 1.579 | 25.000 | 39.475 |
| 96 | 95.194,95.211,94.848,94.83 | 95.021 | 25.000 | 97.106,97.401,96.909,96.589 | 97.001 | 25.000 | | | | 1.960 | 25.000 | 49.500 |
| 97 | 95.211,95.223,94.82,94.848 | 95.026 | 25.000 | 97.401,97.603,96.979,96.909 | 97.223 | 25.000 | | | | 2.197 | 25.000 | 54.925 |
| 98 | 95.223,95.186,94.783,94.82 | 95.003 | 25.000 | 97.603,97.805,97.043,96.979 | 97.358 | 25.000 | | | | 2.355 | 25.000 | 58.875 |
| 99 | 95.186,95.149,94.746,94.783 | 94.966 | 25.000 | 97.805,97.952,97.099,97.043 | 97.475 | 25.000 | | | | 2.509 | 25.000 | 62.725 |
| 100 | 95.149,95.112,94.709,94.746 | 94.929 | 25.000 | 97.952,97.974,97.242,97.099 | 97.567 | 25.000 | | | | 2.638 | 25.000 | 65.950 |
| 101 | 95.112,95.075,94.672,94.709 | 94.892 | 25.000 | 97.974,97.735,96.995,97.242 | 97.487 | 25.000 | | | | 2.595 | 25.000 | 64.875 |
| 102 | 95.075,95.038,94.635,94.672 | 94.855 | 25.000 | 97.735,97.495,96.722,96.995 | 97.237 | 25.000 | | | | 2.382 | 25.000 | 59.550 |
| 103 | 95.038,95.001,94.598,94.635 | 94.818 | 25.000 | 97.495,97.255,96.476,96.722 | 96.987 | 25.000 | | | | 2.169 | 25.000 | 54.225 |
| 104 | 95.001,94.964,94.561,94.598 | 94.781 | 25.000 | 97.255,96.993,96.64,96.476 | 96.841 | 25.000 | | | | 2.060 | 25.000 | 51.500 |
| 105 | 94.964,94.927,94.524,94.561 | 94.744 | 25.000 | 96.993,96.985,96.762,96.64 | 96.845 | 25.000 | | | | 2.101 | 25.000 | 52.525 |
| 106 | 94.927,94.89,94.487,94.524 | 94.707 | 25.000 | 96.985,97.077,96.522,96.762 | 96.836 | 25.000 | | | | 2.129 | 25.000 | 53.225 |
| 107 | 94.89,94.853,94.45,94.487 | 94.670 | 25.000 | 97.077,97.169,96.556,96.522 | 96.831 | 25.000 | | | | 2.161 | 25.000 | 54.025 |
| 108 | 94.853,94.816,94.423,94.45 | 94.636 | 25.000 | 97.169,96.988,96.572,96.556 | 96.821 | 25.000 | | | | 2.185 | 25.000 | 54.625 |
| 109 | 94.816,94.779,94.452,94.423 | 94.618 | 25.000 | 96.988,96.547,96.131,96.572 | 96.560 | 25.000 | | | | 1.942 | 25.000 | 48.550 |
| 110 | 94.779,94.742,94.481,94.452 | 94.614 | 25.000 | 96.547,96.106,95.683,96.131 | 96.117 | 25.000 | | | | 1.503 | 25.000 | 37.575 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 111 | 94.742,94.705,94.491,94.507,94.507,94.481 | 94.572 | 24.897 | 96.106,95.652,95.236,95.242,96.242,95.683 | 95.527 | 24.897 | | | | 0.955 | 24.897 | 23.777 |
| 112 | 94.705,94.575,94.547,94.491,94.491 | 94.562 | 8.052 | 95.652,95.294,95.266,95.236,95.236 | 95.337 | 8.052 | | | | 0.775 | 8.052 | 6.240 |
| 113 | 94.129,94.108,94.174,94.168,94.129 | 94.141 | 0.467 | 94.86,94.923,94.883,94.855,94.86 | 94.876 | 0.467 | | | | 0.735 | 0.467 | 0.343 |
| 114 | 94.108,93.611,94.242,94.243,94.174,94.174 | 94.092 | 13.347 | 94.923,95.432,95.297,95.286,94.883,94.883 | 95.117 | 13.347 | | | | 1.025 | 13.347 | 13.681 |
| 115 | 93.611,94.367,94.061,94.215,94.242,94.242 | 94.123 | 24.115 | 95.432,95.996,95.686,95.561,95.297,95.297 | 95.545 | 24.115 | | | | 1.422 | 24.115 | 34.292 |
| 116 | 94.367,94.788,94.717,94.061 | 94.483 | 25.000 | 95.996,96.568,95.937,95.686 | 96.047 | 25.000 | | | | 1.564 | 25.000 | 39.100 |
| 117 | 94.788,95.137,95.067,94.717 | 94.927 | 25.000 | 96.568,97.14,96.551,95.937 | 96.549 | 25.000 | | | | 1.622 | 25.000 | 40.550 |
| 118 | 95.137,95.47,95.194,95.067 | 95.217 | 25.000 | 97.14,97.613,97.106,96.551 | 97.102 | 25.000 | | | | 1.885 | 25.000 | 47.125 |
| 119 | 95.47,95.574,95.211,95.194 | 95.362 | 25.000 | 97.613,97.957,97.401,97.106 | 97.519 | 25.000 | | | | 2.157 | 25.000 | 53.925 |
| 120 | 95.574,95.592,95.223,95.211 | 95.400 | 25.000 | 97.957,98.156,97.603,97.401 | 97.779 | 25.000 | | | | 2.379 | 25.000 | 59.475 |
| 121 | 95.592,95.59,95.186,95.223 | 95.396 | 25.000 | 98.156,98.355,97.805,97.603 | 97.980 | 25.000 | | | | 2.582 | 25.000 | 64.550 |
| 122 | 95.59,95.553,95.149,95.186 | 95.370 | 25.000 | 98.355,98.554,97.952,97.805 | 98.167 | 25.000 | | | | 2.797 | 25.000 | 69.925 |
| 123 | 95.553,95.516,95.112,95.149 | 95.333 | 25.000 | 98.554,98.837,97.974,97.952 | 98.329 | 25.000 | | | | 2.996 | 25.000 | 74.900 |
| 124 | 95.516,95.479,95.075,95.112 | 95.296 | 25.000 | 98.837,98.607,97.735,97.974 | 98.288 | 25.000 | | | | 2.992 | 25.000 | 74.800 |
| 125 | 95.479,95.442,95.038,95.075 | 95.259 | 25.000 | 98.607,98.377,97.495,97.735 | 98.053 | 25.000 | | | | 2.794 | 25.000 | 69.850 |
| 126 | 95.442,95.405,95.001,95.038 | 95.222 | 25.000 | 98.377,98.148,97.255,97.495 | 97.819 | 25.000 | | | | 2.597 | 25.000 | 64.925 |
| 127 | 95.405,95.368,94.964,95.001 | 95.185 | 25.000 | 98.148,97.918,96.993,97.255 | 97.579 | 25.000 | | | | 2.394 | 25.000 | 59.850 |
| 128 | 95.368,95.331,94.927,94.964 | 95.148 | 25.000 | 97.918,97.784,96.985,96.993 | 97.420 | 25.000 | | | | 2.272 | 25.000 | 56.800 |
| 129 | 95.331,95.294,94.89,94.927 | 95.111 | 25.000 | 97.784,97.689,97.077,96.985 | 97.384 | 25.000 | | | | 2.273 | 25.000 | 56.825 |
| 130 | 95.294,95.257,94.853,94.89 | 95.074 | 25.000 | 97.689,97.781,97.169,97.077 | 97.429 | 25.000 | | | | 2.355 | 25.000 | 58.875 |
| 131 | 95.257,95.22,94.816,94.853 | 95.037 | 25.000 | 97.781,97.404,96.988,97.169 | 97.336 | 25.000 | | | | 2.299 | 25.000 | 57.475 |
| 132 | 95.22,95.183,94.779,94.816 | 95.000 | 25.000 | 97.404,97.039,96.547,96.988 | 96.995 | 25.000 | | | | 1.995 | 25.000 | 49.875 |
| 133 | 95.183,95.146,94.742,94.779 | 94.963 | 25.000 | 97.039,96.77,96.106,96.547 | 96.615 | 25.000 | | | | 1.652 | 25.000 | 41.300 |
| 134 | 95.146,95.111,94.705,94.742 | 94.926 | 25.000 | 96.77,96.399,95.652,96.106 | 96.232 | 25.000 | | | | 1.306 | 25.000 | 32.650 |
| 135 | 95.111,94.788,94.622,94.575,94.575,94.705 | 94.729 | 23.080 | 96.399,95.566,95.341,95.294,95.294,95.652 | 95.591 | 23.080 | | | | 0.862 | 23.080 | 19.895 |
| 136 | 94.788,94.672,94.622,94.622 | 94.676 | 2.142 | 95.566,95.391,95.341,95.341 | 95.410 | 2.142 | | | | 0.734 | 2.142 | 1.572 |
| 137 | 93.572,93.272,94.108,94.129,93.572 | 93.730 | 8.920 | 94.743,95.144,94.923,94.86,94.743 | 94.883 | 8.920 | | | | 1.153 | 8.920 | 10.285 |
| 138 | 93.272,93.861,93.611,94.108 | 93.713 | 25.000 | 95.144,95.597,95.432,94.923 | 95.274 | 25.000 | | | | 1.561 | 25.000 | 39.025 |
| 139 | 93.861,94.508,94.367,93.611 | 94.087 | 25.000 | 95.597,96.144,95.996,95.432 | 95.792 | 25.000 | | | | 1.705 | 25.000 | 42.625 |
| 140 | 94.508,94.858,94.788,94.367 | 94.630 | 25.000 | 96.144,96.716,96.568,95.996 | 96.356 | 25.000 | | | | 1.726 | 25.000 | 43.150 |
| 141 | 94.858,95.207,95.137,94.788 | 94.997 | 25.000 | 96.716,97.546,97.14,96.568 | 96.992 | 25.000 | | | | 1.995 | 25.000 | 49.875 |
| 142 | 95.207,95.556,95.47,95.137 | 95.343 | 25.000 | 97.546,98.025,97.613,97.14 | 97.581 | 25.000 | | | | 2.238 | 25.000 | 55.950 |
| 143 | 95.556,95.872,95.574,95.47 | 95.618 | 25.000 | 98.025,98.476,97.957,97.613 | 98.018 | 25.000 | | | | 2.400 | 25.000 | 60.000 |
| 144 | 95.872,95.955,95.592,95.574 | 95.748 | 25.000 | 98.476,98.737,98.156,97.957 | 98.331 | 25.000 | | | | 2.583 | 25.000 | 64.575 |
| 145 | 95.955,95.973,95.59,95.592 | 95.778 | 25.000 | 98.737,98.936,98.355,98.156 | 98.546 | 25.000 | | | | 2.768 | 25.000 | 69.200 |
| 146 | 95.973,95.957,95.553,95.59 | 95.768 | 25.000 | 98.936,99.213,98.554,98.355 | 98.764 | 25.000 | | | | 2.996 | 25.000 | 74.900 |
| 147 | 95.957,95.92,95.516,95.553 | 95.736 | 25.000 | 99.213,99.896,98.837,98.554 | 99.125 | 25.000 | | | | 3.369 | 25.000 | 84.225 |
| 148 | 95.92,95.883,95.479,95.516 | 95.699 | 25.000 | 99.896,99.592,98.607,98.837 | 99.233 | 25.000 | | | | 3.534 | 25.000 | 88.350 |
| 149 | 95.883,95.846,95.442,95.479 | 95.662 | 25.000 | 99.592,99.362,98.377,98.607 | 98.985 | 25.000 | | | | 3.323 | 25.000 | 83.075 |
| 150 | 95.846,95.809,95.405,95.442 | 95.625 | 25.000 | 99.362,99.132,98.148,98.377 | 98.755 | 25.000 | | | | 3.130 | 25.000 | 78.250 |
| 151 | 95.809,95.772,95.368,95.405 | 95.588 | 25.000 | 99.132,98.964,97.918,98.148 | 98.540 | 25.000 | | | | 2.952 | 25.000 | 73.800 |
| 152 | 95.772,95.735,95.331,95.368 | 95.551 | 25.000 | 98.964,98.827,97.784,97.918 | 98.373 | 25.000 | | | | 2.822 | 25.000 | 70.550 |
| 153 | 95.735,95.698,95.294,95.331 | 95.514 | 25.000 | 98.827,98.687,97.689,97.784 | 98.247 | 25.000 | | | | 2.733 | 25.000 | 68.325 |
| 154 | 95.698,95.661,95.257,95.294 | 95.477 | 25.000 | 98.687,98.395,97.781,97.689 | 98.138 | 25.000 | | | | 2.661 | 25.000 | 66.525 |
| 155 | 95.661,95.624,95.22,95.257 | 95.440 | 25.000 | 98.395,98.206,97.404,97.781 | 97.947 | 25.000 | | | | 2.507 | 25.000 | 62.675 |
| 156 | 95.624,95.587,95.183,95.22 | 95.403 | 25.000 | 98.206,97.938,97.039,97.404 | 97.647 | 25.000 | | | | 2.244 | 25.000 | 56.100 |
| 157 | 95.587,95.55,95.146,95.183 | 95.366 | 25.000 | 97.938,97.669,96.77,97.039 | 97.354 | 25.000 | | | | 1.988 | 25.000 | 49.700 |
| 158 | 95.55,95.461,95.111,95.146 | 95.317 | 25.000 | 97.669,97.265,96.399,96.77 | 97.025 | 25.000 | | | | 1.708 | 25.000 | 42.700 |
| 159 | 95.461,95.112,94.788,95.111 | 95.118 | 25.000 | 97.265,96.322,95.566,96.399 | 96.388 | 25.000 | | | | 1.270 | 25.000 | 31.750 |
| 160 | 95.112,94.769,94.672,94.672,94.788 | 94.803 | 16.455 | 96.322,95.488,95.391,95.391,95.566 | 95.632 | 16.455 | | | | 0.829 | 16.455 | 13.641 |
| 161 | 92.991,93.389,93.272,93.572,93.548,92.991 | 93.291 | 13.390 | 94.29,94.751,95.144,94.743,94.707,94.29 | 94.654 | 13.390 | | | | 1.363 | 13.390 | 18.251 |
| 162 | 93.389,94.16,93.861,93.272 | 93.666 | 25.000 | 94.751,95.71,95.597,95.144 | 95.301 | 25.000 | | | | 1.635 | 25.000 | 40.875 |
| 163 | 94.16,94.579,94.508,93.861 | 94.277 | 25.000 | 95.71,96.292,96.144,95.597 | 95.936 | 25.000 | | | | 1.659 | 25.000 | 41.475 |
| 164 | 94.579,94.928,94.858,94.508 | 94.718 | 25.000 | 96.292,97.154,96.716,96.144 | 96.576 | 25.000 | | | | 1.858 | 25.000 | 46.450 |
| 165 | 94.928,95.277,95.207,94.858 | 95.067 | 25.000 | 97.154,97.907,97.546,96.716 | 97.331 | 25.000 | | | | 2.264 | 25.000 | 56.600 |
| 166 | 95.277,95.627,95.556,95.207 | 95.417 | 25.000 | 97.907,98.359,98.025,97.546 | 97.959 | 25.000 | | | | 2.542 | 25.000 | 63.550 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 167 | 96.627,95.973,95.872,95.556 | 96.757 | 25.000 | 98.359,98.903,98.476,98.025 | 98.441 | 25.000 | | | | 2.684 | 25.000 | 67.100 |
| 168 | 95.973,96.274,95.955,95.872 | 96.018 | 25.000 | 98.903,99.288,98.737,98.476 | 98.851 | 25.000 | | | | 2.833 | 25.000 | 70.825 |
| 169 | 96.274,96.336,95.973,95.955 | 96.135 | 25.000 | 99.288,99.517,98.936,98.737 | 99.120 | 25.000 | | | | 2.985 | 25.000 | 74.625 |
| 170 | 96.336,96.364,95.957,95.973 | 96.155 | 25.000 | 99.517,100.093,99.213,98.936 | 99.440 | 25.000 | | | | 3.285 | 25.000 | 82.125 |
| 171 | 96.354,96.323,95.92,95.957 | 96.138 | 25.000 | 100.093,100.921,99.896,99.213 | 100.031 | 25.000 | | | | 3.893 | 25.000 | 97.325 |
| 172 | 96.323,96.286,95.883,95.92 | 96.103 | 25.000 | 100.921,100.585,99.592,99.896 | 100.248 | 25.000 | | | | 4.145 | 25.000 | 103.625 |
| 173 | 96.286,96.249,95.846,95.883 | 96.066 | 25.000 | 100.585,100.347,99.362,99.592 | 99.971 | 25.000 | | | | 3.905 | 25.000 | 97.625 |
| 174 | 96.249,96.212,95.809,95.846 | 96.029 | 25.000 | 100.347,100.131,99.132,99.362 | 99.743 | 25.000 | | | | 3.714 | 25.000 | 92.850 |
| 175 | 96.212,96.175,95.772,95.809 | 95.992 | 25.000 | 100.131,100.009,98.964,99.132 | 99.559 | 25.000 | | | | 3.567 | 25.000 | 89.175 |
| 176 | 96.175,96.138,95.735,95.772 | 95.955 | 25.000 | 100.009,99.871,98.827,98.964 | 99.418 | 25.000 | | | | 3.463 | 25.000 | 86.575 |
| 177 | 96.138,96.101,95.698,95.735 | 95.918 | 25.000 | 99.871,99.474,98.687,98.827 | 99.216 | 25.000 | | | | 3.297 | 25.000 | 82.425 |
| 178 | 96.101,96.064,95.661,95.698 | 95.881 | 25.000 | 99.474,99.1,98.395,98.687 | 98.914 | 25.000 | | | | 3.033 | 25.000 | 75.825 |
| 179 | 96.064,96.027,95.624,95.661 | 95.844 | 25.000 | 99.1,98.828,98.206,98.395 | 98.633 | 25.000 | | | | 2.789 | 25.000 | 69.725 |
| 180 | 96.027,95.99,95.587,95.624 | 95.807 | 25.000 | 98.828,98.741,97.938,98.206 | 98.428 | 25.000 | | | | 2.621 | 25.000 | 65.525 |
| 181 | 95.99,95.953,95.55,95.587 | 95.770 | 25.000 | 98.741,98.568,97.669,97.938 | 98.229 | 25.000 | | | | 2.459 | 25.000 | 61.475 |
| 182 | 95.953,95.784,95.461,95.55 | 95.687 | 25.000 | 98.568,98.131,97.265,97.669 | 97.908 | 25.000 | | | | 2.221 | 25.000 | 55.525 |
| 183 | 95.784,95.435,95.112,95.461 | 95.448 | 25.000 | 98.131,97.188,96.322,97.265 | 97.226 | 25.000 | | | | 1.778 | 25.000 | 44.450 |
| 184 | 95.435,95.087,94.772,94.769,94.769,95.112 | 94.991 | 24.994 | 97.188,96.245,95.491,95.488,95.488,96.322 | 96.037 | 24.994 | | | | 1.046 | 24.994 | 26.144 |
| 185 | 95.087,94.866,94.772,94.772 | 94.874 | 7.694 | 96.245,95.648,95.491,95.491 | 95.719 | 7.694 | | | | 0.845 | 7.694 | 6.501 |
| 186 | 93.37,93.662,93.369,92.991,93.37 | 93.352 | 10.662 | 93.881,94.301,94.751,94.29,93.881 | 94.221 | 10.662 | | | | 0.869 | 10.662 | 9.265 |
| 187 | 93.662,94.299,94.16,93.369 | 93.873 | 25.000 | 94.301,95.475,95.71,94.751 | 95.059 | 25.000 | | | | 1.186 | 25.000 | 29.650 |
| 188 | 94.299,94.649,94.579,94.16 | 94.422 | 25.000 | 95.475,96.624,96.292,95.71 | 96.025 | 25.000 | | | | 1.603 | 25.000 | 40.075 |
| 189 | 94.649,94.998,94.928,94.579 | 94.788 | 25.000 | 96.624,97.729,97.154,96.292 | 96.950 | 25.000 | | | | 2.162 | 25.000 | 54.050 |
| 190 | 94.998,95.347,95.277,94.928 | 95.138 | 25.000 | 97.729,98.268,97.907,97.154 | 97.765 | 25.000 | | | | 2.627 | 25.000 | 65.675 |
| 191 | 95.347,95.697,95.627,95.277 | 95.487 | 25.000 | 98.268,98.721,98.359,97.907 | 98.314 | 25.000 | | | | 2.827 | 25.000 | 70.675 |
| 192 | 95.697,96.046,95.973,95.627 | 95.835 | 25.000 | 98.721,99.224,98.903,98.359 | 98.802 | 25.000 | | | | 2.967 | 25.000 | 74.175 |
| 193 | 96.046,96.374,96.274,95.973 | 96.167 | 25.000 | 99.224,99.781,99.288,98.903 | 99.299 | 25.000 | | | | 3.132 | 25.000 | 78.300 |
| 194 | 96.374,96.676,96.336,96.274 | 96.415 | 25.000 | 99.781,100.055,99.517,99.288 | 99.660 | 25.000 | | | | 3.245 | 25.000 | 81.125 |
| 195 | 96.676,96.717,96.354,96.336 | 96.521 | 25.000 | 100.055,100.938,100.093,99.517 | 100.151 | 25.000 | | | | 3.630 | 25.000 | 90.750 |
| 196 | 96.717,96.727,96.323,96.354 | 96.530 | 25.000 | 100.938,101.801,100.921,100.093 | 100.938 | 25.000 | | | | 4.408 | 25.000 | 110.200 |
| 197 | 96.727,96.69,96.286,96.323 | 96.507 | 25.000 | 101.801,101.65,100.585,100.921 | 101.239 | 25.000 | | | | 4.732 | 25.000 | 118.300 |
| 198 | 96.69,96.653,96.249,96.286 | 96.470 | 25.000 | 101.65,101.331,100.347,100.585 | 100.978 | 25.000 | | | | 4.508 | 25.000 | 112.700 |
| 199 | 96.653,96.616,96.212,96.249 | 96.433 | 25.000 | 101.331,101.176,100.131,100.347 | 100.746 | 25.000 | | | | 4.313 | 25.000 | 107.825 |
| 200 | 96.616,96.579,96.175,96.212 | 96.396 | 25.000 | 101.176,101.026,100.009,100.131 | 100.586 | 25.000 | | | | 4.190 | 25.000 | 104.750 |
| 201 | 96.579,96.542,96.138,96.175 | 96.359 | 25.000 | 101.026,100.534,99.871,100.009 | 100.360 | 25.000 | | | | 4.001 | 25.000 | 100.025 |
| 202 | 96.542,96.505,96.101,96.138 | 96.322 | 25.000 | 100.534,100.06,99.474,99.871 | 99.985 | 25.000 | | | | 3.663 | 25.000 | 91.575 |
| 203 | 96.505,96.468,96.064,96.101 | 96.285 | 25.000 | 100.06,99.804,99.1,99.474 | 99.610 | 25.000 | | | | 3.325 | 25.000 | 83.125 |
| 204 | 96.468,96.431,96.027,96.064 | 96.248 | 25.000 | 99.804,99.533,98.828,99.1 | 99.316 | 25.000 | | | | 3.068 | 25.000 | 76.700 |
| 205 | 96.431,96.394,95.99,96.027 | 96.211 | 25.000 | 99.533,99.28,98.741,98.828 | 99.095 | 25.000 | | | | 2.884 | 25.000 | 72.100 |
| 206 | 96.394,96.358,95.953,95.99 | 96.174 | 25.000 | 99.28,99.207,98.568,98.741 | 98.949 | 25.000 | | | | 2.775 | 25.000 | 69.375 |
| 207 | 96.358,96.108,95.784,95.953 | 96.051 | 25.000 | 99.207,99.202,98.131,98.568 | 98.777 | 25.000 | | | | 2.726 | 25.000 | 68.150 |
| 208 | 96.108,95.759,95.435,95.784 | 95.772 | 25.000 | 99.202,98.436,97.188,98.131 | 98.239 | 25.000 | | | | 2.467 | 25.000 | 61.675 |
| 209 | 95.759,95.41,95.087,95.435 | 95.423 | 25.000 | 98.436,97.611,96.245,97.188 | 97.370 | 25.000 | | | | 1.947 | 25.000 | 48.675 |
| 210 | 95.41,95.377,95.256,94.965,94.866,94.866,95.( | 95.118 | 22.216 | 97.611,96.622,96.23,95.912,95.648,95.648,96. | 96.274 | 22.216 | | | | 1.156 | 22.216 | 25.682 |
| 211 | 95.377,95.558,96.256,95.256 | 95.362 | 0.319 | 96.622,96.532,96.23,96.23 | 96.404 | 0.319 | | | | 1.042 | 0.319 | 0.332 |
| 212 | 93.754,93.954,93.662,93.37,93.478,93.754 | 93.662 | 7.866 | 94.436,94.739,94.301,93.881,94.024,94.436 | 94.303 | 7.866 | | | | 0.641 | 7.866 | 5.042 |
| 213 | 93.954,94.369,94.299,93.662 | 94.071 | 25.000 | 94.739,95.913,95.475,94.301 | 95.107 | 25.000 | | | | 1.036 | 25.000 | 25.900 |
| 214 | 94.369,94.719,94.649,94.299 | 94.509 | 25.000 | 95.913,97.026,96.624,95.475 | 96.260 | 25.000 | | | | 1.751 | 25.000 | 43.775 |
| 215 | 94.719,95.068,94.998,94.649 | 94.858 | 25.000 | 97.026,97.736,97.729,96.624 | 97.279 | 25.000 | | | | 2.421 | 25.000 | 60.525 |
| 216 | 95.068,95.417,95.347,94.998 | 95.208 | 25.000 | 97.736,98.344,98.268,97.729 | 98.019 | 25.000 | | | | 2.811 | 25.000 | 70.275 |
| 217 | 95.417,95.767,95.697,95.347 | 95.557 | 25.000 | 98.344,98.893,98.721,98.268 | 98.556 | 25.000 | | | | 2.999 | 25.000 | 74.975 |
| 218 | 95.767,96.116,96.046,95.697 | 95.906 | 25.000 | 98.893,99.447,99.224,98.721 | 99.071 | 25.000 | | | | 3.165 | 25.000 | 79.125 |
| 219 | 96.116,96.465,96.374,96.046 | 96.250 | 25.000 | 99.447,99.899,99.781,99.224 | 99.588 | 25.000 | | | | 3.338 | 25.000 | 83.450 |
| 220 | 96.465,96.776,96.676,96.374 | 96.573 | 25.000 | 99.899,100.196,100.055,99.781 | 99.983 | 25.000 | | | | 3.410 | 25.000 | 85.250 |
| 221 | 96.776,97.078,96.717,96.676 | 96.812 | 25.000 | 100.196,100.649,100.938,100.055 | 100.459 | 25.000 | | | | 3.647 | 25.000 | 91.175 |
| 222 | 97.078,97.098,96.727,96.717 | 96.905 | 25.000 | 100.649,101.555,101.801,100.938 | 101.236 | 25.000 | | | | 4.331 | 25.000 | 108.275 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 223 | 97.098,97.094,96.69,96.727 | 96.902 | 25.000 | 101.555,101.838,101.65,101.801 | 101.711 | 25.000 | | | | 4.809 | 25.000 | 120.225 |
| 224 | 97.094,97.057,96.653,96.69 | 96.873 | 25.000 | 101.838,101.918,101.331,101.65 | 101.684 | 25.000 | | | | 4.811 | 25.000 | 120.275 |
| 225 | 97.057,97.02,96.616,96.653 | 96.836 | 25.000 | 101.918,101.646,101.176,101.331 | 101.518 | 25.000 | | | | 4.682 | 25.000 | 117.050 |
| 226 | 97.02,96.983,96.579,96.616 | 96.799 | 25.000 | 101.646,101.217,101.026,101.176 | 101.266 | 25.000 | | | | 4.467 | 25.000 | 111.675 |
| 227 | 96.983,96.946,96.542,96.579 | 96.762 | 25.000 | 101.217,100.752,100.534,101.026 | 100.882 | 25.000 | | | | 4.120 | 25.000 | 103.000 |
| 228 | 96.946,96.909,96.505,96.542 | 96.725 | 25.000 | 100.752,100.215,100.06,100.534 | 100.390 | 25.000 | | | | 3.665 | 25.000 | 91.625 |
| 229 | 96.909,96.872,96.468,96.505 | 96.688 | 25.000 | 100.215,99.942,99.804,100.06 | 100.005 | 25.000 | | | | 3.317 | 25.000 | 82.925 |
| 230 | 96.872,96.835,96.431,96.468 | 96.651 | 25.000 | 99.942,99.873,99.533,99.804 | 99.788 | 25.000 | | | | 3.137 | 25.000 | 78.425 |
| 231 | 96.835,96.798,96.394,96.431 | 96.614 | 25.000 | 99.873,99.805,99.28,99.533 | 99.623 | 25.000 | | | | 3.009 | 25.000 | 75.225 |
| 232 | 96.798,96.76,96.358,96.394 | 96.582 | 25.000 | 99.805,99.786,99.207,99.28 | 99.519 | 25.000 | | | | 2.937 | 25.000 | 73.425 |
| 233 | 96.76,96.431,96.108,96.358 | 96.419 | 25.000 | 99.786,99.84,99.202,99.207 | 99.509 | 25.000 | | | | 3.090 | 25.000 | 77.250 |
| 234 | 96.431,96.083,95.759,96.108 | 96.095 | 25.000 | 99.84,99.894,98.436,99.202 | 99.343 | 25.000 | | | | 3.248 | 25.000 | 81.200 |
| 235 | 96.083,95.807,95.41,95.759 | 95.765 | 25.000 | 99.894,99.014,97.611,98.436 | 98.739 | 25.000 | | | | 2.974 | 25.000 | 74.350 |
| 236 | 95.807,95.803,95.377,95.41 | 95.599 | 25.000 | 99.014,98.012,96.622,97.611 | 97.815 | 25.000 | | | | 2.216 | 25.000 | 55.400 |
| 237 | 95.803,96.627,95.558,95.558,95.377 | 95.785 | 6.255 | 98.012,97.601,96.532,96.532,96.622 | 97.060 | 6.255 | | | | 1.275 | 6.255 | 7.975 |
| 238 | 94.042,94.09,93.954,93.754,94.042 | 93.977 | 4.914 | 95.013,95.176,94.739,94.436,95.013 | 94.875 | 4.914 | | | | 0.898 | 4.914 | 4.413 |
| 239 | 94.09,94.44,94.369,93.954 | 94.213 | 25.000 | 95.176,96.323,95.913,94.739 | 95.538 | 25.000 | | | | 1.325 | 25.000 | 33.125 |
| 240 | 94.44,94.789,94.719,94.369 | 94.579 | 25.000 | 96.323,97.048,97.026,95.913 | 96.578 | 25.000 | | | | 1.999 | 25.000 | 49.975 |
| 241 | 94.789,95.138,95.068,94.719 | 94.928 | 25.000 | 97.048,97.722,97.736,97.026 | 97.383 | 25.000 | | | | 2.455 | 25.000 | 61.375 |
| 242 | 95.138,95.488,95.417,95.068 | 95.278 | 25.000 | 97.722,98.368,98.344,97.736 | 98.042 | 25.000 | | | | 2.764 | 25.000 | 69.100 |
| 243 | 95.488,95.837,95.767,95.417 | 95.627 | 25.000 | 98.368,98.958,98.893,98.344 | 98.640 | 25.000 | | | | 3.013 | 25.000 | 75.325 |
| 244 | 95.837,96.186,96.116,95.767 | 95.976 | 25.000 | 98.958,99.6,99.447,98.893 | 99.224 | 25.000 | | | | 3.248 | 25.000 | 81.200 |
| 245 | 96.186,96.536,96.465,96.116 | 96.326 | 25.000 | 99.6,100.005,99.899,99.447 | 99.738 | 25.000 | | | | 3.412 | 25.000 | 85.300 |
| 246 | 96.536,96.877,96.776,96.465 | 96.664 | 25.000 | 100.005,100.337,100.196,99.899 | 100.109 | 25.000 | | | | 3.445 | 25.000 | 86.125 |
| 247 | 96.877,97.176,97.078,96.776 | 96.977 | 25.000 | 100.337,100.541,100.649,100.196 | 100.431 | 25.000 | | | | 3.454 | 25.000 | 86.350 |
| 248 | 97.176,97.461,97.098,97.078 | 97.204 | 25.000 | 100.541,101.266,101.555,100.649 | 101.003 | 25.000 | | | | 3.799 | 25.000 | 94.975 |
| 249 | 97.461,97.479,97.094,97.098 | 97.283 | 25.000 | 101.266,101.62,101.836,101.555 | 101.569 | 25.000 | | | | 4.286 | 25.000 | 107.150 |
| 250 | 97.479,97.46,97.057,97.094 | 97.272 | 25.000 | 101.62,101.764,101.918,101.836 | 101.785 | 25.000 | | | | 4.513 | 25.000 | 112.825 |
| 251 | 97.46,97.423,97.02,97.057 | 97.240 | 25.000 | 101.764,101.873,101.646,101.918 | 101.800 | 25.000 | | | | 4.560 | 25.000 | 114.000 |
| 252 | 97.423,97.386,96.983,97.02 | 97.203 | 25.000 | 101.873,101.408,101.217,101.646 | 101.536 | 25.000 | | | | 4.333 | 25.000 | 108.325 |
| 253 | 97.386,97.349,96.946,96.983 | 97.166 | 25.000 | 101.408,100.943,100.752,101.217 | 101.080 | 25.000 | | | | 3.914 | 25.000 | 97.850 |
| 254 | 97.349,97.312,96.909,96.946 | 97.129 | 25.000 | 100.943,100.478,100.215,100.752 | 100.597 | 25.000 | | | | 3.468 | 25.000 | 86.700 |
| 255 | 97.312,97.275,96.872,96.909 | 97.092 | 25.000 | 100.478,100.193,99.942,100.215 | 100.207 | 25.000 | | | | 3.115 | 25.000 | 77.875 |
| 256 | 97.275,97.238,96.835,96.872 | 97.055 | 25.000 | 100.193,100.198,99.873,99.942 | 100.052 | 25.000 | | | | 2.997 | 25.000 | 74.925 |
| 257 | 97.238,97.201,96.798,96.835 | 97.018 | 25.000 | 100.198,100.304,99.805,99.873 | 100.045 | 25.000 | | | | 3.027 | 25.000 | 75.675 |
| 258 | 97.201,97.103,96.78,96.798 | 96.971 | 25.000 | 100.304,100.407,99.786,99.805 | 100.075 | 25.000 | | | | 3.104 | 25.000 | 77.600 |
| 259 | 97.103,96.755,96.431,96.78 | 96.767 | 25.000 | 100.407,100.314,99.84,99.786 | 100.087 | 25.000 | | | | 3.320 | 25.000 | 83.000 |
| 260 | 96.755,96.406,96.083,96.431 | 96.419 | 25.000 | 100.314,100.224,99.894,99.84 | 100.068 | 25.000 | | | | 3.649 | 25.000 | 91.225 |
| 261 | 96.406,96.323,95.807,96.083 | 96.155 | 25.000 | 100.224,99.963,99.014,99.894 | 99.774 | 25.000 | | | | 3.619 | 25.000 | 90.475 |
| 262 | 96.323,96.293,95.803,95.807 | 96.057 | 25.000 | 99.963,99.401,98.012,99.014 | 99.097 | 25.000 | | | | 3.040 | 25.000 | 76.000 |
| 263 | 96.293,97.696,96.627,96.627,95.803 | 96.609 | 14.250 | 99.401,98.67,97.601,97.601,98.012 | 98.257 | 14.250 | | | | 1.648 | 14.250 | 23.484 |
| 264 | 94.154,94.16,94.09,94.042,94.154 | 94.120 | 1.952 | 95.59,95.613,95.176,95.013,95.59 | 95.396 | 1.952 | | | | 1.276 | 1.952 | 2.491 |
| 265 | 94.16,94.51,94.44,94.09 | 94.300 | 25.000 | 95.613,96.36,96.323,95.176 | 95.868 | 25.000 | | | | 1.568 | 25.000 | 39.200 |
| 266 | 94.51,94.859,94.789,94.44 | 94.649 | 25.000 | 96.36,97.034,97.048,96.323 | 96.691 | 25.000 | | | | 2.042 | 25.000 | 51.050 |
| 267 | 94.859,95.208,95.138,94.789 | 94.999 | 25.000 | 97.034,97.708,97.722,97.048 | 97.378 | 25.000 | | | | 2.379 | 25.000 | 59.475 |
| 268 | 95.208,95.558,95.488,95.138 | 95.348 | 25.000 | 97.708,98.375,98.368,97.722 | 98.043 | 25.000 | | | | 2.695 | 25.000 | 67.375 |
| 269 | 95.558,95.907,95.837,95.488 | 95.697 | 25.000 | 98.375,99.115,98.958,98.368 | 98.704 | 25.000 | | | | 3.007 | 25.000 | 75.175 |
| 270 | 95.907,96.256,96.186,95.837 | 96.047 | 25.000 | 99.115,99.762,99.6,98.958 | 99.359 | 25.000 | | | | 3.312 | 25.000 | 82.800 |
| 271 | 96.256,96.606,96.536,96.186 | 96.396 | 25.000 | 99.762,100.111,100.005,99.6 | 99.870 | 25.000 | | | | 3.474 | 25.000 | 86.850 |
| 272 | 96.606,96.955,96.877,96.536 | 96.743 | 25.000 | 100.111,100.478,100.337,100.005 | 100.233 | 25.000 | | | | 3.490 | 25.000 | 87.250 |
| 273 | 96.955,97.279,97.178,96.877 | 97.072 | 25.000 | 100.478,100.683,100.541,100.337 | 100.510 | 25.000 | | | | 3.438 | 25.000 | 85.950 |
| 274 | 97.279,97.58,97.461,97.178 | 97.376 | 25.000 | 100.683,100.978,101.266,100.541 | 100.867 | 25.000 | | | | 3.492 | 25.000 | 87.300 |
| 275 | 97.58,97.842,97.479,97.461 | 97.591 | 25.000 | 100.978,101.406,101.62,101.266 | 101.318 | 25.000 | | | | 3.727 | 25.000 | 93.175 |
| 276 | 97.842,97.86,97.46,97.479 | 97.660 | 25.000 | 101.406,101.62,101.764,101.62 | 101.602 | 25.000 | | | | 3.942 | 25.000 | 98.550 |
| 277 | 97.86,97.827,97.423,97.46 | 97.642 | 25.000 | 101.62,102.014,101.873,101.764 | 101.817 | 25.000 | | | | 4.175 | 25.000 | 104.375 |
| 278 | 97.827,97.79,97.386,97.423 | 97.607 | 25.000 | 102.014,101.811,101.408,101.873 | 101.776 | 25.000 | | | | 4.169 | 25.000 | 104.225 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 279 | 97.79,97.753,97.349,97.386 | 97.570 | 25.000 | 101.811,101.36,100.943,101.408 | 101.380 | 25.000 | | | | 3.810 | 25.000 | 95.250 |
| 280 | 97.753,97.716,97.312,97.349 | 97.533 | 25.000 | 101.36,100.896,100.478,100.943 | 100.919 | 25.000 | | | | 3.386 | 25.000 | 84.650 |
| 281 | 97.716,97.679,97.275,97.312 | 97.496 | 25.000 | 100.896,100.591,100.193,100.478 | 100.540 | 25.000 | | | | 3.044 | 25.000 | 76.100 |
| 282 | 97.679,97.642,97.238,97.275 | 97.459 | 25.000 | 100.591,100.556,100.198,100.193 | 100.385 | 25.000 | | | | 2.926 | 25.000 | 73.150 |
| 283 | 97.642,97.605,97.201,97.238 | 97.422 | 25.000 | 100.556,100.523,100.304,100.198 | 100.396 | 25.000 | | | | 2.973 | 25.000 | 74.325 |
| 284 | 97.605,97.427,97.103,97.201 | 97.334 | 25.000 | 100.523,100.648,100.407,100.304 | 100.470 | 25.000 | | | | 3.136 | 25.000 | 78.400 |
| 285 | 97.427,97.078,96.755,97.103 | 97.091 | 25.000 | 100.648,100.541,100.314,100.407 | 100.477 | 25.000 | | | | 3.386 | 25.000 | 84.650 |
| 286 | 97.078,96.869,96.406,96.755 | 96.777 | 25.000 | 100.541,100.546,100.224,100.314 | 100.406 | 25.000 | | | | 3.629 | 25.000 | 90.725 |
| 287 | 96.869,96.839,96.323,96.406 | 96.609 | 25.000 | 100.546,100.485,99.963,100.224 | 100.304 | 25.000 | | | | 3.695 | 25.000 | 92.375 |
| 288 | 96.839,96.809,96.293,96.323 | 96.566 | 25.000 | 100.485,99.962,99.401,99.963 | 99.953 | 25.000 | | | | 3.387 | 25.000 | 84.675 |
| 289 | 96.809,98.63,98.581,97.696,97.696,96.293 | 97.618 | 22.147 | 99.962,99.389,99.329,98.67,98.67,99.401 | 99.237 | 22.147 | | | | 1.619 | 22.147 | 35.856 |
| 290 | 98.63,98.668,98.635,98.581,98.581 | 98.619 | 0.067 | 99.389,99.375,99.341,99.329,99.329 | 99.352 | 0.067 | | | | 0.733 | 0.067 | 0.049 |
| 291 | 94.172,94.16,94.154,94.172 | 94.164 | 0.038 | 95.651,95.613,95.59,95.651 | 95.626 | 0.038 | | | | 1.462 | 0.038 | 0.056 |
| 292 | 94.282,94.58,94.51,94.16,94.172,94.201,94.28 | 94.312 | 24.134 | 95.513,96.413,96.36,95.613,95.651,95.587,95. | 95.807 | 24.134 | | | | 1.495 | 24.134 | 36.080 |
| 293 | 94.58,94.929,94.859,94.51 | 94.719 | 25.000 | 96.413,96.851,97.034,96.36 | 96.664 | 25.000 | | | | 1.945 | 25.000 | 48.625 |
| 294 | 94.929,95.278,95.208,94.859 | 95.069 | 25.000 | 96.851,97.518,97.708,97.034 | 97.278 | 25.000 | | | | 2.209 | 25.000 | 55.225 |
| 295 | 95.278,95.628,95.558,95.208 | 95.418 | 25.000 | 97.518,98.401,98.375,97.708 | 98.001 | 25.000 | | | | 2.583 | 25.000 | 64.575 |
| 296 | 95.628,95.977,95.907,95.558 | 95.767 | 25.000 | 98.401,99.272,99.115,98.375 | 98.790 | 25.000 | | | | 3.023 | 25.000 | 75.575 |
| 297 | 95.977,96.326,96.256,95.907 | 96.117 | 25.000 | 99.272,99.924,99.762,99.115 | 99.518 | 25.000 | | | | 3.401 | 25.000 | 85.025 |
| 298 | 96.326,96.676,96.606,96.256 | 96.466 | 25.000 | 99.924,100.258,100.111,99.762 | 100.014 | 25.000 | | | | 3.548 | 25.000 | 88.700 |
| 299 | 96.676,97.025,96.955,96.606 | 96.815 | 25.000 | 100.258,100.62,100.478,100.111 | 100.367 | 25.000 | | | | 3.552 | 25.000 | 88.800 |
| 300 | 97.025,97.374,97.279,96.955 | 97.158 | 25.000 | 100.62,100.824,100.683,100.478 | 100.651 | 25.000 | | | | 3.493 | 25.000 | 87.325 |
| 301 | 97.374,97.681,97.58,97.279 | 97.479 | 25.000 | 100.824,101.028,100.978,100.683 | 100.878 | 25.000 | | | | 3.399 | 25.000 | 84.975 |
| 302 | 97.681,97.982,97.842,97.58 | 97.771 | 25.000 | 101.028,101.271,101.406,100.978 | 101.171 | 25.000 | | | | 3.400 | 25.000 | 85.000 |
| 303 | 97.982,98.223,97.86,97.842 | 97.977 | 25.000 | 101.271,101.547,101.62,101.406 | 101.461 | 25.000 | | | | 3.484 | 25.000 | 87.100 |
| 304 | 98.223,98.23,97.827,97.86 | 98.035 | 25.000 | 101.547,102.122,102.014,101.62 | 101.826 | 25.000 | | | | 3.791 | 25.000 | 94.775 |
| 305 | 98.23,98.193,97.79,97.827 | 98.010 | 25.000 | 102.122,101.919,101.811,102.014 | 101.967 | 25.000 | | | | 3.957 | 25.000 | 98.925 |
| 306 | 98.193,98.156,97.753,97.79 | 97.973 | 25.000 | 101.919,101.716,101.36,101.811 | 101.702 | 25.000 | | | | 3.729 | 25.000 | 93.225 |
| 307 | 98.156,98.119,97.716,97.753 | 97.936 | 25.000 | 101.716,101.323,100.896,101.36 | 101.324 | 25.000 | | | | 3.388 | 25.000 | 84.700 |
| 308 | 98.119,98.082,97.679,97.716 | 97.899 | 25.000 | 101.323,101.005,100.591,100.896 | 100.954 | 25.000 | | | | 3.055 | 25.000 | 76.375 |
| 309 | 98.082,98.046,97.642,97.679 | 97.862 | 25.000 | 101.005,100.971,100.556,100.591 | 100.781 | 25.000 | | | | 2.919 | 25.000 | 72.975 |
| 310 | 98.046,98.03,97.605,97.642 | 97.831 | 25.000 | 100.971,100.968,100.523,100.556 | 100.755 | 25.000 | | | | 2.924 | 25.000 | 73.100 |
| 311 | 98.03,97.751,97.427,97.605 | 97.703 | 25.000 | 100.968,100.888,100.648,100.523 | 100.757 | 25.000 | | | | 3.054 | 25.000 | 76.350 |
| 312 | 97.751,97.416,97.078,97.427 | 97.418 | 25.000 | 100.888,100.86,100.541,100.648 | 100.734 | 25.000 | | | | 3.316 | 25.000 | 82.900 |
| 313 | 97.416,97.385,96.869,97.078 | 97.187 | 25.000 | 100.86,100.866,100.546,100.541 | 100.703 | 25.000 | | | | 3.516 | 25.000 | 87.900 |
| 314 | 97.385,97.355,96.839,96.869 | 97.112 | 25.000 | 100.866,100.871,100.485,100.546 | 100.692 | 25.000 | | | | 3.580 | 25.000 | 89.500 |
| 315 | 97.355,97.325,96.809,96.839 | 97.082 | 25.000 | 100.871,100.138,99.962,100.485 | 100.364 | 25.000 | | | | 3.282 | 25.000 | 82.050 |
| 316 | 97.325,98.947,98.63,96.809 | 97.928 | 25.000 | 100.138,99.633,99.389,99.962 | 99.780 | 25.000 | | | | 1.852 | 25.000 | 46.300 |
| 317 | 98.947,98.969,98.668,98.668,98.63 | 98.777 | 0.987 | 99.633,99.654,99.375,99.375,99.389 | 99.485 | 0.987 | | | | 0.708 | 0.987 | 0.699 |
| 318 | 94.364,94.698,94.58,94.282,94.364 | 94.458 | 22.203 | 95.634,96.447,96.413,95.513,96.634 | 96.928 | 22.203 | | | | 1.470 | 22.203 | 32.638 |
| 319 | 94.698,95.032,94.929,94.58 | 94.810 | 25.000 | 96.447,97.18,96.851,96.413 | 96.723 | 25.000 | | | | 1.913 | 25.000 | 47.825 |
| 320 | 95.032,95.349,95.278,94.929 | 95.147 | 25.000 | 97.18,97.627,97.518,96.851 | 97.294 | 25.000 | | | | 2.147 | 25.000 | 53.675 |
| 321 | 95.349,95.698,95.628,95.278 | 95.488 | 25.000 | 97.627,98.455,98.401,97.518 | 98.000 | 25.000 | | | | 2.512 | 25.000 | 62.800 |
| 322 | 95.698,96.047,95.977,95.628 | 95.837 | 25.000 | 98.455,99.336,99.272,98.401 | 98.866 | 25.000 | | | | 3.029 | 25.000 | 75.725 |
| 323 | 96.047,96.397,96.326,95.977 | 96.187 | 25.000 | 99.336,100.086,99.924,99.272 | 99.654 | 25.000 | | | | 3.467 | 25.000 | 86.675 |
| 324 | 96.397,96.746,96.676,96.326 | 96.536 | 25.000 | 100.086,100.419,100.258,99.924 | 100.172 | 25.000 | | | | 3.636 | 25.000 | 90.900 |
| 325 | 96.746,97.095,97.025,96.676 | 96.885 | 25.000 | 100.419,100.761,100.62,100.258 | 100.514 | 25.000 | | | | 3.629 | 25.000 | 90.725 |
| 326 | 97.095,97.445,97.374,97.025 | 97.235 | 25.000 | 100.761,100.94,100.824,100.62 | 100.786 | 25.000 | | | | 3.551 | 25.000 | 88.775 |
| 327 | 97.445,97.781,97.681,97.374 | 97.570 | 25.000 | 100.94,101.049,101.028,100.824 | 100.960 | 25.000 | | | | 3.390 | 25.000 | 84.750 |
| 328 | 97.781,98.083,97.982,97.681 | 97.882 | 25.000 | 101.049,101.23,101.271,101.028 | 101.144 | 25.000 | | | | 3.262 | 25.000 | 81.550 |
| 329 | 98.083,98.384,98.223,97.982 | 98.168 | 25.000 | 101.23,101.498,101.547,101.271 | 101.387 | 25.000 | | | | 3.219 | 25.000 | 80.475 |
| 330 | 98.384,98.604,98.23,98.223 | 98.360 | 25.000 | 101.498,102.229,102.122,101.547 | 101.849 | 25.000 | | | | 3.489 | 25.000 | 87.225 |
| 331 | 98.604,98.597,98.193,98.23 | 98.406 | 25.000 | 102.229,102.027,101.919,102.122 | 102.074 | 25.000 | | | | 3.668 | 25.000 | 91.700 |
| 332 | 98.597,98.56,98.156,98.193 | 98.377 | 25.000 | 102.027,101.824,101.716,101.919 | 101.872 | 25.000 | | | | 3.495 | 25.000 | 87.375 |
| 333 | 98.56,98.523,98.119,98.156 | 98.340 | 25.000 | 101.824,101.661,101.323,101.716 | 101.631 | 25.000 | | | | 3.291 | 25.000 | 82.275 |
| 334 | 98.523,98.486,98.082,98.119 | 98.303 | 25.000 | 101.661,101.543,101.005,101.323 | 101.383 | 25.000 | | | | 3.080 | 25.000 | 77.000 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 335 | 98.486,98.449,98.046,98.082 | 98.266 | 25.000 | 101.543,101.646,100.971,101.005 | 101.291 | 25.000 | | | | 3.025 | 25.000 | 75.625 |
| 336 | 98.449,98.423,98.03,98.046 | 98.237 | 25.000 | 101.646,101.475,100.968,100.971 | 101.285 | 25.000 | | | | 3.028 | 25.000 | 75.700 |
| 337 | 98.423,98.074,97.751,98.03 | 98.089 | 25.000 | 101.475,101.132,100.868,100.968 | 101.116 | 25.000 | | | | 3.047 | 25.000 | 76.175 |
| 338 | 98.074,97.931,97.416,97.751 | 97.793 | 25.000 | 101.132,101.16,100.86,100.868 | 101.010 | 25.000 | | | | 3.217 | 25.000 | 80.425 |
| 339 | 97.931,97.901,97.385,97.416 | 97.658 | 25.000 | 101.16,101.177,100.866,100.86 | 101.016 | 25.000 | | | | 3.358 | 25.000 | 83.950 |
| 340 | 97.901,97.871,97.355,97.385 | 97.628 | 25.000 | 101.177,100.619,100.871,100.866 | 100.883 | 25.000 | | | | 3.255 | 25.000 | 81.375 |
| 341 | 97.871,97.84,97.325,97.355 | 97.598 | 25.000 | 100.619,99.34,100.138,100.871 | 100.242 | 25.000 | | | | 2.644 | 25.000 | 66.100 |
| 342 | 97.84,98.427,98.855,98.855,98.947,97.325 | 98.375 | 20.561 | 99.34,99.112,99.54,99.54,99.633,100.138 | 99.551 | 20.561 | | | | 1.176 | 20.561 | 24.180 |
| 343 | 98.969,98.947,98.855,98.908,98.969 | 98.930 | 0.340 | 99.654,99.633,99.54,99.593,99.654 | 99.615 | 0.340 | | | | 0.685 | 0.340 | 0.233 |
| 344 | 94.447,94.751,94.698,94.364,94.447 | 94.542 | 20.334 | 95.755,96.502,96.447,95.634,95.755 | 96.018 | 20.334 | | | | 1.476 | 20.334 | 30.013 |
| 345 | 94.751,95.143,96.032,94.698 | 94.906 | 25.000 | 96.502,97.481,97.18,96.447 | 96.902 | 25.000 | | | | 1.996 | 25.000 | 49.900 |
| 346 | 95.143,95.505,95.349,95.032 | 95.257 | 25.000 | 97.481,97.934,97.627,97.18 | 97.555 | 25.000 | | | | 2.298 | 25.000 | 57.450 |
| 347 | 95.505,95.779,95.698,95.349 | 95.583 | 25.000 | 97.934,98.762,98.455,97.627 | 98.194 | 25.000 | | | | 2.611 | 25.000 | 65.275 |
| 348 | 95.779,96.117,96.047,95.698 | 95.910 | 25.000 | 98.762,99.59,99.336,98.455 | 99.036 | 25.000 | | | | 3.126 | 25.000 | 78.150 |
| 349 | 96.117,96.467,96.397,96.047 | 96.257 | 25.000 | 99.59,100.409,100.086,99.336 | 99.855 | 25.000 | | | | 3.598 | 25.000 | 89.950 |
| 350 | 96.467,96.816,96.746,96.397 | 96.606 | 25.000 | 100.409,100.746,100.419,100.086 | 100.415 | 25.000 | | | | 3.809 | 25.000 | 95.225 |
| 351 | 96.816,97.165,97.095,96.746 | 96.956 | 25.000 | 100.746,100.976,100.761,100.419 | 100.726 | 25.000 | | | | 3.770 | 25.000 | 94.250 |
| 352 | 97.165,97.515,97.445,97.095 | 97.305 | 25.000 | 100.976,101.026,100.94,100.761 | 100.928 | 25.000 | | | | 3.621 | 25.000 | 90.525 |
| 353 | 97.515,97.864,97.781,97.445 | 97.651 | 25.000 | 101.026,101.296,101.049,100.94 | 101.078 | 25.000 | | | | 3.427 | 25.000 | 85.675 |
| 354 | 97.864,98.183,98.083,97.781 | 97.978 | 25.000 | 101.296,101.87,101.23,101.049 | 101.361 | 25.000 | | | | 3.383 | 25.000 | 84.575 |
| 355 | 98.183,98.485,98.384,98.083 | 98.284 | 25.000 | 101.87,101.213,101.498,101.23 | 101.453 | 25.000 | | | | 3.169 | 25.000 | 79.225 |
| 356 | 98.485,98.786,98.604,98.384 | 98.585 | 25.000 | 101.213,102.299,102.229,101.498 | 101.810 | 25.000 | | | | 3.245 | 25.000 | 81.125 |
| 357 | 98.786,98.985,98.597,98.604 | 98.743 | 25.000 | 102.299,102.285,102.027,102.229 | 102.210 | 25.000 | | | | 3.467 | 25.000 | 86.675 |
| 358 | 98.985,98.964,98.56,98.597 | 98.776 | 25.000 | 102.285,102.13,101.824,102.027 | 102.067 | 25.000 | | | | 3.291 | 25.000 | 82.275 |
| 359 | 98.964,98.927,98.523,98.56 | 98.743 | 25.000 | 102.13,102.03,101.661,101.824 | 101.911 | 25.000 | | | | 3.168 | 25.000 | 79.200 |
| 360 | 98.927,98.89,98.486,98.523 | 98.706 | 25.000 | 102.03,102.238,101.543,101.661 | 101.868 | 25.000 | | | | 3.162 | 25.000 | 79.050 |
| 361 | 98.89,98.853,98.449,98.486 | 98.669 | 25.000 | 102.238,102.067,101.646,101.543 | 101.874 | 25.000 | | | | 3.205 | 25.000 | 80.125 |
| 362 | 98.853,98.746,98.423,98.449 | 98.618 | 25.000 | 102.067,101.772,101.475,101.646 | 101.740 | 25.000 | | | | 3.122 | 25.000 | 78.050 |
| 363 | 98.746,98.478,98.074,98.423 | 98.430 | 25.000 | 101.772,101.715,101.132,101.475 | 101.523 | 25.000 | | | | 3.093 | 25.000 | 77.325 |
| 364 | 98.478,98.447,97.931,98.074 | 98.233 | 25.000 | 101.715,101.979,101.16,101.132 | 101.496 | 25.000 | | | | 3.263 | 25.000 | 81.575 |
| 365 | 98.447,98.417,97.901,97.931 | 98.174 | 25.000 | 101.979,101.814,101.177,101.16 | 101.532 | 25.000 | | | | 3.358 | 25.000 | 83.950 |
| 366 | 98.417,98.387,97.871,97.901 | 98.144 | 25.000 | 101.814,101.024,100.619,101.177 | 101.158 | 25.000 | | | | 3.014 | 25.000 | 75.350 |
| 367 | 98.387,98.179,97.84,97.871 | 98.069 | 25.000 | 101.024,99.382,99.34,100.619 | 100.091 | 25.000 | | | | 2.022 | 25.000 | 50.550 |
| 368 | 98.179,98.11,98.166,98.427,98.427,97.84 | 98.192 | 5.912 | 99.382,99.039,99.114,99.112,99.112,99.34 | 99.183 | 5.912 | | | | 0.991 | 5.912 | 5.859 |
| 369 | 94.529,94.804,94.751,94.447,94.529 | 94.612 | 18.464 | 95.685,96.572,96.502,95.755,95.685 | 96.119 | 18.464 | | | | 1.507 | 18.464 | 27.825 |
| 370 | 94.804,95.196,95.143,94.751 | 94.974 | 25.000 | 96.572,97.551,97.481,96.502 | 97.026 | 25.000 | | | | 2.052 | 25.000 | 51.300 |
| 371 | 95.196,95.589,95.505,95.143 | 95.359 | 25.000 | 97.551,98.32,97.934,97.481 | 97.822 | 25.000 | | | | 2.463 | 25.000 | 61.575 |
| 372 | 95.589,95.979,95.779,95.505 | 95.713 | 25.000 | 98.32,99.069,98.762,97.934 | 98.521 | 25.000 | | | | 2.808 | 25.000 | 70.200 |
| 373 | 95.979,96.253,96.117,95.779 | 96.032 | 25.000 | 99.069,99.966,99.59,98.762 | 99.347 | 25.000 | | | | 3.315 | 25.000 | 82.875 |
| 374 | 96.253,96.537,96.467,96.117 | 96.343 | 25.000 | 99.966,100.848,100.409,99.59 | 100.203 | 25.000 | | | | 3.860 | 25.000 | 96.500 |
| 375 | 96.537,96.886,96.816,96.467 | 96.676 | 25.000 | 100.848,101.089,100.746,100.409 | 100.773 | 25.000 | | | | 4.097 | 25.000 | 102.425 |
| 376 | 96.886,97.235,97.165,96.816 | 97.026 | 25.000 | 101.089,101.238,100.976,100.746 | 101.012 | 25.000 | | | | 3.966 | 25.000 | 99.150 |
| 377 | 97.235,97.585,97.515,97.165 | 97.375 | 25.000 | 101.238,101.346,101.026,100.976 | 101.146 | 25.000 | | | | 3.771 | 25.000 | 94.275 |
| 378 | 97.585,97.934,97.864,97.515 | 97.724 | 25.000 | 101.346,102.14,101.296,101.026 | 101.452 | 25.000 | | | | 3.728 | 25.000 | 93.200 |
| 379 | 97.934,98.283,98.183,97.864 | 98.066 | 25.000 | 102.14,102.07,101.87,101.296 | 101.844 | 25.000 | | | | 3.778 | 25.000 | 94.450 |
| 380 | 98.283,98.585,98.485,98.183 | 98.384 | 25.000 | 102.07,101.621,101.213,101.87 | 101.693 | 25.000 | | | | 3.309 | 25.000 | 82.725 |
| 381 | 98.585,98.886,98.786,98.485 | 98.686 | 25.000 | 101.621,102.311,102.299,101.213 | 101.861 | 25.000 | | | | 3.175 | 25.000 | 79.375 |
| 382 | 98.886,99.188,98.985,98.786 | 98.961 | 25.000 | 102.311,102.555,102.285,102.299 | 102.363 | 25.000 | | | | 3.402 | 25.000 | 85.050 |
| 383 | 99.188,99.386,98.964,98.985 | 99.126 | 25.000 | 102.555,102.445,102.13,102.285 | 102.354 | 25.000 | | | | 3.228 | 25.000 | 80.700 |
| 384 | 99.366,99.33,98.927,98.964 | 99.147 | 25.000 | 102.445,102.506,102.03,102.13 | 102.278 | 25.000 | | | | 3.131 | 25.000 | 78.275 |
| 385 | 99.33,99.293,98.89,98.927 | 99.110 | 25.000 | 102.506,103.017,102.238,102.03 | 102.448 | 25.000 | | | | 3.338 | 25.000 | 83.450 |
| 386 | 99.293,99.277,98.853,98.89 | 99.078 | 25.000 | 103.017,101.998,102.067,102.238 | 102.330 | 25.000 | | | | 3.252 | 25.000 | 81.300 |
| 387 | 99.277,99.07,98.746,98.853 | 98.987 | 25.000 | 101.998,102.051,101.772,102.067 | 101.972 | 25.000 | | | | 2.985 | 25.000 | 74.625 |
| 388 | 99.07,98.993,98.476,98.746 | 98.822 | 25.000 | 102.051,102.149,101.715,101.772 | 101.921 | 25.000 | | | | 3.099 | 25.000 | 77.475 |
| 389 | 98.993,98.963,98.447,98.478 | 98.720 | 25.000 | 102.149,102.159,101.979,101.715 | 102.000 | 25.000 | | | | 3.280 | 25.000 | 82.000 |
| 390 | 98.963,98.843,98.417,98.447 | 98.667 | 25.000 | 102.159,101.846,101.814,101.979 | 101.950 | 25.000 | | | | 3.283 | 25.000 | 82.075 |

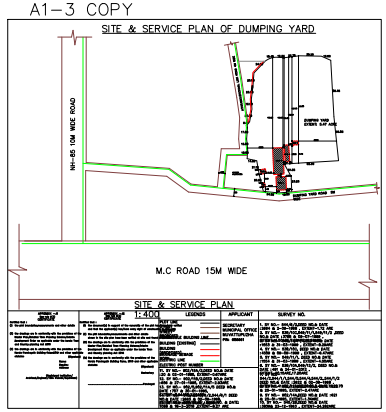
| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 391 | 98.843,98.507,98.387,98.417 | 98.538 | 25.000 | 101.846,101.33,101.024,101.814 | 101.504 | 25.000 | | | | 2.966 | 25.000 | 74.150 |
| 392 | 98.507,98.171,98.179,98.387 | 98.311 | 25.000 | 101.33,100.07,99.382,101.024 | 100.451 | 25.000 | | | | 2.140 | 25.000 | 53.500 |
| 393 | 98.171,97.995,98.11,98.11,98.179 | 98.113 | 14.041 | 100.07,98.901,99.039,99.039,99.382 | 99.286 | 14.041 | | | | 1.173 | 14.041 | 16.470 |
| 394 | 94.612,94.857,94.804,94.529,94.612 | 94.683 | 16.594 | 96.028,96.641,96.572,95.885,96.028 | 96.231 | 16.594 | | | | 1.548 | 16.594 | 25.688 |
| 395 | 94.857,95.249,95.196,94.804 | 95.027 | 25.000 | 96.641,97.621,97.551,96.572 | 97.096 | 25.000 | | | | 2.069 | 25.000 | 51.725 |
| 396 | 95.249,95.642,95.589,95.196 | 95.419 | 25.000 | 97.621,98.6,98.32,97.551 | 98.023 | 25.000 | | | | 2.604 | 25.000 | 65.100 |
| 397 | 95.642,96.034,95.979,95.589 | 95.811 | 25.000 | 98.6,99.398,99.069,98.32 | 98.847 | 25.000 | | | | 3.036 | 25.000 | 75.900 |
| 398 | 96.034,96.426,96.253,95.979 | 96.173 | 25.000 | 99.398,100.415,99.966,99.069 | 99.712 | 25.000 | | | | 3.539 | 25.000 | 88.475 |
| 399 | 96.426,96.726,96.537,96.253 | 96.485 | 25.000 | 100.415,101.096,100.848,99.966 | 100.581 | 25.000 | | | | 4.096 | 25.000 | 102.400 |
| 400 | 96.726,97,96.686,96.537 | 96.787 | 25.000 | 101.096,101.199,101.089,100.848 | 101.058 | 25.000 | | | | 4.271 | 25.000 | 106.775 |
| 401 | 97,97.306,97.236,96.886 | 97.107 | 25.000 | 101.199,101.301,101.238,101.089 | 101.207 | 25.000 | | | | 4.100 | 25.000 | 102.500 |
| 402 | 97.306,97.655,97.585,97.235 | 97.445 | 25.000 | 101.301,101.436,101.346,101.238 | 101.330 | 25.000 | | | | 3.885 | 25.000 | 97.125 |
| 403 | 97.655,98.004,97.934,97.585 | 97.794 | 25.000 | 101.436,101.682,102.14,101.346 | 101.651 | 25.000 | | | | 3.857 | 25.000 | 96.425 |
| 404 | 98.004,98.354,98.283,97.934 | 98.144 | 25.000 | 101.682,101.7,102.07,102.14 | 101.898 | 25.000 | | | | 3.754 | 25.000 | 93.850 |
| 405 | 98.354,98.686,98.585,98.283 | 98.477 | 25.000 | 101.7,101.576,101.621,102.07 | 101.742 | 25.000 | | | | 3.265 | 25.000 | 81.625 |
| 406 | 98.686,98.987,98.886,98.585 | 98.786 | 25.000 | 101.576,101.907,102.311,101.621 | 101.854 | 25.000 | | | | 3.068 | 25.000 | 76.700 |
| 407 | 98.987,99.288,99.188,98.886 | 99.087 | 25.000 | 101.907,101.582,102.555,102.311 | 102.089 | 25.000 | | | | 3.002 | 25.000 | 75.050 |
| 408 | 99.288,99.59,99.366,99.188 | 99.358 | 25.000 | 101.582,101.258,102.445,102.555 | 101.960 | 25.000 | | | | 2.602 | 25.000 | 65.050 |
| 409 | 99.59,99.647,99.712,99.688,99.688,99.33,99.3 | 99.575 | 23.639 | 101.258,101.28,101.651,102.27,102.27,102.50 | 101.954 | 23.639 | | | | 2.379 | 23.639 | 56.237 |
| 410 | 99.615,99.293,99.33,99.688,99.615 | 99.508 | 21.038 | 103.01,103.017,102.506,102.27,103.01 | 102.763 | 21.038 | | | | 3.256 | 21.038 | 68.479 |
| 411 | 99.691,99.703,99.277,99.293,99.615,99.608,99 | 99.554 | 23.201 | 102.193,102.069,101.998,103.017,103.01,102. | 102.484 | 23.201 | | | | 2.930 | 23.201 | 67.979 |
| 412 | 99.703,99.54,99.07,99.277 | 99.397 | 25.000 | 102.069,101.674,102.051,101.998 | 101.948 | 25.000 | | | | 2.551 | 25.000 | 63.775 |
| 413 | 99.54,99.506,98.993,99.07 | 99.277 | 25.000 | 101.674,101.812,102.149,102.051 | 101.921 | 25.000 | | | | 2.644 | 25.000 | 66.100 |
| 414 | 99.506,99.17,98.963,98.993 | 99.158 | 25.000 | 101.812,101.883,102.159,102.149 | 102.001 | 25.000 | | | | 2.843 | 25.000 | 71.075 |
| 415 | 99.17,98.834,98.843,98.963 | 98.952 | 25.000 | 101.883,101.51,101.846,102.159 | 101.850 | 25.000 | | | | 2.898 | 25.000 | 72.450 |
| 416 | 98.834,98.498,98.507,98.843 | 98.670 | 25.000 | 101.51,101.156,101.33,101.846 | 101.460 | 25.000 | | | | 2.790 | 25.000 | 69.750 |
| 417 | 98.498,98.162,98.171,98.507 | 98.334 | 25.000 | 101.156,100.684,100.07,101.33 | 100.810 | 25.000 | | | | 2.476 | 25.000 | 61.900 |
| 418 | 98.162,98.01,97.972,97.995,97.995,98.171 | 98.051 | 24.699 | 100.684,99.365,98.874,98.901,98.901,100.07 | 99.466 | 24.699 | | | | 1.415 | 24.699 | 34.949 |
| 419 | 98.01,98.053,97.973,97.972,97.972 | 97.996 | 4.073 | 99.365,98.888,98.808,98.874,98.874 | 98.961 | 4.073 | | | | 0.965 | 4.073 | 3.930 |
| 420 | 94.949,95.062,94.857,94.612,94.949 | 94.884 | 14.724 | 96.253,96.794,96.641,96.028,96.253 | 96.394 | 14.724 | | | | 1.510 | 14.724 | 22.233 |
| 421 | 95.052,95.303,95.249,94.857 | 95.115 | 25.000 | 96.794,97.759,97.621,96.641 | 97.204 | 25.000 | | | | 2.089 | 25.000 | 52.225 |
| 422 | 95.303,95.695,95.642,95.249 | 95.472 | 25.000 | 97.759,98.725,98.6,97.621 | 98.176 | 25.000 | | | | 2.704 | 25.000 | 67.600 |
| 423 | 95.695,96.087,96.034,95.642 | 95.864 | 25.000 | 98.725,99.601,99.398,98.6 | 99.081 | 25.000 | | | | 3.217 | 25.000 | 80.425 |
| 424 | 96.087,96.479,96.426,96.034 | 96.257 | 25.000 | 99.601,100.488,100.415,99.398 | 99.975 | 25.000 | | | | 3.718 | 25.000 | 92.950 |
| 425 | 96.479,96.871,96.726,96.426 | 96.626 | 25.000 | 100.488,100.966,101.096,100.415 | 100.741 | 25.000 | | | | 4.115 | 25.000 | 102.875 |
| 426 | 96.871,97.199,97,96.726 | 96.949 | 25.000 | 100.966,101.076,101.199,101.096 | 101.084 | 25.000 | | | | 4.135 | 25.000 | 103.375 |
| 427 | 97.199,97.473,97.306,97 | 97.245 | 25.000 | 101.076,101.179,101.301,101.199 | 101.189 | 25.000 | | | | 3.944 | 25.000 | 98.600 |
| 428 | 97.473,97.747,97.655,97.306 | 97.545 | 25.000 | 101.179,101.334,101.436,101.301 | 101.313 | 25.000 | | | | 3.768 | 25.000 | 94.200 |
| 429 | 97.747,98.074,98.004,97.655 | 97.870 | 25.000 | 101.334,101.011,101.682,101.436 | 101.366 | 25.000 | | | | 3.496 | 25.000 | 87.400 |
| 430 | 98.074,98.424,98.354,98.004 | 98.214 | 25.000 | 101.011,100.047,101.7,101.682 | 101.110 | 25.000 | | | | 2.896 | 25.000 | 72.400 |
| 431 | 98.424,98.743,98.77,98.77,98.686,98.354 | 98.624 | 24.962 | 100.047,100.351,100.556,100.556,101.576,101 | 100.798 | 24.962 | | | | 2.174 | 24.962 | 54.267 |
| 432 | 99.043,98.987,98.686,98.77,99.043 | 98.906 | 18.986 | 101.232,101.907,101.576,100.556,101.232 | 101.300 | 18.986 | | | | 2.394 | 18.986 | 45.452 |
| 433 | 99.374,99.303,99.237,99.389,99.374,99.312,99 | 99.255 | 10.353 | 100.562,100.573,100.528,100.5,100.552,101.2 | 101.032 | 10.353 | | | | 1.777 | 10.353 | 18.397 |
| 434 | 99.389,99.69,99.655,99.374,99.593,99.59,99.2 | 99.474 | 17.355 | 100.5,100.644,100.662,100.552,101.212,101.2 | 100.917 | 17.355 | | | | 1.443 | 17.355 | 25.043 |
| 435 | 99.69,99.991,99.924,99.838,99.655,99.593,99.( | 99.718 | 11.159 | 100.644,100.788,100.967,100.762,100.662,101 | 100.945 | 11.159 | | | | 1.227 | 11.159 | 13.692 |
| 436 | 99.991,100.101,99.859,99.858,99.924,99.924 | 99.943 | 13.901 | 100.788,101.162,101.941,101.961,100.967,100 | 101.298 | 13.901 | | | | 1.355 | 13.901 | 18.836 |
| 437 | 100.101,100.117,100.117,99.997,99.859,99.69 | 99.891 | 9.190 | 101.162,100.967,101.125,101.161,101.941,102 | 101.667 | 9.190 | | | | 1.776 | 9.190 | 16.321 |
| 438 | 99.955,99.834,99.54,99.703,99.776,99.768,99.5 | 99.806 | 17.528 | 102.159,102.469,101.674,102.069,101.899,101 | 101.984 | 17.528 | | | | 2.178 | 17.528 | 38.176 |
| 439 | 99.834,99.498,99.506,99.54 | 99.594 | 25.000 | 102.469,102.18,101.812,101.674 | 102.034 | 25.000 | | | | 2.440 | 25.000 | 61.000 |
| 440 | 99.498,99.162,99.17,99.506 | 99.334 | 25.000 | 102.18,101.772,101.883,101.812 | 101.912 | 25.000 | | | | 2.578 | 25.000 | 64.450 |
| 441 | 99.162,98.826,98.834,99.17 | 98.998 | 25.000 | 101.772,101.499,101.51,101.883 | 101.666 | 25.000 | | | | 2.668 | 25.000 | 66.700 |
| 442 | 98.826,98.49,98.498,98.834 | 98.662 | 25.000 | 101.499,101.507,101.156,101.51 | 101.418 | 25.000 | | | | 2.756 | 25.000 | 68.900 |
| 443 | 98.49,98.163,98.162,98.498 | 98.328 | 25.000 | 101.507,101.065,100.684,101.156 | 101.103 | 25.000 | | | | 2.775 | 25.000 | 69.375 |
| 444 | 98.163,98.12,98.01,98.162 | 98.114 | 25.000 | 101.065,99.845,99.365,100.684 | 100.240 | 25.000 | | | | 2.126 | 25.000 | 53.150 |
| 445 | 98.12,98.2,98.053,98.053,98.01 | 98.087 | 13.009 | 99.845,98.949,98.888,98.888,99.365 | 99.187 | 13.009 | | | | 1.100 | 13.009 | 14.310 |
| 446 | 95.121,95.374,95.052,94.949,95.121 | 95.124 | 12.854 | 96.407,96.902,96.794,96.253,96.407 | 96.553 | 12.854 | | | | 1.429 | 12.854 | 18.368 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 447 | 96.374,95.78,95.303,95.052 | 95.377 | 25.000 | 96.902,97.931,97.759,96.794 | 97.346 | 25.000 | | | | 1.969 | 25.000 | 49.225 |
| 448 | 95.78,95.966,95.695,95.303 | 95.686 | 25.000 | 97.931,98.858,98.725,97.759 | 98.318 | 25.000 | | | | 2.632 | 25.000 | 65.800 |
| 449 | 95.966,96.153,96.087,95.695 | 95.975 | 25.000 | 98.858,99.691,99.601,98.725 | 99.218 | 25.000 | | | | 3.243 | 25.000 | 81.075 |
| 450 | 96.153,96.532,96.479,96.087 | 96.313 | 25.000 | 99.691,100.555,100.488,99.601 | 100.084 | 25.000 | | | | 3.771 | 25.000 | 94.275 |
| 451 | 96.532,96.924,96.871,96.479 | 96.702 | 25.000 | 100.555,100.836,100.966,100.488 | 100.711 | 25.000 | | | | 4.009 | 25.000 | 100.225 |
| 452 | 96.924,97.317,97.199,96.871 | 97.078 | 25.000 | 100.836,100.951,101.076,100.966 | 100.957 | 25.000 | | | | 3.879 | 25.000 | 96.975 |
| 453 | 97.317,97.673,97.473,97.199 | 97.416 | 25.000 | 100.951,101.057,101.179,101.076 | 101.066 | 25.000 | | | | 3.650 | 25.000 | 91.250 |
| 454 | 97.673,97.947,97.747,97.473 | 97.710 | 25.000 | 101.057,101.233,101.334,101.179 | 101.201 | 25.000 | | | | 3.491 | 25.000 | 87.275 |
| 455 | 97.947,98.221,98.074,97.747 | 97.997 | 25.000 | 101.233,99.426,101.011,101.334 | 100.751 | 25.000 | | | | 2.754 | 25.000 | 68.850 |
| 456 | 98.221,98.268,98.458,98.458,98.424,98.074 | 98.317 | 19.786 | 99.426,99.491,99.769,99.769,100.047,101.011 | 99.919 | 19.786 | | | | 1.602 | 19.786 | 31.697 |
| 457 | 98.608,98.843,98.816,98.78,98.608,98.458,98.4 | 98.639 | 8.631 | 99.936,100.207,100.141,100.106,99.936,99.76 | 100.024 | 8.631 | | | | 1.385 | 8.631 | 11.954 |
| 458 | 98.843,99.188,99.108,98.816,98.816 | 98.954 | 14.801 | 100.207,100.305,100.442,100.141,100.141 | 100.247 | 14.801 | | | | 1.293 | 14.801 | 19.138 |
| 459 | 99.188,99.49,99.389,99.237,99.108,99.108 | 99.253 | 23.745 | 100.305,100.449,100.5,100.528,100.442,100.4 | 100.444 | 23.745 | | | | 1.191 | 23.745 | 28.280 |
| 460 | 99.49,99.791,99.69,99.389 | 99.590 | 25.000 | 100.449,100.593,100.644,100.5 | 100.546 | 25.000 | | | | 0.956 | 25.000 | 23.900 |
| 461 | 99.791,100.092,99.991,99.69 | 99.891 | 25.000 | 100.593,100.737,100.788,100.644 | 100.691 | 25.000 | | | | 0.800 | 25.000 | 20.000 |
| 462 | 100.092,100.107,100.268,100.268,100.101,99.5 | 100.138 | 17.825 | 100.737,100.744,100.976,100.976,101.162,100 | 100.897 | 17.825 | | | | 0.759 | 17.825 | 13.529 |
| 463 | 100.117,100.101,100.268,100.117 | 100.151 | 3.096 | 100.987,101.162,100.976,100.987 | 101.028 | 3.096 | | | | 0.877 | 3.096 | 2.715 |
| 464 | 99.829,99.834,99.955,99.829 | 99.862 | 2.389 | 102.492,102.469,102.159,102.492 | 102.403 | 2.389 | | | | 2.541 | 2.389 | 6.070 |
| 465 | 99.793,99.489,99.498,99.834,99.829,99.793 | 99.706 | 23.082 | 102.154,102.15,102.18,102.469,102.492,102.1 | 102.266 | 23.082 | | | | 2.560 | 23.082 | 59.090 |
| 466 | 99.489,99.153,99.162,99.498 | 99.325 | 25.000 | 102.15,101.987,101.772,102.18 | 102.022 | 25.000 | | | | 2.697 | 25.000 | 67.425 |
| 467 | 99.153,98.817,98.826,99.162 | 98.990 | 25.000 | 101.987,101.693,101.499,101.772 | 101.738 | 25.000 | | | | 2.748 | 25.000 | 68.700 |
| 468 | 98.817,98.482,98.49,98.826 | 98.654 | 25.000 | 101.693,101.438,101.507,101.499 | 101.534 | 25.000 | | | | 2.880 | 25.000 | 72.000 |
| 469 | 98.482,98.166,98.163,98.49 | 98.325 | 25.000 | 101.438,100.633,101.065,101.507 | 101.161 | 25.000 | | | | 2.836 | 25.000 | 70.900 |
| 470 | 98.166,98.204,98.12,98.163 | 98.163 | 25.000 | 100.633,99.607,99.845,101.065 | 100.288 | 25.000 | | | | 2.125 | 25.000 | 53.125 |
| 471 | 98.204,98.201,98.201,98.2,98.2,98.12 | 98.188 | 15.335 | 99.607,99.082,98.934,98.949,98.949,99.845 | 99.228 | 15.335 | | | | 1.040 | 15.335 | 15.948 |
| 472 | 95.288,95.501,95.374,95.121,95.288 | 95.315 | 10.984 | 96.561,96.978,96.902,96.407,96.561 | 96.682 | 10.984 | | | | 1.367 | 10.984 | 15.015 |
| 473 | 95.501,96.03,95.78,95.374 | 95.671 | 25.000 | 96.978,96.03,97.931,96.902 | 97.460 | 25.000 | | | | 1.769 | 25.000 | 44.225 |
| 474 | 96.03,96.507,95.966,95.78 | 96.071 | 25.000 | 96.03,98.853,98.858,97.931 | 98.418 | 25.000 | | | | 2.347 | 25.000 | 58.675 |
| 475 | 96.507,96.694,96.153,95.966 | 96.330 | 25.000 | 98.853,99.726,99.691,98.858 | 99.282 | 25.000 | | | | 2.952 | 25.000 | 73.800 |
| 476 | 96.694,96.881,96.532,96.153 | 96.565 | 25.000 | 99.726,100.593,100.555,99.691 | 100.141 | 25.000 | | | | 3.576 | 25.000 | 89.400 |
| 477 | 96.881,97.067,96.924,96.532 | 96.851 | 25.000 | 100.593,100.705,100.836,100.555 | 100.672 | 25.000 | | | | 3.821 | 25.000 | 95.525 |
| 478 | 97.067,97.37,97.317,96.924 | 97.170 | 25.000 | 100.705,100.82,100.951,100.836 | 100.828 | 25.000 | | | | 3.658 | 25.000 | 91.450 |
| 479 | 97.37,97.762,97.673,97.317 | 97.530 | 25.000 | 100.82,100.935,101.057,100.951 | 100.941 | 25.000 | | | | 3.411 | 25.000 | 85.275 |
| 480 | 97.762,98.144,98.145,98.145,97.947,97.673 | 97.969 | 24.999 | 100.935,100.043,100.037,100.037,101.233,101 | 100.557 | 24.999 | | | | 2.588 | 24.999 | 64.697 |
| 481 | 98.405,98.396,98.42,98.405,98.248,98.221,97.9 | 98.270 | 14.189 | 99.558,99.536,99.574,99.558,99.444,99.426,10 | 99.757 | 14.189 | | | | 1.487 | 14.189 | 21.099 |
| 482 | 98.42,98.694,98.534,98.454,98.405,98.248,98.2 | 98.378 | 11.998 | 99.574,99.998,99.838,99.677,99.558,99.444,99 | 99.589 | 11.998 | | | | 1.211 | 11.998 | 14.530 |
| 483 | 98.694,98.968,98.843,98.608,98.534,98.534 | 98.697 | 24.189 | 99.998,100.237,100.207,99.936,99.838,99.838 | 100.009 | 24.189 | | | | 1.312 | 24.189 | 31.736 |
| 484 | 98.968,99.263,99.188,98.843 | 99.065 | 25.000 | 100.237,100.289,100.305,100.207 | 100.259 | 25.000 | | | | 1.194 | 25.000 | 29.850 |
| 485 | 99.263,99.59,99.49,99.188 | 99.383 | 25.000 | 100.289,100.398,100.449,100.305 | 100.360 | 25.000 | | | | 0.977 | 25.000 | 24.425 |
| 486 | 99.59,99.733,99.858,99.858,99.791,99.49 | 99.720 | 22.799 | 100.398,100.466,100.559,100.559,100.593,100 | 100.504 | 22.799 | | | | 0.784 | 22.799 | 17.874 |
| 487 | 100.095,100.092,99.791,99.858,100.095 | 99.986 | 8.710 | 100.736,100.737,100.593,100.559,100.736 | 100.672 | 8.710 | | | | 0.686 | 8.710 | 5.975 |
| 488 | 100.107,100.092,100.095,100.107 | 100.100 | 0.019 | 100.744,100.737,100.736,100.744 | 100.740 | 0.019 | | | | 0.640 | 0.019 | 0.012 |
| 489 | 99.841,99.489,99.793,99.841 | 99.741 | 8.299 | 101.68,102.15,102.154,101.68 | 101.916 | 8.299 | | | | 2.175 | 8.299 | 18.050 |
| 490 | 99.842,99.398,99.153,99.489,99.841,99.842 | 99.594 | 24.998 | 101.678,102.063,101.987,102.15,101.68,101.6 | 101.873 | 24.998 | | | | 2.279 | 24.998 | 56.970 |
| 491 | 99.398,98.948,98.817,99.153 | 99.079 | 25.000 | 102.063,101.393,101.693,101.987 | 101.784 | 25.000 | | | | 2.705 | 25.000 | 67.625 |
| 492 | 98.948,98.498,98.482,98.817 | 98.686 | 25.000 | 101.393,100.478,101.438,101.693 | 101.250 | 25.000 | | | | 2.564 | 25.000 | 64.100 |
| 493 | 98.498,98.209,98.209,98.209,98.166,98.482 | 98.295 | 24.987 | 100.478,98.999,98.999,98.999,100.633,101.43 | 99.924 | 24.987 | | | | 1.629 | 24.987 | 40.704 |
| 494 | 98.203,98.204,98.166,98.209,98.203 | 98.197 | 16.766 | 98.993,99.607,100.633,98.999,98.993 | 99.445 | 16.766 | | | | 1.248 | 16.766 | 20.924 |
| 495 | 98.201,98.204,98.203,98.201,98.201 | 98.202 | 2.437 | 99.082,99.607,98.993,98.991,99.082 | 99.151 | 2.437 | | | | 0.949 | 2.437 | 2.313 |
| 496 | 95.456,95.629,95.501,95.288,95.456 | 95.466 | 9.115 | 96.715,97.055,96.978,96.561,96.715 | 96.806 | 9.115 | | | | 1.339 | 9.115 | 12.206 |
| 497 | 95.629,98.157,96.03,95.501 | 95.829 | 25.000 | 97.055,98.18,98.03,96.978 | 97.561 | 25.000 | | | | 1.732 | 25.000 | 43.300 |
| 498 | 96.157,96.686,96.507,96.03 | 96.345 | 25.000 | 98.18,98.729,98.853,98.03 | 98.448 | 25.000 | | | | 2.103 | 25.000 | 52.575 |
| 499 | 96.686,97.215,96.694,96.507 | 96.776 | 25.000 | 98.729,99.742,99.726,98.853 | 99.263 | 25.000 | | | | 2.487 | 25.000 | 62.175 |
| 500 | 97.215,97.422,96.881,96.694 | 97.053 | 25.000 | 99.742,100.46,100.593,99.726 | 100.130 | 25.000 | | | | 3.077 | 25.000 | 76.925 |
| 501 | 97.422,97.608,97.067,96.881 | 97.244 | 25.000 | 100.46,100.678,100.705,100.593 | 100.609 | 25.000 | | | | 3.365 | 25.000 | 84.125 |
| 502 | 97.608,97.795,97.37,97.067 | 97.460 | 25.000 | 100.678,100.776,100.82,100.705 | 100.745 | 25.000 | | | | 3.285 | 25.000 | 82.125 |

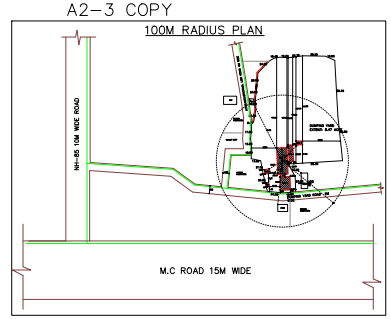
| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 503 | 97.795,97.962,97.905,97.905,97.762,97.37 | 97.781 | 24.719 | 100.776,100.858,100.874,100.874,100.935,100 | 100.856 | 24.719 | | | | 3.075 | 24.719 | 76.011 |
| 504 | 98.121,98.207,98.196,98.121,97.905,97.87,98.1 | 98.026 | 11.267 | 100.546,100.231,100.106,100.546,100.874,100 | 100.558 | 11.267 | | | | 2.532 | 11.267 | 28.528 |
| 505 | 98.207,98.599,98.42,98.396,98.196,98.196 | 98.336 | 16.040 | 100.231,99.985,99.574,99.538,100.106,100.10 | 99.923 | 16.040 | | | | 1.587 | 16.040 | 25.455 |
| 506 | 98.599,98.893,98.694,98.42 | 98.652 | 25.000 | 99.985,100.215,99.998,99.574 | 99.943 | 25.000 | | | | 1.291 | 25.000 | 32.275 |
| 507 | 98.893,99.167,98.968,98.694 | 98.931 | 25.000 | 100.215,100.261,100.237,99.998 | 100.178 | 25.000 | | | | 1.247 | 25.000 | 31.175 |
| 508 | 99.167,99.413,99.428,99.428,99.263,98.968 | 99.276 | 24.917 | 100.261,100.285,100.302,100.302,100.289,100 | 100.279 | 24.917 | | | | 1.001 | 24.917 | 24.942 |
| 509 | 99.621,99.59,99.263,99.428,99.621 | 99.504 | 15.441 | 100.383,100.398,100.289,100.302,100.383 | 100.351 | 15.441 | | | | 0.847 | 15.441 | 13.079 |
| 510 | 99.733,99.59,99.621,99.733 | 99.669 | 1.777 | 100.466,100.398,100.383,100.466 | 100.428 | 1.777 | | | | 0.759 | 1.777 | 1.349 |
| 511 | 100.076,100.02,99.398,99.842,100.076 | 99.882 | 16.123 | 101.199,101.17,102.063,101.678,101.199 | 101.462 | 16.123 | | | | 1.580 | 16.123 | 25.474 |
| 512 | 100.02,99.671,98.948,99.398 | 99.509 | 25.000 | 101.17,100.637,101.393,102.063 | 101.316 | 25.000 | | | | 1.807 | 25.000 | 45.175 |
| 513 | 99.671,99.554,98.897,98.897,98.498,98.948 | 99.078 | 21.444 | 100.637,100.261,99.663,99.663,100.478,101.3 | 100.349 | 21.444 | | | | 1.271 | 21.444 | 27.255 |
| 514 | 98.209,98.498,98.897,98.32,98.209 | 98.427 | 7.001 | 98.999,100.478,99.663,99.138,98.999 | 99.456 | 7.001 | | | | 1.029 | 7.001 | 7.204 |
| 515 | 95.623,95.756,95.629,95.456,95.623 | 95.617 | 7.245 | 97.101,97.454,97.055,96.715,97.101 | 97.085 | 7.245 | | | | 1.468 | 7.245 | 10.636 |
| 516 | 95.756,96.285,96.157,95.629 | 95.957 | 25.000 | 97.454,98.181,98.18,97.055 | 97.717 | 25.000 | | | | 1.760 | 25.000 | 44.000 |
| 517 | 96.285,96.814,96.686,96.157 | 96.486 | 25.000 | 98.181,98.905,98.729,98.18 | 98.499 | 25.000 | | | | 2.013 | 25.000 | 50.325 |
| 518 | 96.814,97.343,97.215,96.686 | 97.014 | 25.000 | 98.905,99.854,99.742,98.729 | 99.308 | 25.000 | | | | 2.294 | 25.000 | 57.350 |
| 519 | 97.343,97.871,97.422,97.215 | 97.463 | 25.000 | 99.854,100.326,100.46,99.742 | 100.096 | 25.000 | | | | 2.633 | 25.000 | 65.825 |
| 520 | 97.871,98.149,97.608,97.422 | 97.763 | 25.000 | 100.326,100.656,100.678,100.46 | 100.530 | 25.000 | | | | 2.767 | 25.000 | 69.175 |
| 521 | 98.149,98.283,98.2,98.2,97.795,97.608 | 98.039 | 24.122 | 100.656,100.726,100.759,100.759,100.776,100 | 100.726 | 24.122 | | | | 2.687 | 24.122 | 64.816 |
| 522 | 98.452,98.522,98.34,98.452,98.2,97.952,97.79 | 98.239 | 9.484 | 100.788,100.741,100.78,100.788,100.759,100. | 100.781 | 9.484 | | | | 2.542 | 9.484 | 24.108 |
| 523 | 98.522,98.709,98.207,98.121,98.169,98.34,98.1 | 98.344 | 18.841 | 100.741,100.634,100.231,100.546,100.777,100 | 100.641 | 18.841 | | | | 2.297 | 18.841 | 43.278 |
| 524 | 98.709,98.896,98.599,98.207 | 98.603 | 25.000 | 100.634,100.41,99.985,100.231 | 100.315 | 25.000 | | | | 1.712 | 25.000 | 42.800 |
| 525 | 98.896,99.082,98.893,98.599 | 98.868 | 25.000 | 100.41,100.164,100.215,99.985 | 100.194 | 25.000 | | | | 1.326 | 25.000 | 33.150 |
| 526 | 99.082,99.171,99.281,99.281,99.167,98.893 | 99.146 | 21.351 | 100.164,100.084,100.139,100.139,100.261,100 | 100.167 | 21.351 | | | | 1.021 | 21.351 | 21.799 |
| 527 | 99.413,99.167,99.281,99.413 | 99.319 | 6.390 | 100.285,100.261,100.139,100.285 | 100.243 | 6.390 | | | | 0.924 | 6.390 | 5.904 |
| 528 | 99.956,100.02,100.076,99.956 | 100.002 | 1.663 | 100.777,101.17,101.199,100.777 | 100.981 | 1.663 | | | | 0.979 | 1.663 | 1.618 |
| 529 | 99.671,100.02,99.956,99.956 | 99.901 | 9.643 | 100.494,100.637,101.17,100.777,100.777,100. | 100.725 | 11.628 | | | | 0.624 | 9.643 | 7.946 |
| 531 | 95.774,95.87,95.756,95.623,95.774 | 95.758 | 5.375 | 97.491,97.639,97.454,97.101,97.491 | 97.435 | 5.375 | | | | 1.676 | 5.375 | 9.009 |
| 532 | 95.87,96.411,96.285,95.756 | 96.080 | 25.000 | 97.639,98.385,98.181,97.454 | 97.915 | 25.000 | | | | 1.835 | 25.000 | 45.875 |
| 533 | 96.411,96.941,96.814,96.285 | 96.613 | 25.000 | 98.385,99.13,98.905,98.181 | 98.650 | 25.000 | | | | 2.037 | 25.000 | 50.925 |
| 534 | 96.941,97.47,97.343,96.814 | 97.142 | 25.000 | 99.13,99.721,99.854,98.905 | 99.402 | 25.000 | | | | 2.260 | 25.000 | 56.500 |
| 535 | 97.47,97.999,97.871,97.343 | 97.671 | 25.000 | 99.721,100.193,100.326,99.854 | 100.023 | 25.000 | | | | 2.352 | 25.000 | 58.800 |
| 536 | 97.999,98.315,98.482,98.482,98.149,97.871 | 98.216 | 23.194 | 100.193,100.475,100.642,100.642,100.656,100 | 100.489 | 23.194 | | | | 2.273 | 23.194 | 52.720 |
| 537 | 98.783,98.877,98.635,98.783,98.482,98.283,98 | 98.559 | 8.561 | 100.682,100.731,100.741,100.682,100.642,100 | 100.688 | 8.561 | | | | 2.129 | 8.561 | 18.226 |
| 538 | 98.877,99.063,98.522,98.452,98.635,98.635 | 98.697 | 20.705 | 100.731,100.624,100.741,100.788,100.741,100 | 100.728 | 20.705 | | | | 2.031 | 20.705 | 42.052 |
| 539 | 99.063,99.25,98.709,98.522 | 98.886 | 25.000 | 100.624,100.33,100.634,100.741 | 100.582 | 25.000 | | | | 1.696 | 25.000 | 42.400 |
| 540 | 99.25,99.389,99.349,99.349,98.896,98.709 | 99.157 | 24.489 | 100.33,99.849,99.907,99.907,100.41,100.634 | 100.173 | 24.489 | | | | 1.016 | 24.489 | 24.881 |
| 541 | 99.193,99.082,98.896,99.349,99.193 | 99.142 | 13.039 | 100.137,100.164,100.41,99.907,100.137 | 100.151 | 13.039 | | | | 1.009 | 13.039 | 13.156 |
| 542 | 99.171,99.082,99.193,99.171 | 99.154 | 0.822 | 100.084,100.164,100.137,100.084 | 100.117 | 0.822 | | | | 0.963 | 0.822 | 0.792 |
| 543 | 95.891,95.943,95.87,95.774,95.784,95.891 | 95.859 | 3.433 | 97.313,97.388,97.639,97.481,97.475,97.313 | 97.437 | 3.433 | | | | 1.578 | 3.433 | 5.417 |
| 544 | 95.943,96.484,96.411,95.87 | 96.177 | 25.000 | 97.388,98.267,98.385,97.639 | 97.920 | 25.000 | | | | 1.743 | 25.000 | 43.575 |
| 545 | 96.484,97.025,96.941,96.411 | 96.715 | 25.000 | 98.267,99.012,99.13,98.385 | 98.698 | 25.000 | | | | 1.983 | 25.000 | 49.575 |
| 546 | 97.025,97.566,97.47,96.941 | 97.251 | 25.000 | 99.012,98.364,99.721,99.13 | 99.056 | 25.000 | | | | 1.805 | 25.000 | 45.125 |
| 547 | 97.566,97.823,98.067,98.067,97.999,97.47 | 97.832 | 21.934 | 98.364,99.024,100.122,100.122,100.193,99.72 | 99.591 | 21.934 | | | | 1.759 | 21.934 | 38.582 |
| 548 | 98.31,98.647,98.585,98.31,98.067,98.315,97.9 | 98.288 | 8.299 | 100.238,100.532,100.606,100.238,100.122,100 | 100.316 | 8.299 | | | | 2.028 | 8.299 | 16.830 |
| 549 | 98.647,99.184,98.877,98.783,98.585,98.585 | 98.777 | 22.226 | 100.532,100.632,100.731,100.682,100.606,100 | 100.632 | 22.226 | | | | 1.855 | 22.226 | 41.229 |
| 550 | 99.184,99.604,99.063,98.877 | 99.182 | 25.000 | 100.632,100.507,100.624,100.731 | 100.624 | 25.000 | | | | 1.442 | 25.000 | 36.050 |
| 551 | 99.604,99.636,99.506,99.506,99.25,99.063 | 99.428 | 19.540 | 100.507,100.488,100.076,100.076,100.33,100. | 100.350 | 19.540 | | | | 0.922 | 19.540 | 18.016 |
| 552 | 99.389,99.25,99.506,99.389 | 99.384 | 4.416 | 99.849,100.33,100.076,99.849 | 100.026 | 4.416 | | | | 0.642 | 4.416 | 2.835 |
| 553 | 96.009,96.017,95.943,95.891,96.009 | 95.974 | 1.391 | 97.136,97.141,97.388,97.313,97.136 | 97.223 | 1.391 | | | | 1.249 | 1.391 | 1.737 |
| 554 | 96.017,96.557,96.484,95.943 | 96.250 | 25.000 | 97.141,98.061,98.267,97.388 | 97.714 | 25.000 | | | | 1.464 | 25.000 | 36.600 |
| 555 | 96.557,97.098,97.025,96.484 | 96.791 | 25.000 | 98.061,98.895,99.012,98.267 | 98.559 | 25.000 | | | | 1.768 | 25.000 | 44.200 |
| 556 | 97.098,97.639,97.566,97.025 | 97.332 | 25.000 | 98.895,98.95,98.364,99.012 | 98.806 | 25.000 | | | | 1.473 | 25.000 | 36.825 |
| 557 | 97.639,98.18,98.131,97.867,97.619,97.823,97.8 | 97.831 | 12.909 | 98.95,99.781,99.265,99.188,98.508,99.024,99. | 99.013 | 12.909 | | | | 1.182 | 12.909 | 15.258 |
| 558 | 98.18,98.721,98.647,98.31,98.131,98.131 | 98.353 | 23.416 | 99.781,100.393,100.532,100.238,99.265,99.26 | 99.912 | 23.416 | | | | 1.559 | 23.416 | 36.506 |
| 559 | 98.721,99.02,99.184,98.647 | 98.893 | 25.000 | 100.393,100.531,100.632,100.532 | 100.522 | 25.000 | | | | 1.629 | 25.000 | 40.725 |

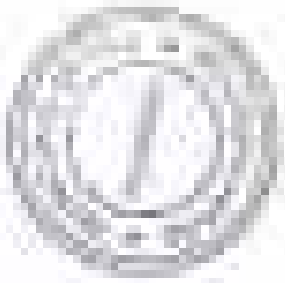
| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 560 | 99.02,99.064,99.231,99.663,99.663,99.604,99. | 99.347 | 11.374 | 100.531,100.512,100.549,100.495,100.495,100 | 100.531 | 11.374 | | | | 1.184 | 11.374 | 13.467 |
| 561 | 99.636,99.604,99.663,99.636 | 99.635 | 0.230 | 100.488,100.507,100.495,100.488 | 100.495 | 0.230 | | | | 0.860 | 0.230 | 0.198 |
| 562 | 96.03,96.017,96.009,96.03 | 96.021 | 0.033 | 97.104,97.141,97.136,97.104 | 97.121 | 0.033 | | | | 1.100 | 0.033 | 0.036 |
| 563 | 96.126,96.631,96.557,96.017,96.03,96.126 | 96.248 | 24.315 | 96.959,97.808,98.061,97.141,97.104,96.959 | 97.339 | 24.315 | | | | 1.091 | 24.315 | 26.528 |
| 564 | 96.631,97.172,97.098,96.557 | 96.884 | 25.000 | 97.808,98.724,98.695,98.061 | 98.372 | 25.000 | | | | 1.508 | 25.000 | 37.700 |
| 565 | 97.172,97.519,97.639,97.098 | 97.357 | 25.000 | 98.724,99.291,98.95,98.695 | 98.965 | 25.000 | | | | 1.608 | 25.000 | 40.200 |
| 566 | 97.519,97.793,98.18,97.639 | 97.783 | 25.000 | 99.291,99.772,99.781,98.95 | 99.449 | 25.000 | | | | 1.666 | 25.000 | 41.650 |
| 567 | 97.793,98.067,98.721,98.18 | 98.190 | 25.000 | 99.772,100.253,100.393,99.781 | 100.050 | 25.000 | | | | 1.860 | 25.000 | 46.500 |
| 568 | 98.067,98.341,99.02,98.721 | 98.537 | 25.000 | 100.253,100.532,100.531,100.393 | 100.427 | 25.000 | | | | 1.890 | 25.000 | 47.250 |
| 569 | 98.341,98.813,99.064,99.064,99.02 | 98.860 | 8.527 | 100.532,100.383,100.512,100.512,100.531 | 100.494 | 8.527 | | | | 1.634 | 8.527 | 13.933 |
| 570 | 96.059,96.292,96.631,96.126,96.059 | 96.233 | 22.305 | 96.782,97.489,97.808,96.959,96.782 | 97.164 | 22.305 | | | | 0.931 | 22.305 | 20.766 |
| 571 | 96.292,96.566,97.172,96.631 | 96.665 | 25.000 | 97.489,98.328,98.724,97.808 | 98.087 | 25.000 | | | | 1.422 | 25.000 | 35.550 |
| 572 | 96.566,96.84,97.519,97.172 | 97.024 | 25.000 | 98.328,99.032,99.291,98.724 | 98.844 | 25.000 | | | | 1.820 | 25.000 | 45.500 |
| 573 | 96.84,97.114,97.793,97.519 | 97.317 | 25.000 | 99.032,99.561,99.772,99.291 | 99.414 | 25.000 | | | | 2.097 | 25.000 | 52.425 |
| 574 | 97.114,97.388,98.067,97.793 | 97.591 | 25.000 | 99.561,100.09,100.253,99.772 | 99.919 | 25.000 | | | | 2.328 | 25.000 | 58.200 |
| 575 | 97.388,97.871,98.341,98.067 | 97.917 | 25.000 | 100.09,100.595,100.532,100.253 | 100.368 | 25.000 | | | | 2.451 | 25.000 | 61.275 |
| 576 | 97.871,98.898,98.813,98.813,98.341 | 98.547 | 17.688 | 100.595,99.583,100.383,100.383,100.532 | 100.295 | 17.688 | | | | 1.748 | 17.688 | 30.919 |
| 577 | 95.953,95.995,96.292,96.059,95.88,95.953 | 96.022 | 19.510 | 96.784,97.232,97.489,96.782,96.769,96.784 | 96.973 | 19.510 | | | | 0.951 | 19.510 | 18.554 |
| 578 | 95.995,96.056,96.566,96.292 | 96.227 | 25.000 | 97.232,97.941,98.328,97.489 | 97.748 | 25.000 | | | | 1.521 | 25.000 | 38.025 |
| 579 | 96.056,96.161,96.84,96.566 | 96.406 | 25.000 | 97.941,98.753,99.032,98.328 | 98.514 | 25.000 | | | | 2.108 | 25.000 | 52.700 |
| 580 | 96.161,96.435,97.114,96.84 | 96.637 | 25.000 | 98.753,99.282,99.561,99.032 | 99.157 | 25.000 | | | | 2.520 | 25.000 | 63.000 |
| 581 | 96.435,96.709,97.388,97.114 | 96.911 | 25.000 | 99.282,98.973,100.09,99.561 | 99.477 | 25.000 | | | | 2.566 | 25.000 | 64.150 |
| 582 | 96.709,97.139,97.134,97.134,97.871,97.388 | 97.229 | 24.969 | 98.973,97.824,97.819,97.819,100.595,100.09 | 98.854 | 24.969 | | | | 1.625 | 24.969 | 40.575 |
| 583 | 97.065,97.723,97.723,98.898,97.871,97.134,97 | 97.640 | 17.859 | 97.75,98.408,98.408,99.583,100.595,97.819,97 | 98.616 | 17.859 | | | | 0.976 | 17.859 | 17.430 |
| 584 | 96.065,96.091,95.995,95.953,96.051,96.065 | 96.037 | 14.232 | 96.824,97.089,97.232,96.784,96.805,96.824 | 96.926 | 14.232 | | | | 0.889 | 14.232 | 12.652 |
| 585 | 96.091,96.152,96.056,95.995 | 96.073 | 25.000 | 97.089,97.799,97.941,97.232 | 97.515 | 25.000 | | | | 1.442 | 25.000 | 36.050 |
| 586 | 96.152,96.214,96.161,96.056 | 96.146 | 25.000 | 97.799,97.884,98.753,97.941 | 98.094 | 25.000 | | | | 1.948 | 25.000 | 48.700 |
| 587 | 96.214,96.263,96.266,96.266,96.435,96.161 | 96.268 | 24.774 | 97.884,97.276,97.313,97.313,99.282,98.753 | 97.970 | 24.774 | | | | 1.702 | 24.774 | 42.165 |
| 588 | 96.412,96.709,96.435,96.266,96.412 | 96.447 | 16.808 | 97.687,98.973,99.282,97.313,97.687 | 98.188 | 16.808 | | | | 1.741 | 16.808 | 29.263 |
| 589 | 97.139,96.709,96.412,97.139 | 96.850 | 5.067 | 97.824,98.973,97.687,97.824 | 98.077 | 5.067 | | | | 1.227 | 5.067 | 6.217 |
| 590 | 96.147,96.091,96.065,96.147 | 96.112 | 2.996 | 97.007,97.089,96.824,97.007 | 96.982 | 2.996 | | | | 0.870 | 2.996 | 2.607 |
| 591 | 96.206,96.147,96.234,96.152,96.091,96.147 | 96.163 | 17.856 | 97.159,96.917,96.917,96.933,97.799,97.089,97 | 97.123 | 22.615 | | | | 0.960 | 17.856 | 17.142 |
| 592 | 96.25,96.214,96.152,96.234,96.25 | 96.220 | 15.350 | 97.123,97.884,97.799,96.933,97.123 | 97.372 | 15.350 | | | | 1.152 | 15.350 | 17.683 |
| 593 | 96.263,96.214,96.25,96.263 | 96.248 | 3.805 | 97.276,97.884,97.123,97.276 | 97.390 | 3.805 | | | | 1.142 | 3.805 | 4.345 |
| | | | | | | | | Total Qty | 0.000 | | Total Qty | 31995.179 |

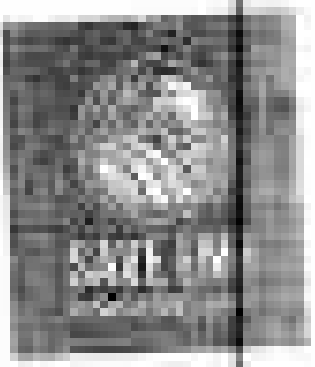
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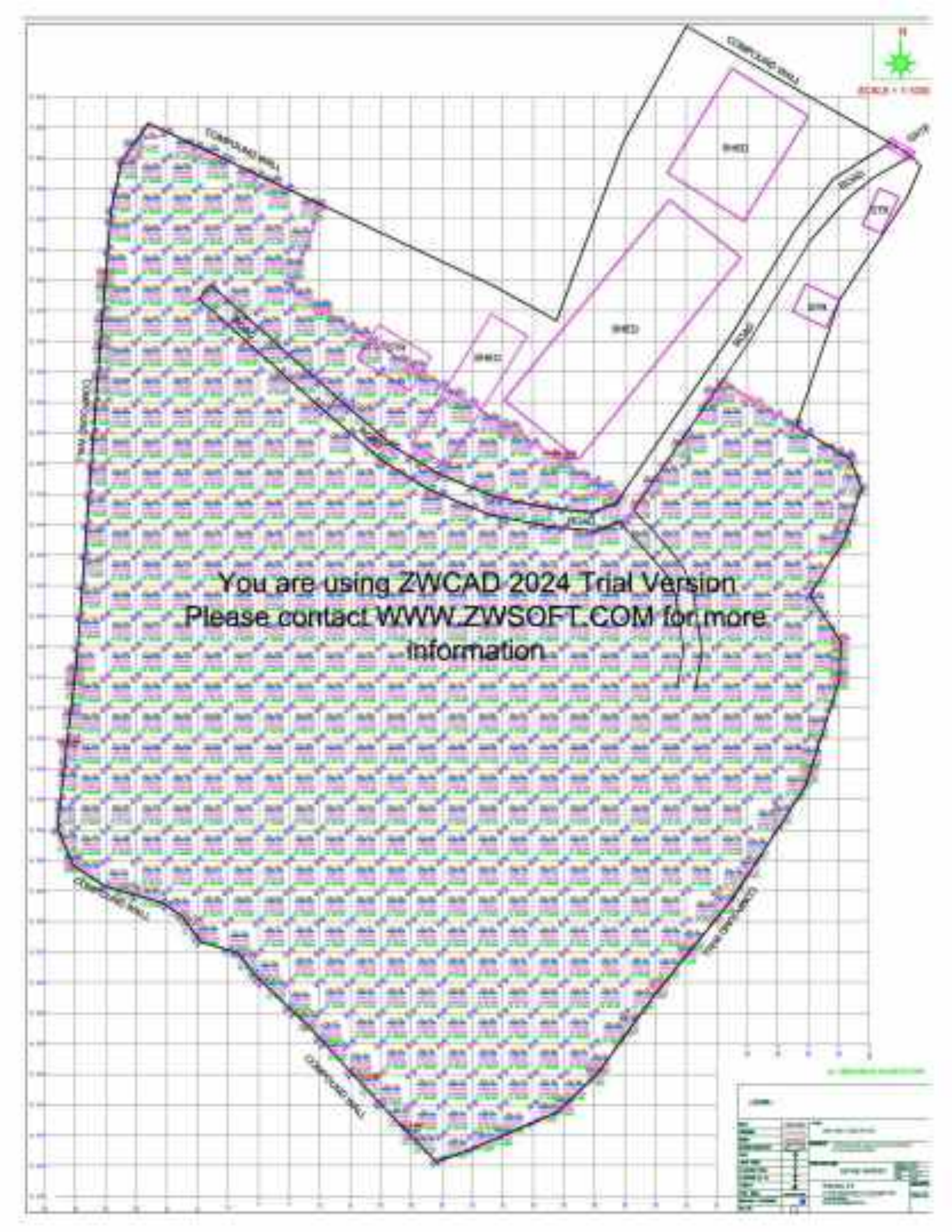



A2-3 COPY








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MatterLab
Where Quality Matters

Report Number: **ML/GT/2220/228/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE B OF KSWMP AT KURIAMALA, MUVATTUPUZHA, ERNAKULAM DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | IPE Global Ltd. |
| Address | : | 2nd Floor, 16/3878-3879, Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact Person | : | Mr. Ranbir Dey |
| Project No | : | GT-221 |
| Project Name | : | Geotechnical examination of dumpsite under package B of KSWMP at Kuriamala, Muvattupuzha, Ernakulam District. |
| Owner | : | KSWMP |
| Project Location | : | Kuriamala, Muvattupuzha, Ernakulam District |
| Tel / Fax No | : | - |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 02-08-2023 | 1st Submission | Dr. Gautham Adapa | |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Dr. Jimmy Thomas | Geotechnical Expert, Consultant, MatterLab | |
| Approved by: | Freddy Suman | General Manager, MatterLab | |

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1 INTRODUCTION ..... 3

2 SCOPE OF WORK ..... 3

3 OBSERVATIONS FROM SITE VISIT ..... 4

4 GEOTECHNICAL INVESTIGATIONS ..... 4

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6 SUMMARY ..... 7

## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results

# 1 INTRODUCTION

Matter Material Testing and Research Laboratory Pvt. Ltd has been set-up as a result of increased demand locally from various industries for a multidisciplinary testing, materials consultancy & investigation facility in alignment with global standards and technological advancements. MatterLab is an independent professional and technical services provider to all who are concerned with quality and performance of materials & products.

IPE Global Ltd. which provides technical support consultancy services to the Urban local bodies in different municipalities for the Kerala State Waste Management Project (KSWMP) has entrusted the geotechnical investigative works as part of their DPR study for the remediation of dumpsite in Kuriamala, Muvattupuzha, Ernakulam district to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was needed to be bored at the site as per the requirements of the project. The initial site visit was done on 23rd May 2023. During the site visit it was observed that the dumpsite is situated in a flat terrain with a few residential homes around on one side and open fields on another side. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 01st June 2023 and was completed on 04th June 2023. Standard Penetration test (SPT) was conducted within the borehole as required. Representative and undisturbed soil samples were collected to conduct relevant laboratory tests to acquire the necessary parameters. This report presents results of the geotechnical investigation of the ground encountered after drilling through the waste at the dumpsite.

# 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil samples and performing necessary laboratory tests on the collected samples to obtain the desired parameters of the ground profile.
- Preparation of report with laboratory test results.

## 3 OBSERVATIONS FROM SITE VISIT

Matterlab has deputed a team from our geotechnical department along with Mr. Ajit Kumar Nayan and Mr. Ravi Kumar of IPE Global during the third week of May 2023, in order to collect the information regarding the site prior to mobilizing the equipment for drilling.

The location of the dumpsite is situated a flat terrain with a few residential homes around on one side and open fields on another side.




**Figure 1** : Location of the borehole drilled at the dumpsite.

## 4 GEOTECHNICAL INVESTIGATIONS

### 4.1 Rotary drilling

Rotary drilling technique was adopted for advancing and clearing out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste in the landfill.

### 4.2 Drilling equipment

Mechanical drilling machine was used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The borehole of 150mm diameter was formed using a drag bit (Soil Cutter) in soil. The drag bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by drilling mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

### 4.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as representative samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

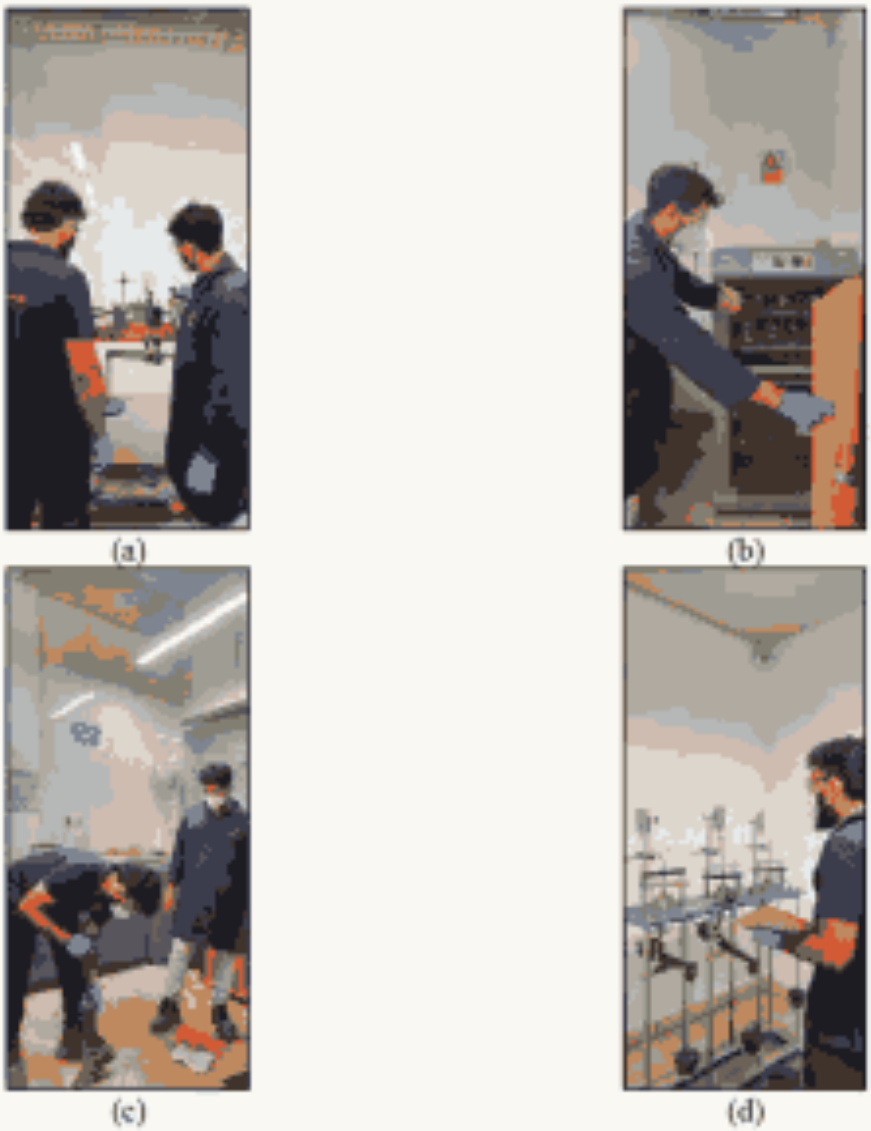
**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log - commencement and completion date, location of borehole, elevation of top and bottom of boring, ground water table, boundaries of each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelog is attached as **Appendix-I.**

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant Standard Codes. A summary of laboratory tests carried out is shown below in **Table 1** and the complete results of laboratory testing are presented in **Appendix II**.



(a) (b) (c) (d)

**Figure 2 :** Laboratory tests performed at MatterLab.

**Table 1: Details of various laboratory tests and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 1 | Soil | Grain-Size Analysis | IS: 2720(Part-4)-1985 |
| 2 | | Atterberg's Limit | IS: 2720(Part-5)-1976 |
| 3 | | MDD/OMC(Light Compaction) | IS:2720(Part-7)-1980 |
| 4 | | Direct Shear | IS:2720(part-130-1986 |
| 5 | | Permeability | IS :2720 (Part-17)-1986 |
| 6 | | Bulk Density & Dry Density | BS:1377-(Part-2)-1990 |
| 7 | | Consolidation | IS: 2720(Part-15)-1986 |
| 8 | | Moisture Content | IS 2720(Part 2)-1973 |
| 9 | | Cation Exchange Capacity | USDA No. 16 |

## 6 SUMMARY

The geotechnical investigation of the original ground below the waste at the dumpsite at Kurianala, Muvattupuzha, Ernakulam district was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a single borehole was drilled through the waste into the ground using a rotary drilling method. The maximum depth of investigation was 10.0m (5.5m in waste and 4.5m in the ground). SPT and collection of undisturbed soil samples were carried out at regular intervals within the ground. Various laboratory tests were carried out on the SPT and undisturbed soil samples.

Based on the investigations carried out, it is observed that the original ground below the dumped waste comprises a 3m thick layer of sandy clay layer underlain by a 1.5m thick layer of clayey sand. As per the information provided by the client, the waste in the dumpsite needs to be excavated, segregated using a few machinery and the inert material left after the bio-mining needs to be dumped within the site. As informed by the client, during the process of bio-mining the waste would be excavated from one feasible location of the site and transferred to another location of the site. During these operations, any temporary storage waste in the form of heaps should be carried out ensuring the stability of the sloping face of the waste. It is suggested that for slopes with a height ≤ 1.5 m the angle of face should not be steeper than 45°. For slopes of a height greater than 1.5 m the slope should be limited to 30°

to horizontal or flatter. It is not advisable to use slope heights > 5 m without a proper stability analysis. If the inert material is being disposed at the site with no further plans of transporting it or transferring it, it is recommended to compact the material into layers using an 8-10 T roller with compacted lift thickness not exceeding 300 mm.

**The Safe Bearing Capacity (SBC)** is calculated as per IS 6403:1981 (Reaffirmed 2021). For any temporary structures planned at the site, the **recommended allowable bearing pressure** for isolated footings at a minimum depth of 1.0 m below **original ground level** is **100 kPa.** For any slope stability calculations involving the natural ground, the parameters presented in the summary sheet of laboratory results can be used.

The above recommendations are made based on the subsoil profile and laboratory test results obtained on the samples collected from the site. If there is any variation in soil profile during execution, fresh recommendation may be obtained from M/s Matter Material Testing & Research Laboratory (P) Ltd. or from a qualified and experienced geotechnical engineer.

# APPENDIX-I

# BORELOGS

Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT** | **: Geotechnical Investigation at Dumpsite in Kuriamala, Muvattupuzha** | **SHEET NO.** | **: 1 of 1** | **START DATE** | **: 01/06/2023** |
| **CLIENT** | **: IPE Global** | **BORE DIAMETER (mm)** | **: 150** | **END DATE** | **: 04/06/2023** |
| **Proposed Structure** | **: Dumpsite remediation** | **BORING TYPE** | **: Rotary** | **REDUCED LEVEL (m)** | **: -** |
| **LOCATION** | **: Kuriamala, Muvattupuzha, Ernakulam District** | **TERMINATION DEPTH (m)** | **: 10.00m** | **EASTING (m)** | **: 76.561362** |
| **BOREHOLE NO.** | **: BH-01** | **WATER LEVEL** | **:** | **NORTHING (m)** | **: 9.993504** |

| DEPTH m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM N1 | N2 | N3 | SPT N VALUE | DEPTH V/S N VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.50 | | Dumped Waste | 5.50 | | | | | | | | |
| 7.00 | | Medium dense greyish coloured fine grained SAND with traces of gravels | 1.50 | 5.50<br>6.00<br>6.50 | SPT-1<br>UDS-1<br>UDS-2 | 3 | 5 | 7 | | | |
| 8.50 | | Very stiff greyish to reddish fine grained silty CLAY with fine sand and little gravel | 1.50 | 7.00<br>7.50<br>8.00 | SPT-2<br>UDS-3<br>UDS-4 | 5 | 7 | 14 | | | |
| 9.5 | | Hard greyish to brown clayey SAND with gravels | 1.0 | 8.50<br>9.00<br>9.50 | SPT-3<br>UDS-4<br>UDS-5 | 12 | 18 | 20 | | | |
| 10.00 | | Hard brownish fine grained sandy SILT with traces of gravel | 0.50 | 10.0 | SPT-4 | 2 | 5 | 3 | | | |
| | | **Bore hole terminated at the depth of 10.0m below top of waste (4.5m below original ground level)** | | | | | | | | | |

Abbreviations
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
CR- Core Recovery, RQD- Rock Quality Designation

Sd/-
Site Supervisor

# APPENDIX-II

# LABORATORY TEST RESULTS

# SUMMARY OF LABORATORY TEST RESULTS

**Report Number : ML23/R-02007 Report Date:17/07/2023**

**Project : Geotechnical Investigation at Dumpsite in Kuriamala, Muvattupuzha, Ernakulam District**

**Borehole ID : BH-01**

| N value | MatterLab ref. | Depth (m) | Type of sample (SPT/UDS/RC) | Soil description | IS Classification | Atterberg Limit | | | Grain size distribution | | | | | | | Maximum dry density, gm/cc | Optimum moisture content, % | Bulk Density, gm/cc | Dry density, gm/cc | Moisture content, % | Cohesion (c), kPa | Internal friction angle, | Permeability, cm/s | Consolidation | | | | Chemical |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit,% | Plastic Limit,% | Plasticity Index | Coarse Gravel,% | Fine Gravel,% | Coarse Sand,% | Medium Sand,% | Fine Sand,% | Silt,% | Clay,% | | | | | | | | | Initial Void ratio | Preconsolidation pressure, kPa | Compression Index, $C_c$ | Recompression Index, $C_r$ | Cation exchange capacity (meq/100gm) |
| 12 | ML23/W-02007/S1 | 5.5 | SPT | Clayey sand / Sandy clay with gravel | SC/CH | 73 | 24 | 49 | | 28 | 14 | 9 | 6 | 18 | 25 | | | | | | | | | | | | | |
| | ML23/W-02007/S2 | 6.0 | UDS | | | | | | | | | | | | | | | 1.54 | 1.43 | 7.4 | 0 | 35 | 2.49 E-03 | 1.247 | 141 | 0.16 | 0.02 | |
| | ML23/W-02007/S3 | 6.5 | UDS | | | | | | | | | | | | | 1.89 | 12 | | | | | | | | | | | |
| 21 | ML23/W-02007/S4 | 7.0 | SPT | Clayey sand / Sandy clay with gravel | SC/CH | 88 | 33 | 55 | | 19 | 9 | 15 | 6 | 51 | | | | | | | | | | | | | | |
| | ML23/W-02007/S5 | 7.5 | UDS | | | | | | | | | | | | | | | 2.20 | 2.05 | 7.3 | 0 | 35 | 8.21 E-04 | 0.548 | 90 | 0.18 | 0.01 | 6.79 |
| | ML23/W-02007/S6 | 8.0 | UDS | | | | | | | | | | | | | 1.90 | 12 | | | | | | | | | | | |
| 38 | ML23/W-02007/S7 | 8.5 | SPT | Clayey sand with gravel | SC | 76 | 26 | 50 | | 28 | 22 | 20 | 9 | 21 | | | | | | | | | | | | | | |
| | ML23/W-02007/S8 | 9.0 | UDS | | | | | | | | | | | | | | | 2.41 | 2.16 | 12.0 | 2 | 35 | 8.26 E-04 | 0.445 | 109 | 0.12 | 0.01 | |
| | ML23/W-02007/S9 | 9.5 | UDS | | | | | | | | | | | | | 1.74 | 14 | | | | | | | | | | | |

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Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur Naka (PO) Thiruvannur,
Kozhikode, Kerala, 673025.

# Grain Size Distribution of Soil Test Report

Report No: ML23/R-020017/1
Issue No : 1
Report Date: 21/06/2023

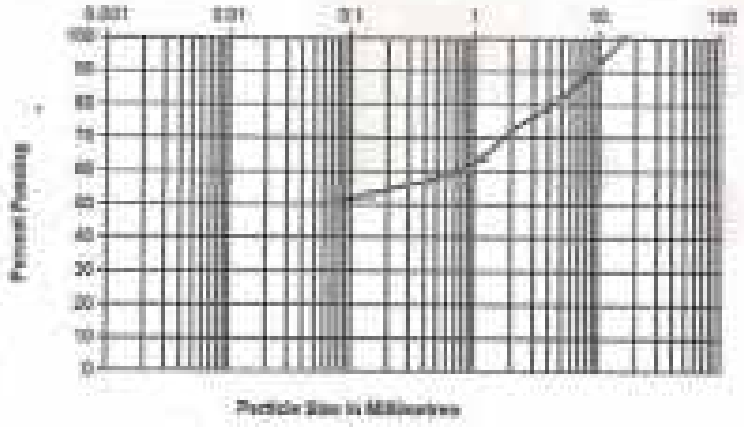
| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanad Building, Kanjangad Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kunnamala, Muvattupuzha ULR-IC[illegible]23000044 53F |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kunnamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 7.00m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/04 | Source*: | BH 01, Depth 7.00m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 – 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kunnamala, Muvattupuzha, Ernakulam District | Date Tested : | 15/06/2023 - 17/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 7.00m |
| Tested By: | GK | Client Sample Desc.*: | Soil, BH 01, Depth 7.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution - Wet & Dry Sieving

Method: IS: 2720 (Part 4)-1985




| Sieve Size (mm) | % Passing | Project Limit |
|---|---|---|
| 16.00 | 100 | - |
| 9.500 | 91 | - |
| 4.750 | 81 | - |
| 2.000 | 72 | - |
| 1.180 | 64 | - |
| 0.850 | 61 | - |
| 0.600 | 59 | - |
| 0.425 | 57 | - |
| 0.300 | 56 | - |
| 0.150 | 53 | - |
| 0.075 | 51 | - |

ANIL POTTEKKAT
DGM / Quality Manager
For and on behalf of MatterLab

Comments
*Information provided by client

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Kozhikode, Kerala, 673020.

TC-10748

# Grain Size Distribution of Soil Test Report

Report No: ML23/W-02007/2
Issue No : 1
Report Date:21/06/2023

| | |
|---|---|
| Client: | PE Global |
| Address: | Kovanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Renabin Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurlamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KDWMP |
| Contractor: | - |
| Project Location: | Kurlamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

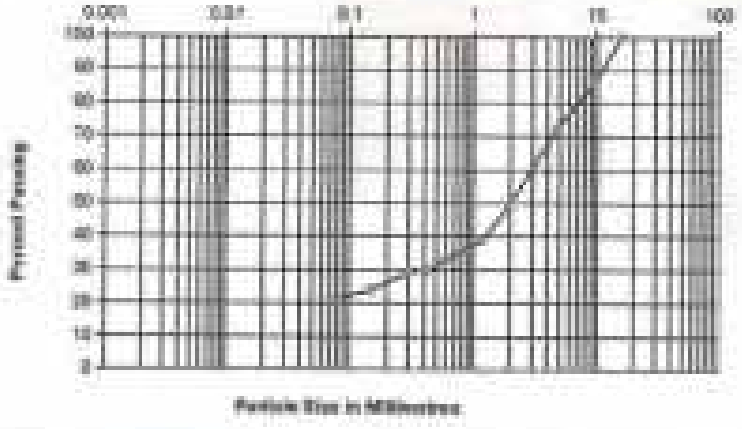
ULR:TC907123000000454F

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*): | Soil, BH 01, Depth 8.50m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/S7 | Source*): | BH 01, Depth 8.50m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*): | Kurlamala, Muvattupuzha, Ernakulam District | Date Tested : | 16/06/2023 - 17/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 8.50m |
| Tested By: | DK | Client Sample Desc.*): | Soil, BH 01, Depth 8.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution - Wet & Dry Sieving

Method: IS: 2720 (Part 4)-1985




| Sieve Size (mm) | % Passing | Project Limit |
|---|---|---|
| 16.00 | 100 | - |
| 9.500 | 88 | - |
| 4.750 | 72 | - |
| 2.000 | 50 | - |
| 1.180 | 39 | - |
| 0.850 | 36 | - |
| 0.600 | 33 | - |
| 0.425 | 30 | - |
| 0.300 | 29 | - |
| 0.150 | 24 | - |
| 0.075 | 21 | - |

ANIL POTTEKKAT
DGM / Quality Manager
For and on behalf of MatterLab

Comments:
*Information provided by client

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Kozhikode, Kerala, 673029.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-020077/2
Issue No.: 1
Report Date: 21/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Karayancor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Kurlamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kurlamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

ULR-TC107A23000044555F

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 5.50m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/01 | Source*: | BH 01, Depth 5.50m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kurlamala, Muvattupuzha, Ernakulam District | Date Tested : | 19/06/2023 - 20/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 5.50m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 5.50m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3 Mechanical Method | Liquid Limit,% | 73 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 24 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 49 | - |

DGM / Quality Manager
Co-sign on behalf of MatterLab

## Comments

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Kozhikode, Kerala, 673019.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-02007/4
Issue No : 1
Report Date:31/05/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Kudamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kudamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

IR-TC07745230808044568F

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/05/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 7.00m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/84 | Source*: | BH 01, Depth 7.00m |
| Date Sampled: | 04/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kudamala, Muvattupuzha, Ernakulam District | Date Tested : | 19/05/2023 - 20/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 7.00m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 7.00m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.5 Mechanical Method | Liquid Limit,% | 88 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 33 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 55 | - |

For and on behalf of MatterLab

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Kozhikode, Kerala, 673029.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-02007/6
Issue No : 1
Report Date: 21/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurlamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kurlamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 8.50m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/67 | Source*: | BH 01, Depth 8.50m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kurlamala, Muvattupuzha, Ernakulam District | Date Tested : | 16/06/2023 - 20/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 8.50m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 8.50m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3 Mechanical Method | Liquid Limit,% | 76 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 26 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 50 | - |

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Kozhikode, Kerala, 673022

TC-10742

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/R-028679
Issue No. : 1
Report Date: 21/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 629030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kuttamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kuttamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

ULR:TC107423000008145F

## Sample Details

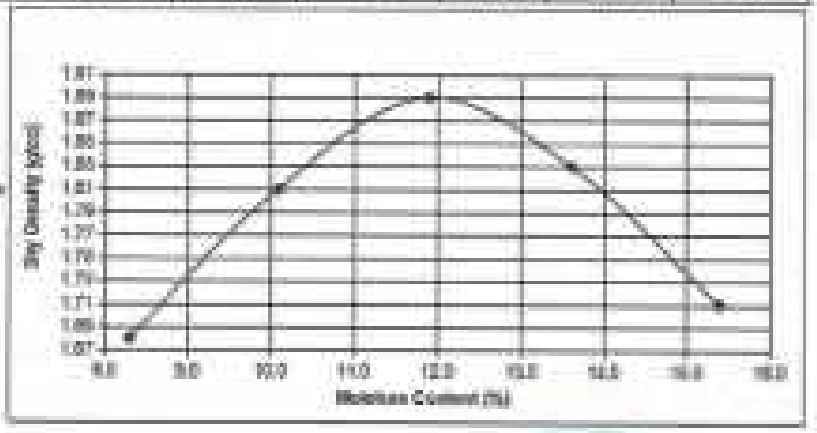
| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*): | Soil (UDS-2), BH 01, Depth 6.50m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By.*): | Geotechnical Division |
| Sample ID: | ML23/W-02007/03 | Source*): | BH 01, Depth 5.50m |
| Date Sampled: | 04/06/2023 | Sampled By*): | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*): | Kuttamala, Muvattupuzha, Ernakulam District | Date Tested : | 16/06/2023 - 17/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 6.50m |
| Tested By: | DK/GK | Client Sample Desc.: | Soil (UDS-2), BH 01, Depth 6.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ (cm$^3$) | 1000 | | | | |
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4063 | | | | |
| Mass of mould + compacted sample | | W (g) | 5879 | 6049 | 6169 | 6139 | 6029 |
| Mass of sample | | | 1816 | 1986 | 2106 | 2076 | 1966 |
| Wet density | $(W-W_m)/V_m$ | $\rho_w$ (Mg/m$^3$) | 1.82 | 1.99 | 2.11 | 2.08 | 1.97 |
| Mass of wet sample | | W (g) | 426.3 | 422.8 | 413.7 | 443.6 | 445.8 |
| Mass of dry sample | | W (g) | 393.6 | 388.5 | 368.7 | 390.9 | 389.9 |
| Moisture content | $[(W_2-W_3)/W_3]x100$ | m (%) | 8.3 | 10.1 | 11.9 | 13.6 | 15.4 |
| Dry density | $\rho_w/[1+m/100]$ | $\rho_d$ (Mg/m$^3$) | 1.68 | 1.81 | 1.89 | 1.83 | 1.71 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc: | 1.89 |
| Optimum moisture content, %: | 13 |
| Material retained on 20mm,%: | 0 |
| Sample used: | Single |
| Size of mould: | 1000cm$^3$ |
| Weight of rammer: | 2.6 kg |




Dept / Quality Manager
For and on behalf of MatterLab

Comments
*Information provided by client

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Kozhikode, Kerala, 673020.

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML/23/0-02007/1
Issue No: 1
Report Date: 21/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 629000 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurlamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kurlamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

IR-TC707493000004459F

## Sample Details

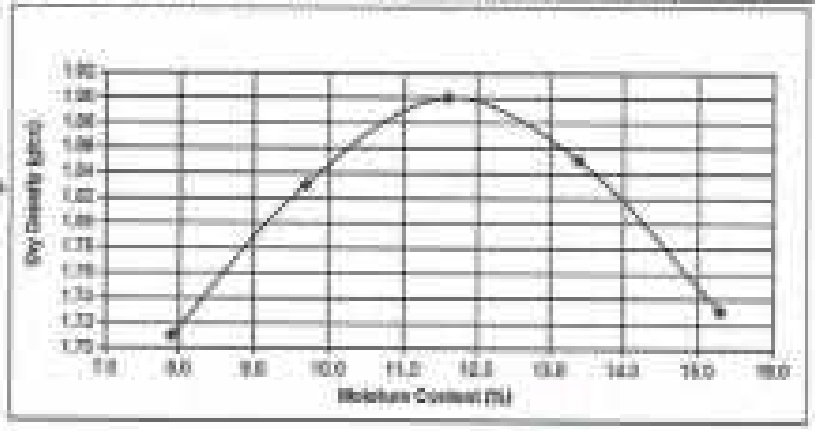
| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*): | Soil (UDS-4), BH 01, Depth 8.00m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By.*): | Geotechnical Division |
| Sample ID: | ML23/W-02007/08 | Source*): | BH 01, Depth 8.00m |
| Date Sampled: | 04/06/2023 | Sampled By*): | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*): | Kurlamala, Muvattupuzha, Ernakulam District | Date Tested : | 16/06/2023 - 17/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-4), BH 01, Depth 8.00m |
| Tested By: | DK/GK | Client Sample Desc.: | Soil (UDS-4), BH 01, Depth 8.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ (cm$^3$) | 950 | | | | |
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4063 | | | | |
| Mass of mould + compacted sample | | W (g) | 5909 | 6069 | 6179 | 6169 | 6049 |
| Mass of sample | | | 1846 | 2006 | 2116 | 2096 | 1986 |
| Wet density | $(W-W_m)/V_m$ | $\rho_w$ (Mg/m$^3$) | 1.80 | 2.01 | 2.12 | 2.10 | 1.99 |
| Mass of wet sample | | $W_{ws}$ (g) | 421.3 | 436.1 | 473.1 | 432.7 | 437.1 |
| Mass of dry sample | | $W_{ds}$ (g) | 380.5 | 400.3 | 423.8 | 381.8 | 378.1 |
| Moisture content | $(W_{ws}-W_{ds})/W_{ds}\times100$ | m (%) | 7.8 | 9.7 | 11.6 | 13.4 | 15.5 |
| Dry density | $\rho_w/(1+m/100)$ | $\rho_d$ (Mg/m$^3$) | 1.71 | 1.83 | 1.90 | 1.85 | 1.73 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc: | 1.90 |
| Optimum moisture content, %: | 13 |
| Material retained on 20mm,%: | 0 |
| Sample used: | Single |
| Size of mould: | 1000cm$^3$ |
| Weight of rammer: | 2.6 kg |




ANIL PHILEKKAT
DGM / Quality Manager
For and on behalf of MatterLab

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# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML23/R-020007/R
Issue No: 0
Report Date: 21/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurlamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSIDC |
| Contractor: | - |
| Project Location: | Kurlamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

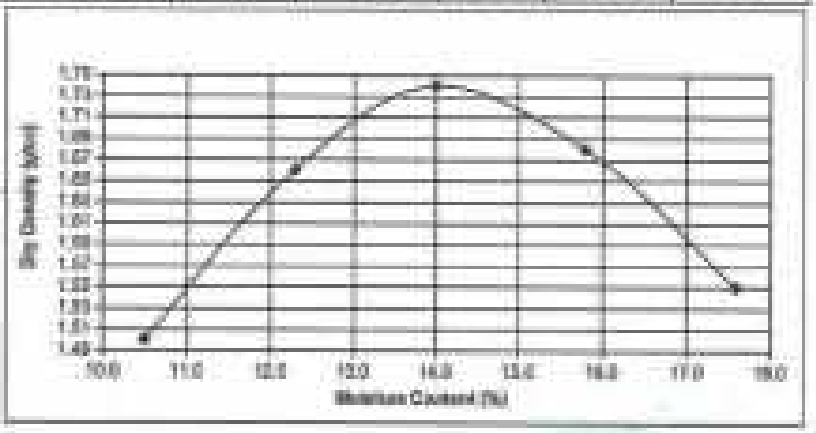
| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*): | Soil (UDS-6), BH 01, Depth 9.50m |
| Work Order ID: | ML23/W-020007 | Sample Submitted By.*): | Geotechnical Division |
| Sample ID: | ML23/W-020007/09 | Source*): | BH 01, Depth 9.50m |
| Date Sampled: | 04/06/2023 | Sampled By*): | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 8 Approx |
| Sample Location*): | Kurlamala, Muvattupuzha, Ernakulam District | Date Tested : | 16/06/2023 - 17/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-6), BH 01, Depth 9.50m |
| Tested By: | DK/DK | Client Sample Desc.: | Soil (UDS-6), BH 01, Depth 9.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ [$cm^3$] | 906 | | | | |
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4003 | | | | |
| Mass of mould + compacted sample | | W (g) | 5720 | 5819 | 5939 | 6009 | 5979 |
| Mass of sample | | | 1607 | 1806 | 1976 | 1946 | 1916 |
| Wet density | $(W-W_m)/V_m$ | $\gamma_b$ [$Mg/m^3$] | 1.66 | 1.88 | 1.98 | 1.88 | 1.82 |
| Mass of wet sample | | $W_w$ (g) | 422.3 | 438.8 | 455.2 | 477.0 | 502.6 |
| Mass of dry sample | | $W_d$ (g) | 383.1 | 390.8 | 399.3 | 411.9 | 427.4 |
| Moisture content | $[(W_w-W_d)/W_d]x100$ | m (%) | 10.8 | 12.3 | 14.0 | 15.8 | 17.6 |
| Dry density | $\gamma_b/(1+m/100)$ | $\gamma_d$ [$Mg/m^3$] | 1.50 | 1.68 | 1.74 | 1.68 | 1.55 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc: | 1.74 |
| Optimum moisture content, % | 14 |
| Material retained on 20mm,% | 0 |
| Sample used | Single |
| Size of mould | 1000cm³ |
| Weight of rammer | 2.6 kg |




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# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-020070
Issue No: 1
Report Date: 21/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveratt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Kuttanadu, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kuttanadu, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Work Order ID: | ML23/WI-020007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/WI-020007/02 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Kuttanadu, Muvattupuzha, Ernakulam District | Date Tested : | 19/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 6.00m |
| Tested By: | GK/DK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 1.54 | - |

Issued on behalf of MatterLab

**Comments**

*Information provided by client

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Thiruvamur, Kozhikode, Kerala, 673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-02/00715
Issue No: 1
Report Date:21/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveratt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kuttanadu, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kuttanadu, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 7.50m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/05 | Source*: | BH 01, Depth 7.50m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Kuttanadu, Muvattupuzha, Ernakulam District | Date Tested : | 16/06/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 7.50m |
| Tested By: | GK/DK | Client Sample Desc.*: | Soil (UDS-3), BH 01, Depth 7.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 2.20 | - |

AMIL POTTEKKAT
DGM - Quality Manager
For and on behalf of MatterLab

**Comments:**
*Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-02007/11
Issue No : 1
Report Date:31/05/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurlamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kurlamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/05/2023 | Client Sample Ref.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/08 | Source*: | BH 01, Depth 9.00m |
| Date Sampled: | 04/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Kurlamala, Muvattupuzha, Ernakulam District | Date Tested : | 18/05/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-5), BH 01, Depth 9.00m |
| Tested By: | GK/DK | Client Sample Desc.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BIS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 2.41 | - |
| | | | |

Authorised Signatory
Quality Manager
For and on behalf of MatterLab

**Comments**

*Information provided by client

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Tests results marked (*) in the samples tested



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# Permeability of Soil Test Report

Report No: ML23/S-03007/12
Issue No : 1
Report Date:21/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayaloor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kudumala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kudumala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Work Order ID: | ML23/W-03007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-03007/02 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kudumala, Muvattupuzha, Ernakulam District | Date Tested : | 19/06/2023 - 19/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 6.00m |
| Tested By: | GR/DK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 3.49 E-03 | - |

RESEESH TV
Head-CMR Laboratory

For and on behalf of Matter Lab

**Comments**

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# Permeability of Soil Test Report

Report No: ML23/W-02007/13
Issue No: 1
Report Date: 21/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveriatt Building, Kanayiwoor Village, Kakkanad, Ernakulam, Kerala - 626500 |
| Contact: | Mr. Renatin Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurlemala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kurlemala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 7.50m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/06 | Source*: | BH 01, Depth 7.50m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kurlemala, Muvattupuzha, Ernakulam District | Date Tested : | 16/06/2023 - 19/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 7.50m |
| Tested By: | GK/DK | Client Sample Desc.*: | Soil (UDS-3), BH 01, Depth 7.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 8.21 E-04 | - |

For and on behalf of Matter Lab

**Comments**

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# Permeability of Soil Test Report

Report No: ML23/W-02007/156
Issue No: 1
Report Date: 21/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurlamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kurlamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 19/06/2023 | Client Sample Ref.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/156 | Source*: | BH 01, Depth 9.00m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kurlamala, Muvattupuzha, Ernakulam District | Date Tested : | 19/06/2023 - 19/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-5), BH 01, Depth 9.00m |
| Tested By: | GK/DK | Client Sample Desc.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 8.25 E-04 | - |

For and on behalf of Matter Lab

## Comments

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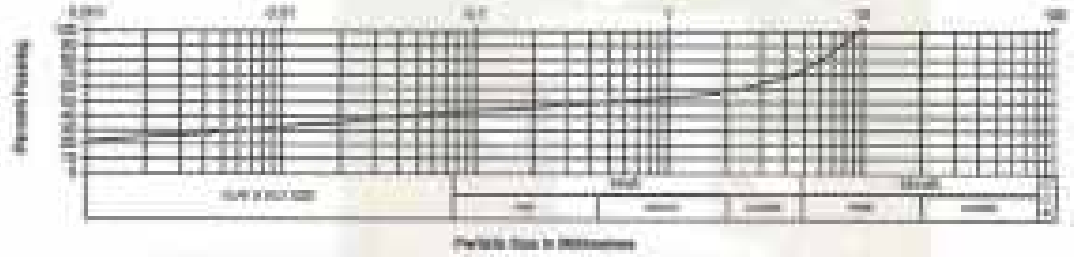
## Hydrometer Analysis Test Report

| | | | |
|---|---|---|---|
| Client: | PE Global | Consultant: | - |
| Address: | Kaveeeli Building, Kanayannoor Village, Kalamassl, Ernakulam, Kerala - 628030 | Owner: | KSHWAP |
| Contact: | Mr. Ramabir Das | Contractor: | - |
| Project No: | - | Project Location: | Kunnamala, Muvattupuzha, Ernakulam District |
| Project Name: | Geotechnical Investigation at Dumpsite in Kunnamala, Muvattupuzha | Ref / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/09/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 3.00m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/01 | Source*: | BH 01, Depth 3.00m |
| Date Sampled: | 04/09/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kunnamala, Muvattupuzha, Ernakulam District | Date Tested: | 13/09/2023 - 17/09/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH01, Depth 3.00m |
| Tested By: | RH | Client Sample Desc.*: | Soil, BH 01, Depth 3.00m |
| Test Location: | MatterLab – Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4): 1985, Cl.9.2



Particle Size in Millimetres

| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 72 |
| 2.000 | 66 |
| 0.850 | 62 |
| 0.600 | 51 |
| 0.425 | 48 |
| 0.300 | 44 |
| 0.150 | 43 |
| 0.075 | 43 |
| 0.053 | 41 |
| 0.037 | 39 |
| 0.026 | 37 |
| 0.019 | 35 |
| 0.014 | 34 |
| 0.010 | 32 |
| 0.007 | 30 |
| 0.006 | 29 |
| 0.004 | 27 |
| 0.002 | 25 |
| 0.001 | 23 |

| | |
|---|---|
| Gravel,% | 28 |
| Sand,% | 29 |
| Silt,% | 19 |
| Clay,% | 23 |

ANIL JOSEPH KAT
GSM / Quality Manager
For MatterLab

**Comments**

*Information provided by client

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Thiruvahnur, Kozhikode, Kerala, 673020

# SHEAR STRENGTH TEST REPORT

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavenad Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Rasabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurisimala, Mavithuruthu |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kurisimala, Mavithuruthu, Ernakulam District |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Work Order ID: | MLESW-S2307 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | MLESW-S2307/02 | Source:* | BH 01, Depth 6.00m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location:* | Kurisimala, Mavithuruthu, Ernakulam District | Date Tested: | 16/06/2023 - 20/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab - Kozhikode | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 6.00m |
| Tested By: | DK | Client Sample Desc: | Soil (UDS-1), BH 01, Depth 6.00m |

## Test Results

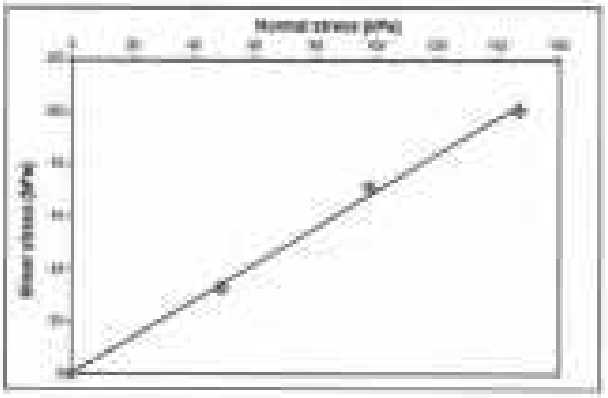
Methods: IS 2720 (Part 13)-1986

| | |
|---|---|
| Area of specimen ($cm^2$) | 36 |
| Height of specimen (mm) | 25 |
| Rate of strain (mm/min) | 1.25 |
| Test Condition | Unconsolidated Drained |
| Bulk Density ($Mg/m^3$) | 1.54 |
| Moisture content (%) | 7.4 |
| Dry Density ($Mg/m^3$) | 1.43 |

| Load increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Stress (mm) |
|---|---|---|---|
| 1 | 49 | 92.9 | 3.2 |
| 2 | 98 | 71.2 | 2.8 |
| 3 | 147 | 192.9 | 3.6 |

Cohesion Intercept (C'), kPa: 0

Angle of Internal Friction (Φ'): 37°




ANIL POTTINGAL
DGM / Quality Manager

For NABL on behalf of MatterLab

## Comments

*Information provided by client

Material tested was passing 4.75 mm test sieve, reconsolidated at maximum achievable density and moisture content

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## SHEAR STRENGTH TEST REPORT

Report No: ML23W-020007/1
Issue No : 1
Report Date: 21/06/2023

| | |
|---|---|
| **Client:** | IPC Global |
| **Address:** | Kaneveli Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kurlamala, Muvattupuzha |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kurlamala, Muvattupuzha, Ernakulam District |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 13/06/2023 | **Client Sample Ref.*):** | Soil (UDS-3), BH 01, Depth 7.50m |
| **Work Order ID:** | ML23W-020007 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23W-020007/06 | **Source:*** | BH 01, Depth 7.50m |
| **Date Sampled:** | 04/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method:** | IS: 2132 : 1986 | **Sample Size(kg):** | 3 Approx |
| **Sample Location:*** | Kurlamala, Muvattupuzha, Ernakulam District | **Date Tested :** | 19/06/2023 - 20/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Test Location:** | MatterLab - Kozhikode | **Lab Sample Desc.:** | Soil (UDS-3), BH 01, Depth 7.50m |
| **Tested By:** | DK | **Client Sample Desc.:** | Soil (UDS-3), BH 01, Depth 7.50m |

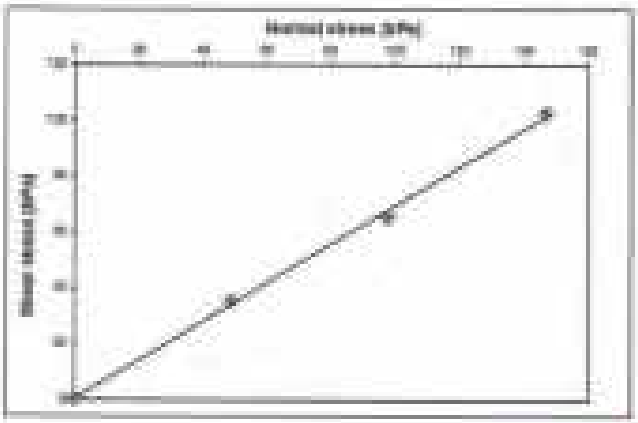
**Test Results :** Method: IS 2720 (Part 13)-1986

| | | |
|---|---|---|
| Area of specimen (cm²) | : | 36 |
| Height of specimen (mm) | : | 25 |
| Rate of strain (mm/min) | : | 1.25 |
| Test Condition | : | Unconsolidated Drained |
| Bulk Density (Mg/m³) | : | 2.20 |
| Moisture content (%) | : | 7.2 |
| Dry Density (Mg/m³) | : | 2.05 |

| Load Increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Stress (mm) |
|---|---|---|---|
| 1 | 49 | 85.1 | 2.4 |
| 2 | 98 | 85.2 | 3.0 |
| 3 | 147 | 102.7 | 3.0 |

**Cohesion Intercept (C'), kPa** 9

**Angle of Internal Friction (ϕ')** 30°




ANIL PETTIKKUNNEL
GSM / Quality Manager

For and on Behalf of MatterLab

**Comments**

*Information provided by client

Material tested was passing 4.75 mm test sieve, recompacted at maximum achievable density and moisture content

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## SHEAR STRENGTH TEST REPORT

Report No: ML23/N-0000708
Issue No : 1
Report Date: 31/08/2023

| | |
|---|---|
| **Client:** | IFE Global |
| **Address:** | Kavenat Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| **Contact:** | Mr. Renabit Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kurlamala, Muvattupuzha |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kurlamala, Muvattupuzha, Ernakulam District |
| **Tel / Email:** | - |

### Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 13/08/2023 | **Client Sample Ref.*:** | Soil (UDS-5), BH 01, Depth 9.00m |
| **Work Order ID:** | ML23/W-000037 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/N-0000708 | **Source:*** | BH 01, Depth 9.00m |
| **Date Sampled:** | 04/08/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method:** | IS: 2132 - 1986 | **Sample Size(kg):** | 5 Approx |
| **Sample Location*:** | Kurlamala, Muvattupuzha, Ernakulam District | **Date Tested :** | 19/08/2023 - 23/08/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Test Location:** | MatterLab - Kozhikode | **Lab Sample Desc.:** | Soil (UDS-5), BH 01, Depth 9.00m |
| **Tested By:** | DK | **Client Sample Desc.:** | Soil (UDS-5), BH 01, Depth 9.00m |

### Test Results

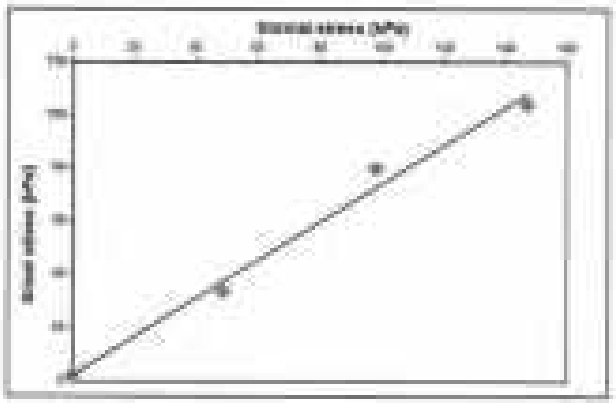
Method: IS 2720 (Part 13)-1986

| | |
|---|---|
| Area of specimen ($cm^2$) | 36 |
| Height of specimen (mm) | 20 |
| Rate of strain (mm/min) | 1.25 |
| Test Condition | Unconsolidated Drained |
| Bulk Density ($kg/m^3$) | 2.41 |
| Moisture content (%) | 12 |
| Dry Density ($kg/m^3$) | 2.15 |

| Load increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Stress (mm) |
|---|---|---|---|
| 1 | 49 | 93.7 | 2.8 |
| 2 | 98 | 78.9 | 3.0 |
| 3 | 147 | 104.2 | 3.6 |

**Cohesion Intercept (C'), kPa** 3

**Angle of Internal friction (Ø')** 32°




ANIL PONNAMMA
Project Quality Manager

For BHAGYA-SHREE of MatterLab

### Comments

*Information provided by client

Material tested was passing 4.75 mm test sieve, moulded at maximum achievable density and moisture content.

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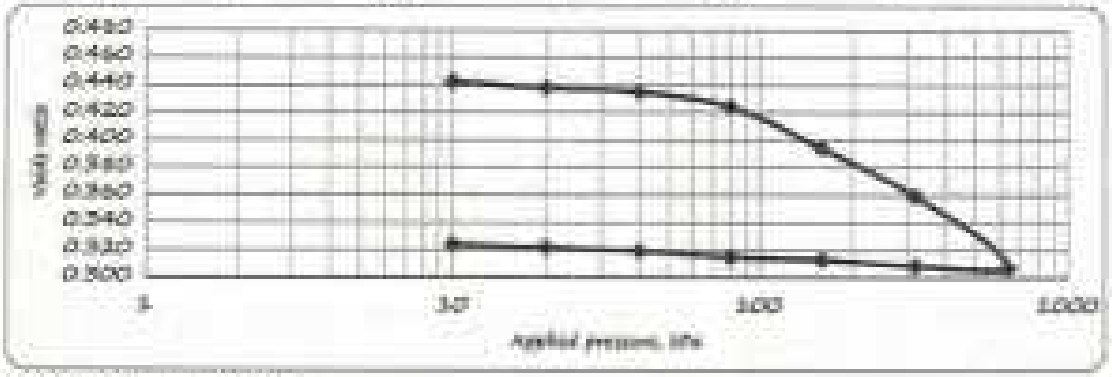
# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | | | |
|---|---|---|---|
| Date Received | 13/06/2023 | Report No. | ML23/R-02007/19 |
| Date Reported | 12/07/2023 | Client Ref. | Soil (UDS-5), BH 01, Depth 9.00m |

| | | | |
|---|---|---|---|
| Client | IPE Global | | |
| Adress | Kavanatt Building, Kanjiramoor Village, Kalmanad, Ernakulam, Kerala - 528030 | | |
| Contact | Mr. Ranabir Dey | | |
| Project Number | - | | |
| Project Name | Geotechnical Investigation at Dumpsite in Kunamala, Muvattupuzha | | |
| Consultant | - | | |
| Owner | KSWMP | | |
| Source* | BH 01, Depth 9.00m | Client Sample Ref*. | Soil (UDS-5), BH 01, Depth 9.00m |
| Sampled by | Geotechnical Division | Date Tested | 26/06/2023 - 04/07/2023 |
| Test Method | IS : 2720 ( Part 15 ) – 1986 | Test Location | MatterLab - Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | ML23/W-02007/05 | Initial diameter (mm) | 60 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Kunamala, Muvattupuzha, Ernakulam District |
| Initial voids ratio | 0.445 | Dry Density (Mg/m$^3$) | 1.552 |
| Moisture content (%) | 30.0 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 10 | 0.442 | 940.34 | 0.200 |
| 20 | 0.439 | 906.94 | 0.301 |
| 40 | 0.435 | 883.96 | 0.101 |
| 80 | 0.434 | 891.56 | 0.189 |
| 160 | 0.394 | 194.52 | 0.266 |
| 320 | 0.389 | 106.48 | 0.150 |
| 640 | 0.387 | 88.09 | 0.120 |




Preconsolidation Pressure: 100 kPa
Compression Index, $C_c$: 0.13
Recompression Index, $C_r$: 0.01

Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 3 of 3 & 4 of 3)
*Information provided by client

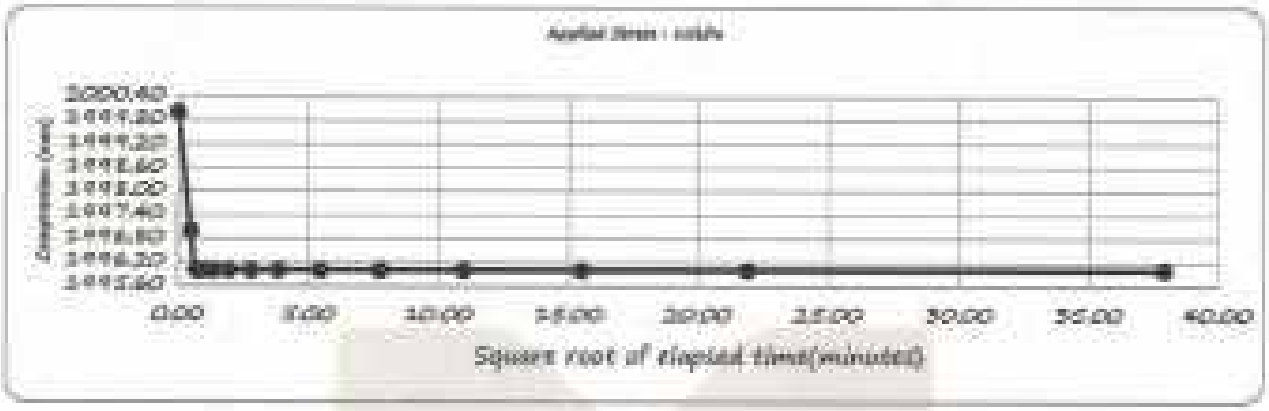


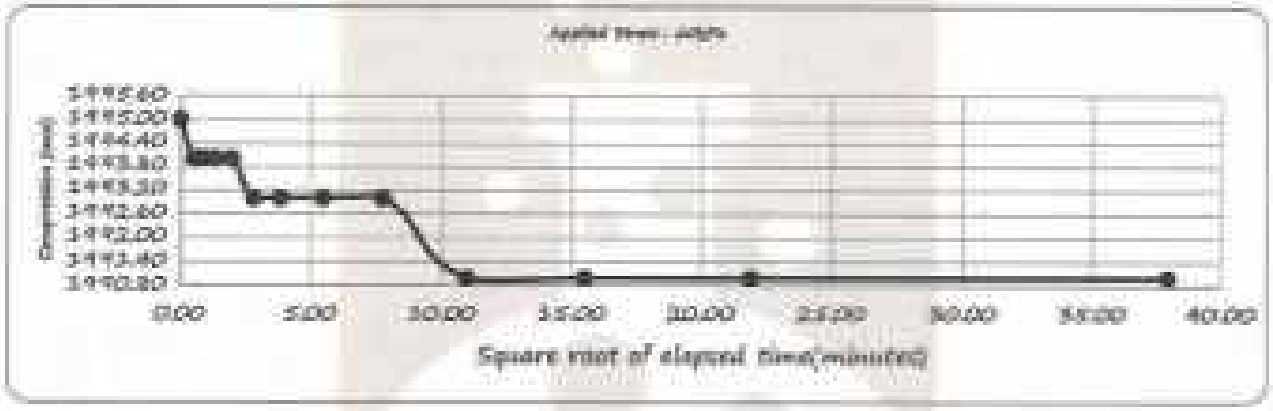
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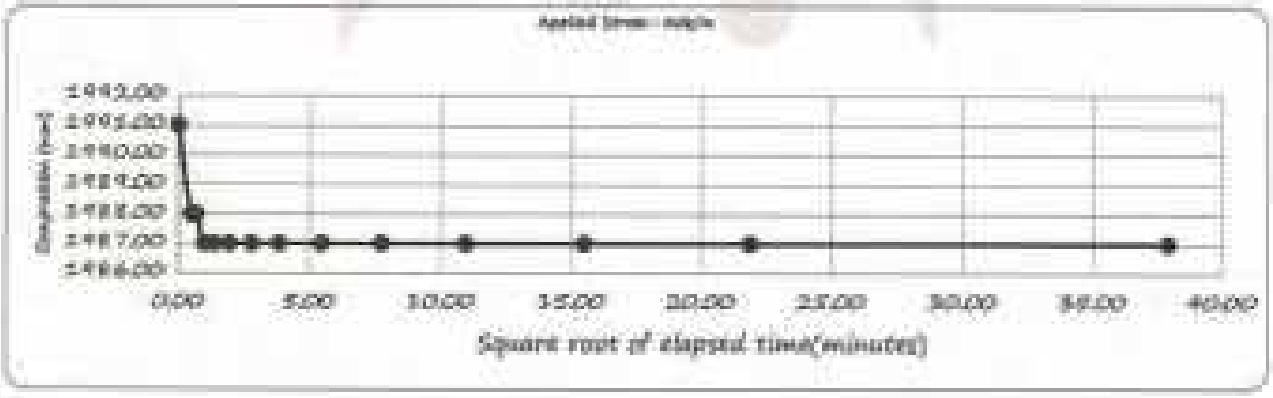
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Thiruvannur, Kozhikode, Kerala, 673029

**Consolidation Vs square root of time curves**



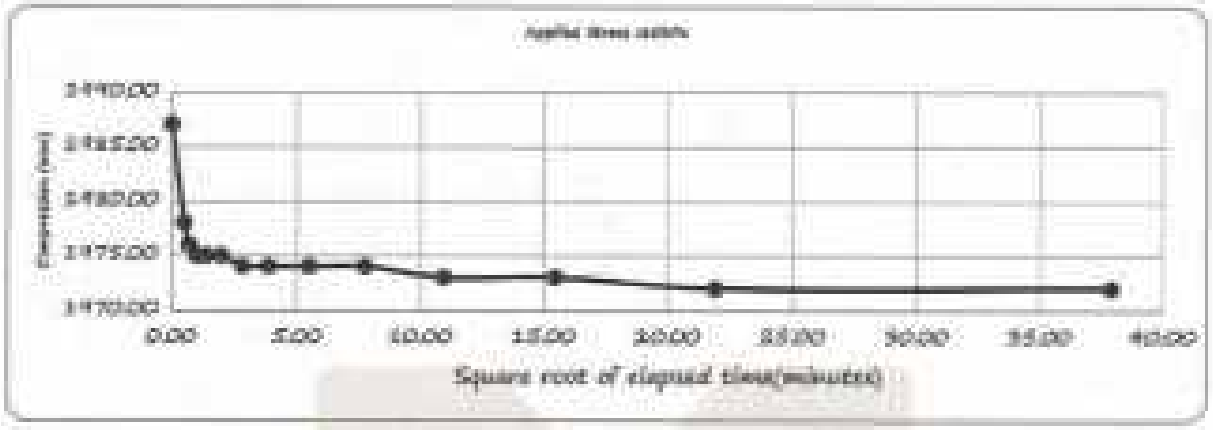



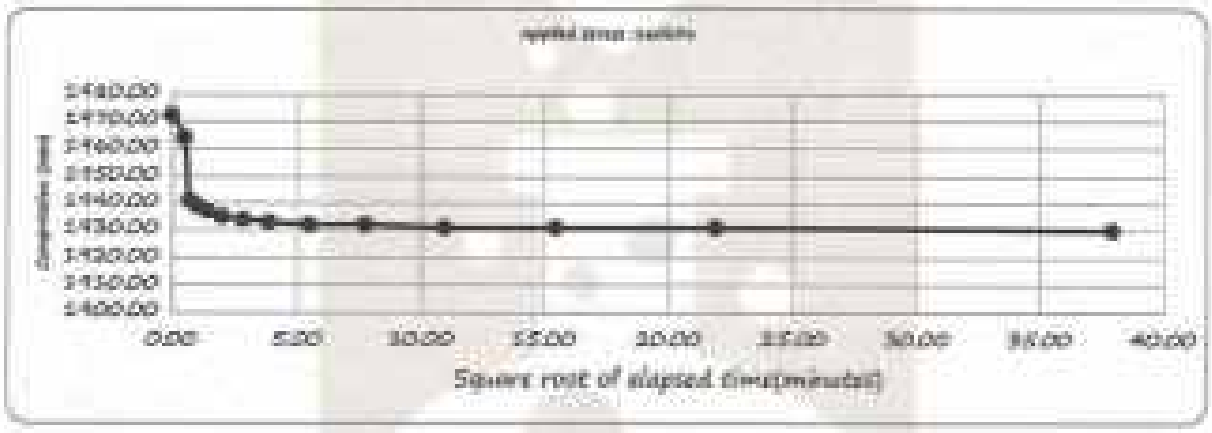


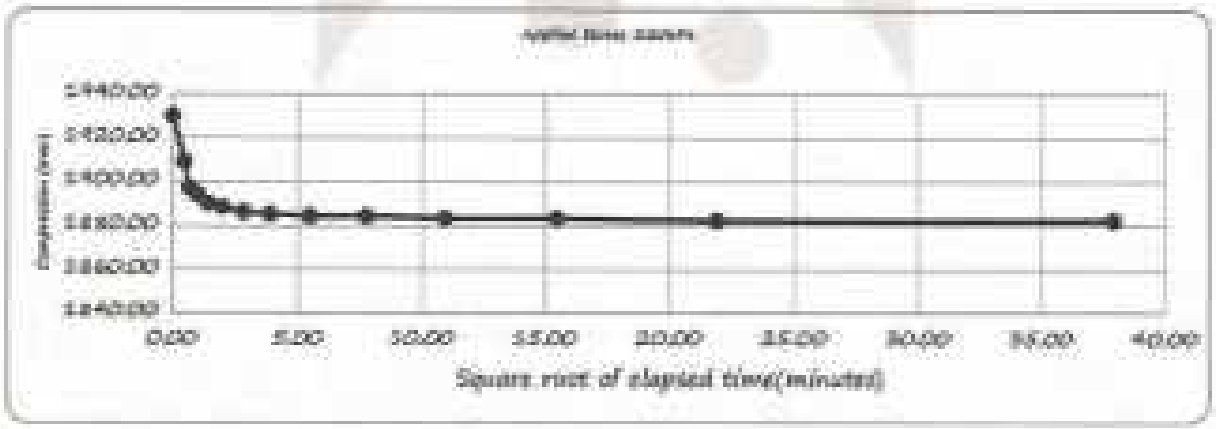

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Compression Vs square root of time curves



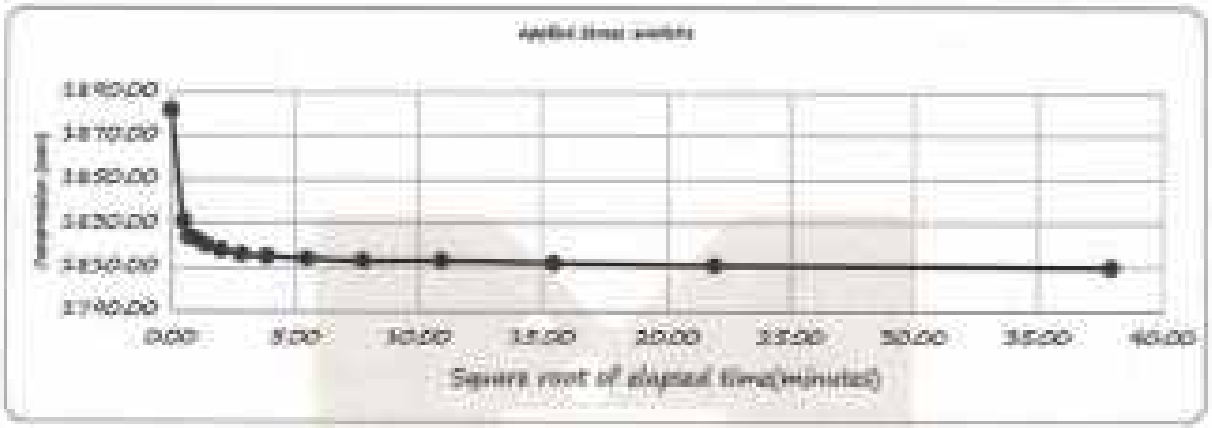



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Consolidation Vs square root of time curves




SREELEEH T.V
Asst. Civil Engineer

For and on behalf of Matter Lab

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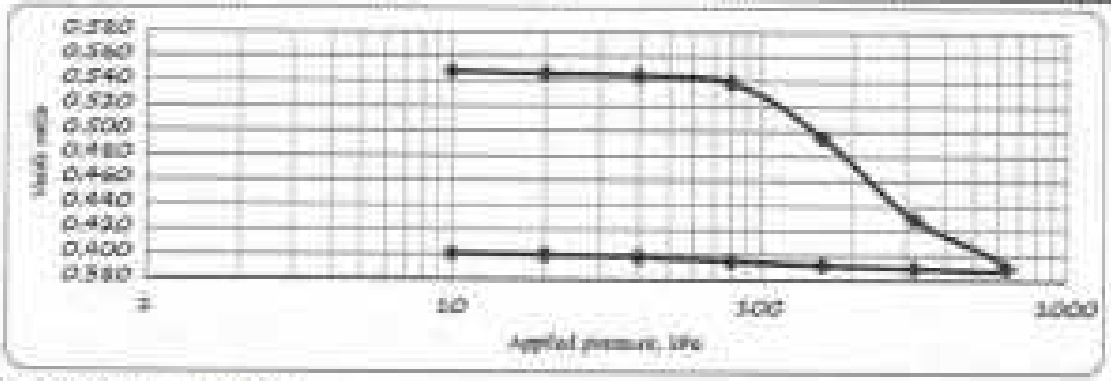
# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | | | |
|---|---|---|---|
| Date Received | 13/06/2023 | Report No. | ML23/R-02007/21 |
| Date Reported | 17/07/2023 | Client Ref. | Soil (UDS-3), BH 01, Depth 7.50m |

| | | | |
|---|---|---|---|
| Client | IPE Global | | |
| Adress | Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 | | |
| Contact | Mr. Ranalal Dily | | |
| Project Number | - | | |
| Project Name | Geotechnical Investigation at Dumpsite in Kuttanad, Mavelikkara | | |
| Consultant | - | | |
| Owner | KSWMP | | |
| Source* | BH 01, Depth 7.50m | Client Sample Ref* | Soil (UDS-3), BH 01, Depth 7.50m |
| Sampled by | Geotechnical Division | Date Tested | 29/06/2023 - 04/07/2023 |
| Test Method | IS : 2720 ( Part 15 ) - 1986 | Test Location | MatterLab - Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | ML23/M-02007/SS | Initial diameter (mm) | 60 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Kuttanadu, Mavelikkara, Ernakulam District |
| Initial voids ratio | 0.548 | Dry Density (Mg/m$^3$) | 1.758 |
| Moisture content (%) | 27.8 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 10 | 0.547 | 1366.12 | 0.350 |
| 20 | 0.546 | 1264.09 | 0.100 |
| 40 | 0.544 | 838.48 | 0.050 |
| 80 | 0.538 | 415.21 | 0.088 |
| 160 | 0.495 | 90.19 | 0.308 |
| 320 | 0.429 | 80.78 | 0.275 |
| 640 | 0.389 | 41.87 | 0.086 |




Preconsolidation Pressure: 80 kPa
Compression Index, $C_c$: 0.18
Recompression Index, $C_r$: 0.01

Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 3 of 5 & 5 of 5)
*Information provided by client

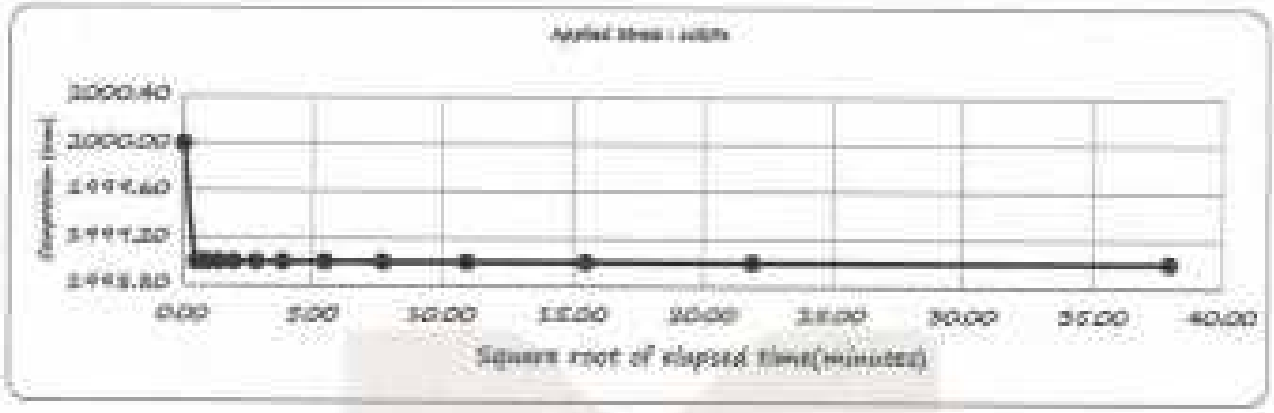


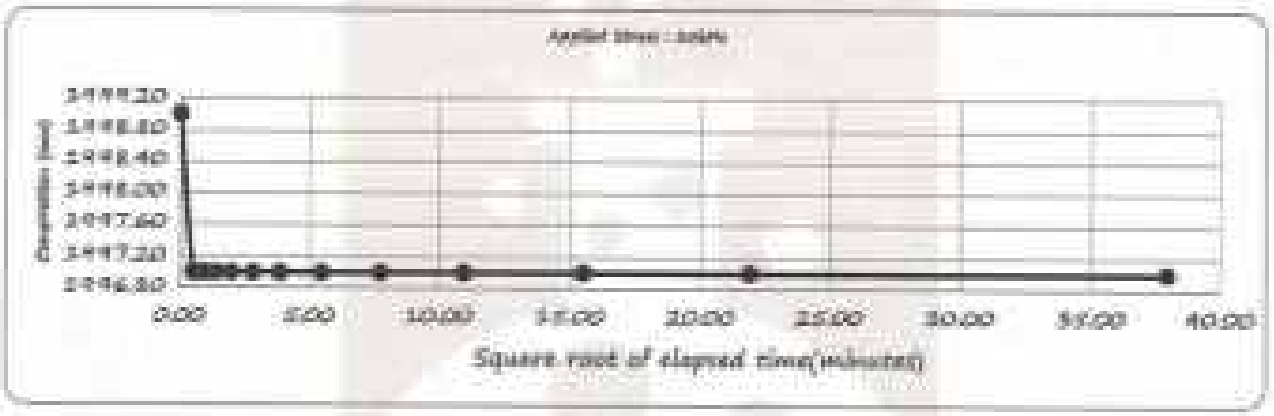
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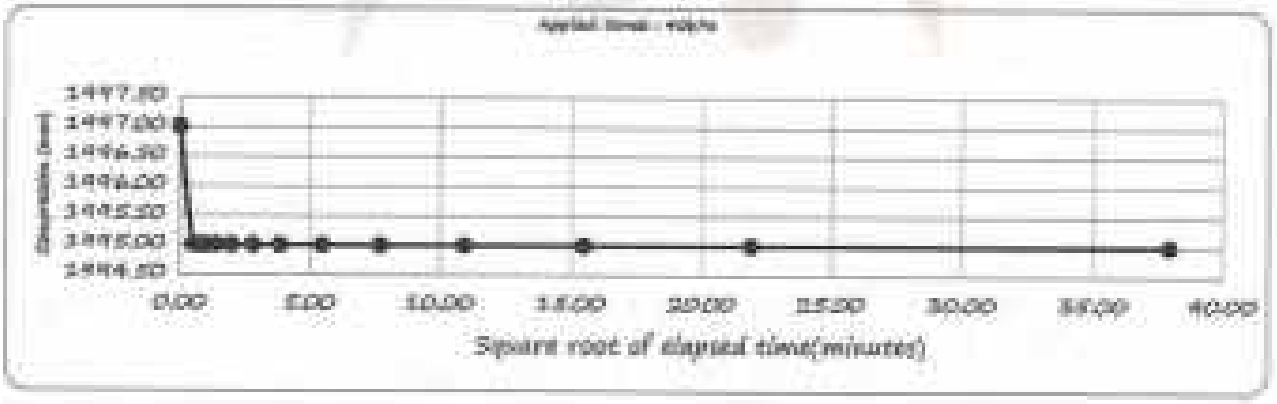
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Compression Vs square root of time curves



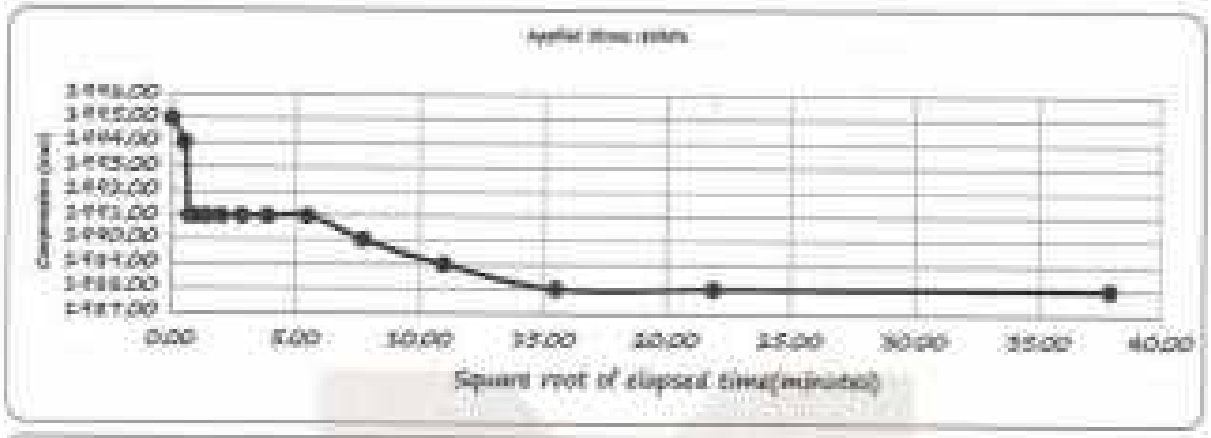



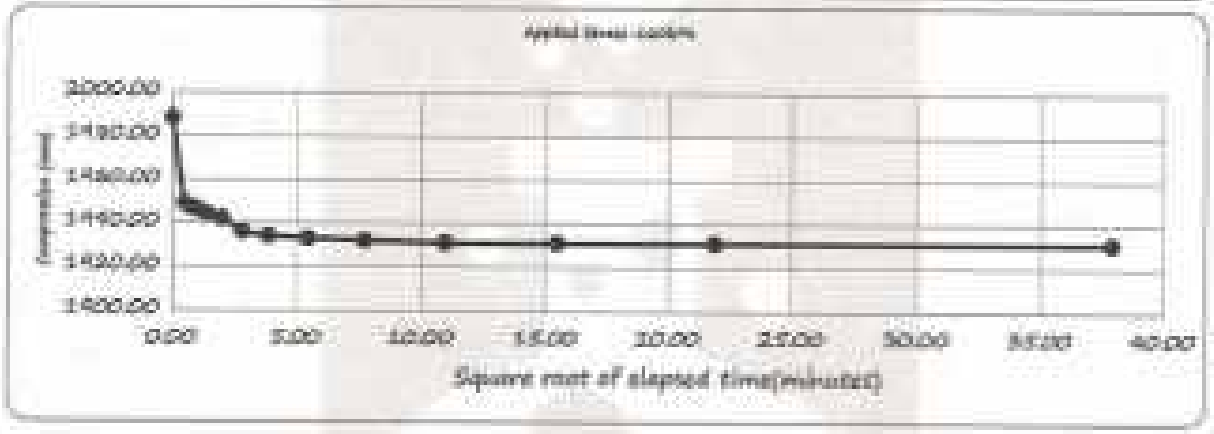



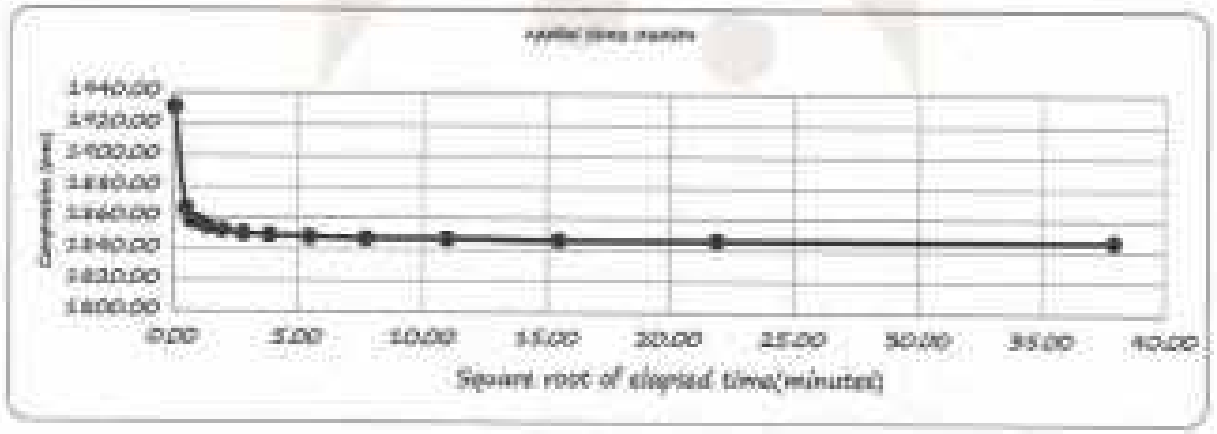



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Compression Vs square root of time curves



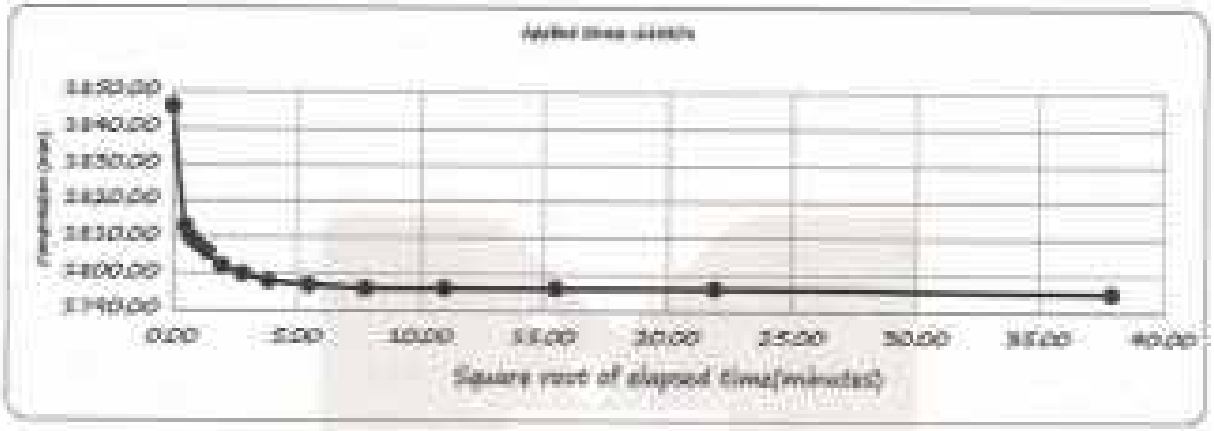



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Compression Vs square root of time curves




SREELESH T.V

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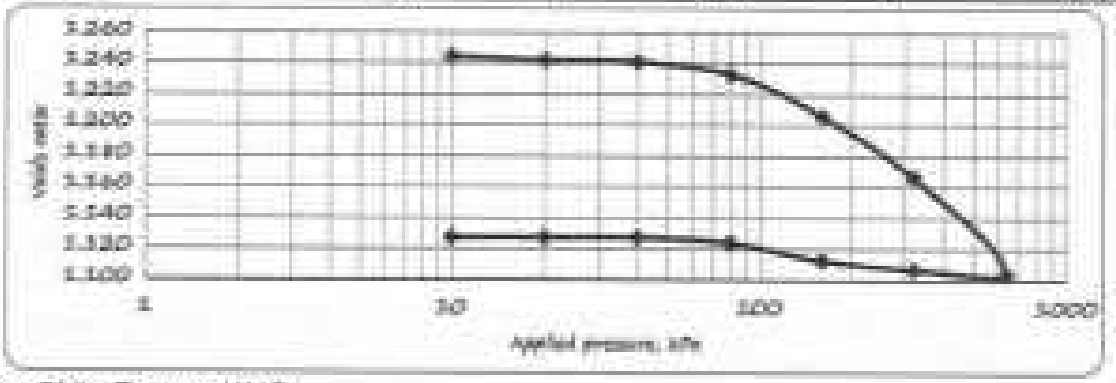
# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | | | |
|---|---|---|---|
| Date Received | 15/06/2023 | Report No: | MLS/R/02007/23 |
| Date Reported | 17/07/2023 | Client Ref. | Soil (UDS-1), BH 01, Depth 6.00m |

| | | | |
|---|---|---|---|
| Client | IPE Global | | |
| Address | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 | | |
| Contact | Mr. Ranabir Dey | | |
| Project Number | - | | |
| Project Name | Geotechnical Investigation at Dumpsite in Kuriamala, Muvattupuzha | | |
| Consultant | - | | |
| Owner | KSWMP | | |
| Source* | BH 01, Depth 6.00m | Client Sample Ref*. | Soil (UDS-1), BH 01, Depth 6.00m |
| Sampled by | Geotechnical Division | Date Tested | 25/06/2023 - 04/07/2023 |
| Test Method | IS : 2720 ( Part 15 ) - 1986 | Test Location | MatterLab - Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | MLS/SW-02007/S2 | Initial diameter (mm) | 60 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Kuriamala, Muvattupuzha, Ernakulam District |
| Initial voids ratio | 1.247 | Dry Density (Mg/m$^3$) | 1.210 |
| Moisture content (%) | 28.1 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 10 | 1.244 | 1334.77 | 0.150 |
| 20 | 1.242 | 1351.38 | 0.100 |
| 40 | 1.241 | 937.06 | 0.026 |
| 80 | 1.233 | 855.29 | 0.068 |
| 160 | 1.206 | 82.89 | 0.151 |
| 320 | 1.166 | 55.72 | 0.111 |
| 640 | 1.102 | 45.20 | 0.091 |




Preconsolidation Pressure: 141 kPa
Compression Index, $C_c$: 0.18
Recompression Index, $C_r$: 0.02

Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 2 of 3 & 3 of 3)
*Information provided by client

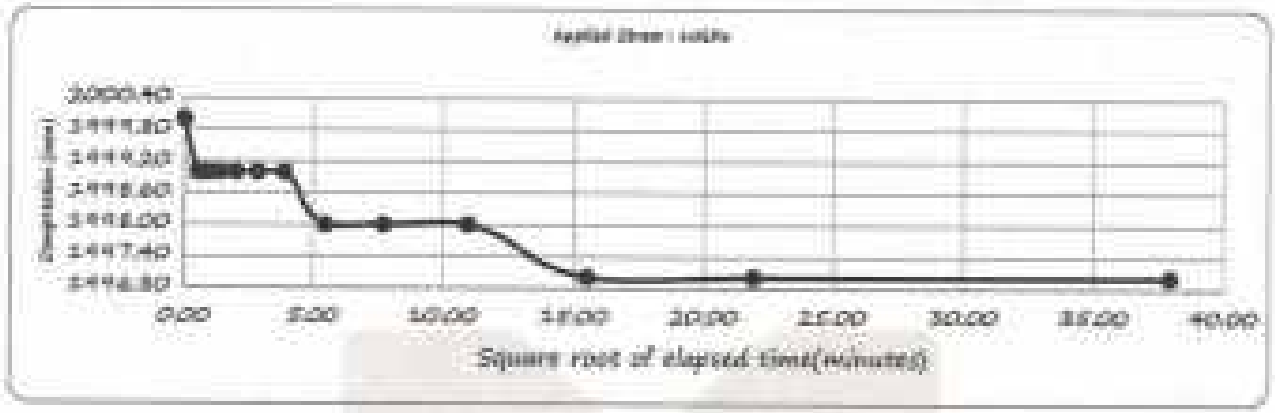


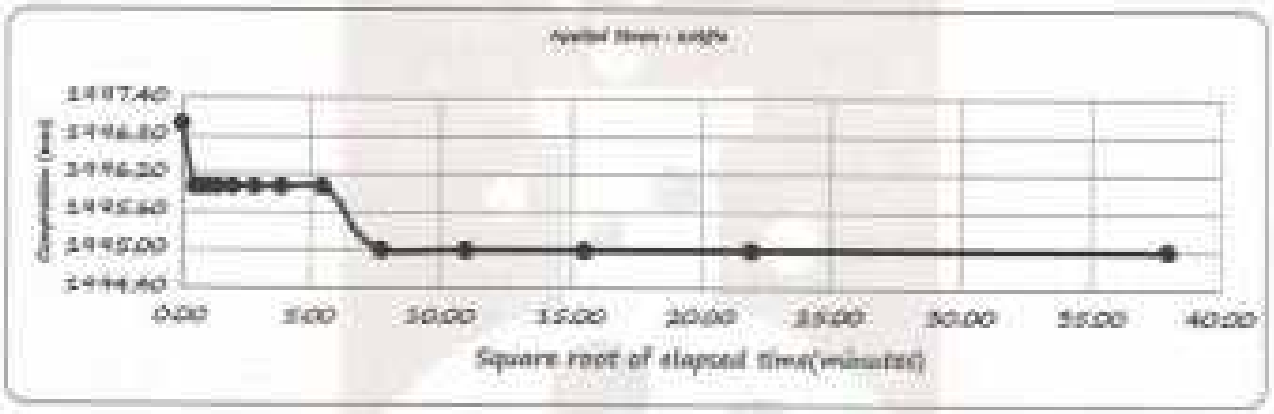
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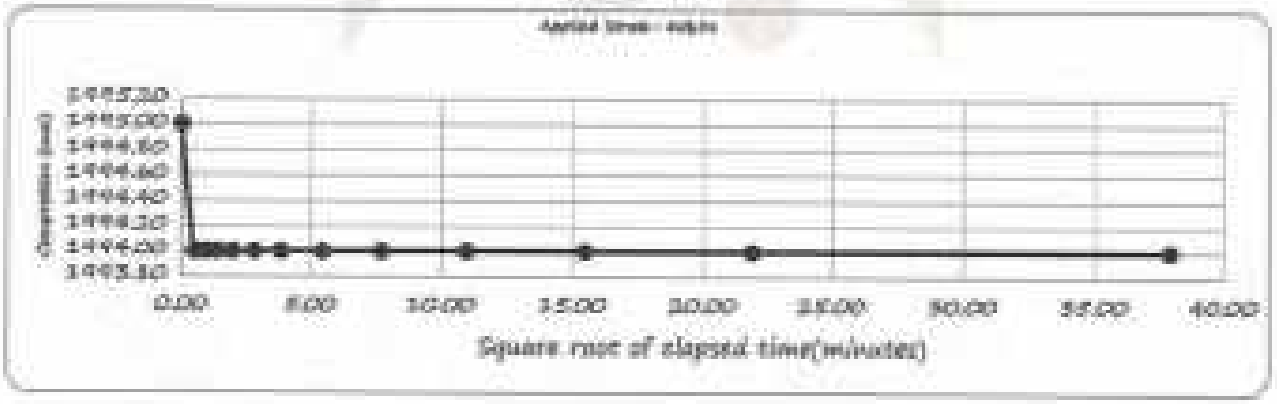
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Compression Vs square root of time curves



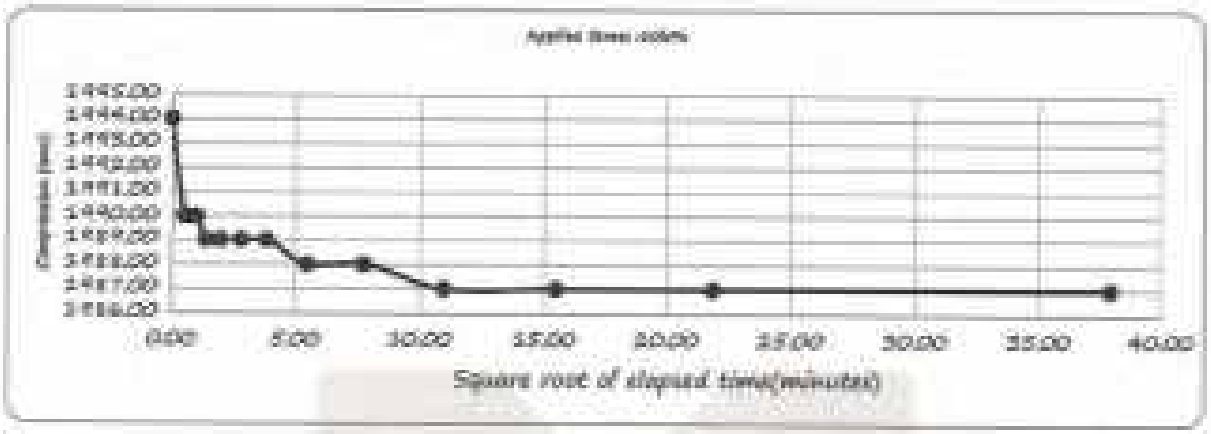



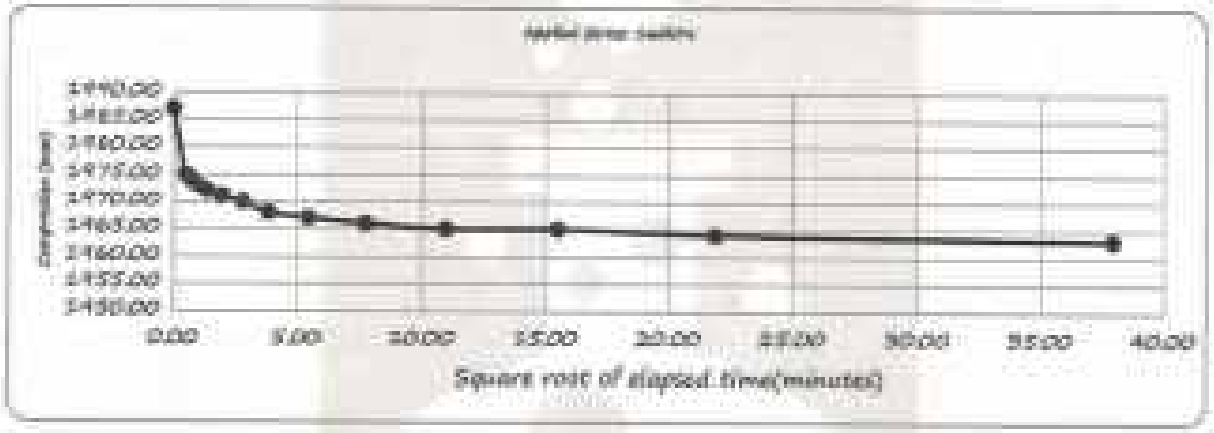


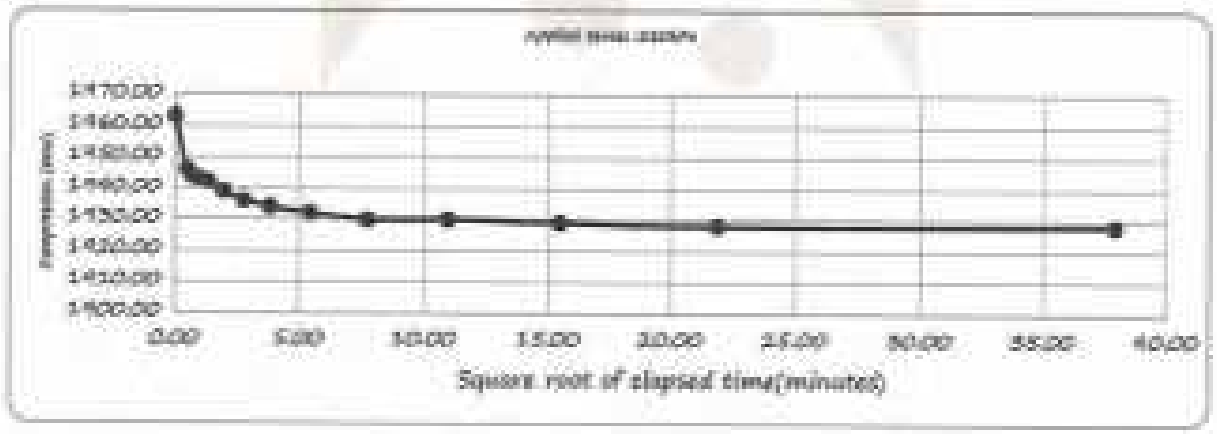

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Consolidation Vs square root of time curves



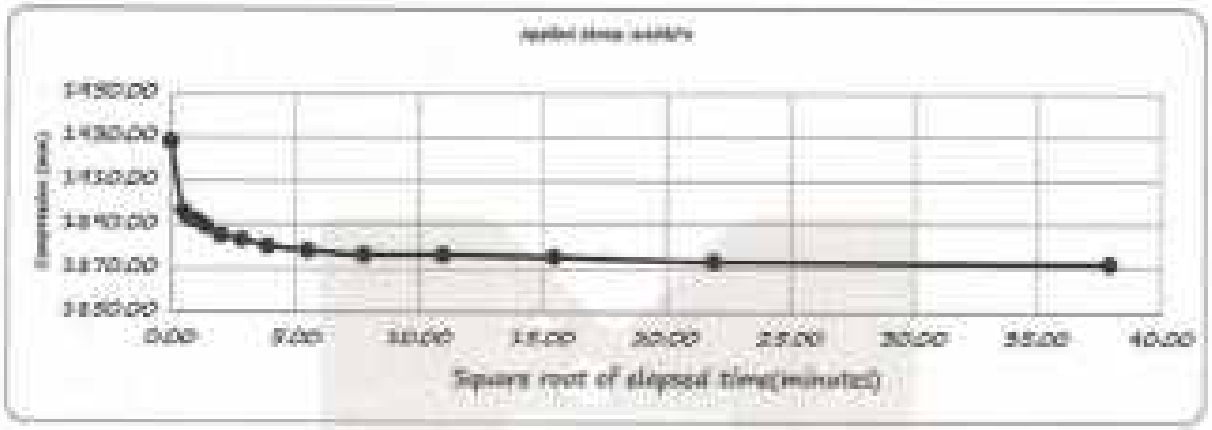



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Compression Vs square root of time curves




SREELESH T.V
Head-Civil Laboratory

For and on behalf of Matter Lab

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TC-10741

## Water Content of Soil Test Report

Report No: MLZ3W-02007/23
Issue No: 1
Report Date: 01/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kutamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kutamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 28/07/2023 | Client Sample Ref.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Work Order ID: | MLZ3W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | MLZ3W-02007/03 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 04/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Kutamala, Muvattupuzha, Ernakulam District | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No./ Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 6.00m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-1), BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w) % | 7.4 | - |

SREELESH T.V
Head-Civil Laboratory

For and on behalf of Matter Lab

**Comments**

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TC-10744

# Water Content of Soil Test Report

Report No: ML23/R-02007/23
Issue No : 1
Report Date:01/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kuttamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kuttamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 7.50m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/08 | Source*: | BH 01, Depth 7.50m |
| Date Sampled: | 04/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 4 Approx |
| Sample Location*: | Kuttamala, Muvattupuzha, Ernakulam District | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 7.50m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-3), BH 01, Depth 7.50m |
| Test Location: | MatterLab - Kozhikode | | |

Test Results

| Test Method | Tests/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 7.0 | - |

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Laboratory

For and on behalf of Matter Lab

Comments
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Kozhikode, Kerala, 673029.

## Water Content of Soil Test Report

Report No: ML23/R-02007/24
Issue No : 1
Report Date:01/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveratt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurisimala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kurisimala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

UR-1670823508000537JF

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Work Order ID: | ML23/WI-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/WI-02007/09 | Source*: | BH 01, Depth 9.00m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 6 Approx |
| Sample Location*: | Kurisimala, Muvattupuzha, Ernakulam District | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-5), BH 01, Depth 9.00m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | TestParameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w) % | 12 | - |

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Head-Civil Laboratory

For and on behalf of Matter Lab

**Comments:**
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Thiruvannur, Kozhikode, Kerala, 673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/K/02007/23
Issue No : 1
Report Date: 01/08/2023

| | |
|---|---|
| Client: | IHE Global |
| Address: | Kavanatt Building, Kanapalcor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Kurlamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWM* |
| Contractor: | - |
| Project Location: | Kurlamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*): | Soil (UDS-1), BH 01, Depth 6.00m |
| Work Order ID: | ML23W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02007/02 | Source*): | BH 01, Depth 6.00m |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2132 - 1986 | Sample Size(kg): | 0 Approx |
| Sample Location: | Kurlamala, Muvattupuzha, Ernakulam District | Date Tested : | 28/07/2023 - 30/07/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-1), BH 01, Depth 6.00m |
| Tested By: | CK | Client Sample Desc.*): | Soil (UDS-1), BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test Parameters | Result | Specification |
|---|---|---|---|
| IS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 1.54 | - |
| | Dry Density g/ml | 1.43 | - |

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Head-Civil Laboratory

For and on behalf of MatterLab

**Comments**

*Information provided by client

Page 1 of 1
End of test

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Thiruvannur, Kozhikode, Kerala, 673029

# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-02007/00
Issue No.: 1
Report Date: 01/08/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kinarath Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| **Contact:** | Mr. Ranajoy Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kurisimala, Muvattupuzha |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kurisimala, Muvattupuzha, Ernakulam District |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 25/07/2023 | **Client Sample Ref.*:** | Soil (JOB-3), BH 01, Depth 7.50m |
| **Work Order ID:** | ML23/W-02007 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02007/88 | **Source*:** | BH 01, Depth 7.50m |
| **Date Sampled:** | 04/08/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2132 - 1986 | **Sample Size(kg):** | 6 Approx |
| **Sample Location:** | Kurisimala, Muvattupuzha, Ernakulam District | **Date Tested :** | 25/07/2023 - 30/07/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil (JOB-3), BH 01, Depth 7.50m |
| **Tested By:** | DK | **Client Sample Desc.*:** | Soil (JOB-3), BH 01, Depth 7.50m |
| **Test Location:** | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | TestParameters | Result | Specification |
|---|---|---|---|
| BS: 1377| Part 2):1990 | Bulk Density of Soil, g/ml | 2.20 | - |
| | Dry Density g/cc | 2.05 | - |

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Head-Civil Laboratory

For and on behalf of MatterLab

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# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R/02307/27
Issue No : 0
Report Date:01/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Renish Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kuttanadu, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kuttanadu, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02000358 | Source*: | BH 01, Depth 9.00m |
| Date Sampled: | 04/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 6 Approx |
| Sample Location: | Kuttanadu, Muvattupuzha, Ernakulam District | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-5), BH 01, Depth 9.00m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-5), BH 01, Depth 9.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 2.41 | - |
| | Dry Density,g/ml | 2.16 | - |

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Head-Civil Laboratory

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## Chemical Test Report of Soil

Report No: ML23/R-02572/1
Issue No : 1
Report Date:27/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building,Kanayanoor Village,Kakkanad,Ernakulam,Kerala - 628030 |
| Contact: | Mr.Ranabir Dev |
| Project Name: | Geotechnical Investigation at Dumpsite in Kuriyamala,Muvattupuzha |
| Owner: | KSWMP |
| Project Location: | Kuriyamala,Muvattupuzha,ErnaKulam District |
| Tel No: | - |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 12/07/2023 | Client Sample ID:* | Soil and Rock |
| Work Order ID: | ML23/W-02572 | Source:* | Borehole - 1 (Depth 2m from orginal soil) |
| Sample ID: | ML23/W-02572/B1 | Sample Submitted By: | Geotechnical Division |
| Date Sampled: | 04/06/2023 | Sampled By: | Geotechnical Division |
| Sample Location: | Kuriyamala,Muvattupuzha | Date Tested: | 13/07/23 - 20/07/23 |
| Tested By: | MLA | Test Method Variation: | None |

### CHEMICAL ANALYSIS

| Test/Parameter | Test Method | Unit | Result |
|---|---|---|---|
| Cation Exchange Capacity | USDA No.19 | (meq/100gm) | 6.78 |

ANWAR. P
Lab Manager-Chemistry

For and on behalf of Matter Lab

### Comments

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# Chemical Test Report of Soil

Report No: ML23/K-03572/1
Issue No: 1
Report Date: 06/10/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavanat Building,Kanayannoor Village,Kakkanad,Ernakulam,Kerala - 628030 |
| **Contact:** | Mr.Ranabir Dey |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kurimala,Muvattupuzha |
| **Owner:** | KSWMP |
| **Project Location:** | Kurimala,Muvattupuzha,Ernakulam District |
| **Tel No:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 12/07/2023 | **Client Sample ID:*** | Soil and Rock |
| **Work Order ID:** | ML23/W-03572 | **Source:*** | Borehole - 1 @ m from orginal ground level) |
| **Sample ID:** | ML23/W-03572/01 | | |
| **Date Sampled:** | 04/05/2023 | **Sampled By:** | Geotechnical Division |
| **Tested By:** | MatterLab,Kozhikode | **Date Tested:** | 13/08/23 - 20/08/23 |
| **Sample Location:** | Kurimala,Muvattupuzha | **Test Method Variation:** | None |

**CHEMICAL ANALYSIS - Test Method: IS 2720:2021 & CPHEEO Manual**

| Test/Parameters | Units | Results |
|---|---|---|
| pH Value | - | 7.19 |
| Electrical Conductivity | mS/cm | 0.377 |
| Nitrogen (N) | % | 0.19 |
| Phosphorus (P) | % | 0.03 |
| Potassium (K) | % | 0.20 |
| Carbon | % | 1.08 |
| Carbon / Nitrogen Ratio | % | 5.64 |
| Biodegradable Factor | % | < 0.1 |
| **HEAVY METALS - Test Method: EPA 3050 (ICP OES)** | | |
| Arsenic (As) | mg/Kg | 10.0 |
| Cadmium (Cd) | mg/Kg | < 5.0 |
| Chromium (Cr) | mg/Kg | 121.9 |
| Copper (Cu) | mg/Kg | 103.8 |
| Lead (Pb) | mg/Kg | 59.5 |
| Nickel (Ni) | mg/Kg | 82.9 |
| Zinc (Zn) | mg/Kg | 544.3 |
| Mercury (Hg) | mg/Kg | < 0.1 |

ANWAR. P
Lab Manager-Chemistry
For and on behalf of Matter Lab

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PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

Phone : 0484-2544030, 8281982322, 9747400085.www.poluchem.com, poluchem@gmail.com

ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


**TEST REPORT** 

| **Client Name & Address** | **Certificate No:** | **PL/RT/4859/2023** |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 12/06/2023 |
| | Date of monitoring | 01/06/2023 |
| | Date of sample received: | 02/06/2023 |
| | Date of analysis | 03/06/2023 |
| | Sample Description | Waste Analysis -Muvattupuzha-Kurianmama |
| | Sample Location | Gps Reading : N- 9 °59'04.238"<br>E -76°33'28.925" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 12.4 |
| 02 | Bulk Density | | | USEPA | $kg/m^3$ | 904 |
| 03 | Density | | | USEPA | $g/cm^3$ | 0.8974 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 187 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 4.75 | 4 + | | | 46.3 |
| | | 2.36 | 8 | | | 6.5 |
| | | 1.18 | 16 | | | 16.5 |
| | | 0.6 | 30 | | | 10.7 |
| | | 0.3 | 50 | | | 5.4 |
| | | 0.15 | 100 | | | 13.7 |
| | | 0.09 | 170 | | | 0.9 |
| | | 0.075 | 200 | | | 0 |
| | | 0.045 | 325 | | | 0 |

* End of the Report*

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For and on behalf of
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SREEJA RAMESH
QUALITY MANAGER

AUTHORIZED SIGNATORY

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/4857/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 12/06/2023 |
| | Date of monitoring | 01/06/2023 |
| | Date of sample received: | 02/06/2023 |
| | Date of analysis | 03/06/2023 |
| | Sample Description | Waste Analysis -Muvattupuzha-Kurianmama |
| | Sample Location | Gps Reading : N- 9 °59'36.84"<br>E -76°33'39.115" |

**CHEMICAL PARAMETERS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 8.02 |
| 02 | Biodegradable Factor | USEPA | % | 3.7 |
| 03 | Total carbon | USEPA 9060A | % | 4.6 |
| 04 | Phosphorus(P) | USEPA | % | 0.041 |
| 05 | Nitrogen(N) | USEPA | % | 0.31 |
| 07 | Potassium(K) | USEPA | % | 0.063 |
| 08 | C/N Ratio | USEPA | .. | 14.8:1 |
| 09 | Calorific Value | ASTM D 5865 | K.cal/kg | 187 |

Conti.....

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/4857/2023 |
|---|---|---|
| M/s. IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 12/06/2023 |
| | Date of monitoring | 01/06/2023 |
| | Date of sample received: | 02/06/2023 |
| | Date of analysis | 03/06/2023 |
| | Sample Description | Waste Analysis -Muvattupuzha-Kurianmama |
| | Sample Location | Gps Reading : N- 9 °59'04.238"<br>E -76°33'28.925" |

**TOXICITY ANALYSIS- HEAVY METALS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 10 | Iron (Fe) | USEPA 3050 | % | 2.4 |
| 11 | Arsenic(As) | USEPA 3050 | mg/kg | <0.1 |
| 12 | Selenium(Se) | USEPA 3050 | mg/kg | <0.1 |
| 13 | Nickel(Ni) | USEPA 3050 | mg/kg | 7.38 |
| 14 | Zinc (Zn) | USEPA 3050 | mg/kg | 15.71 |
| 15 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 |
| 16 | Copper (Cu) | USEPA 3050 | mg/kg | 15.02 |
| 17 | Chromium(Cr) | USEPA 3050 | mg/kg | 9.33 |
| 18 | Lead(Pb) | USEPA 3050 | mg/kg | 9.8 |
| 19 | Mercury(Hg) | USEPA 3050 | mg/kg | <0.1 |
| 20 | Manganese(Mn) | USEPA 3050 | mg/kg | 36.5 |

* End of the Report*

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AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES Pvt. Ltd.

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Where Quality Matters

Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673039

# Size Distribution of Solid Waste - Test Report

Report No: ML23/S-02007128
Issue No : 1
Report Date:19/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurlannala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kurlannala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-020070510 | Source*: | - |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 15 Approx |
| Sample Location*: | Kurlannala, Muvattupuzha, Ernakulam District | Date Tested : | 09/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GK | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4)-1985

| Sieve Size (mm) | % Retained |
|---|---|
| 80.0 | 5.8 |
| 37.5 | 7.8 |
| 10.0 | 25.4 |
| 4.0 | 22.9 |
| Passing | 40.6 |

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Thiruvannur, Kozhikode, Kerala, 673029

# Field Density (Core-Cutter Method) of Solid Waste - Test Report

Report No: ML23/R/02607/23
Issue No : 1
Report Date:19/06/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Kurtamala, Muvattupuzha |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Kurtamala, Muvattupuzha, Ernakulam District |
| **Tel / Email:** | - |

**Test Results**

| | | | |
|---|---|---|---|
| **Date Recieved:** | 09/06/2023 | **Client Ref:*** | - |
| **Work Order ID:** | ML23/W-02607 | **Layer** | - |
| **Sample ID:** | ML23/W-02607/S11 (1-2) | **Depth of test (mm):** | - |
| **Sample Description:** | MSW | **Date Tested** | 09/06/2023 - 10/06/2023 |
| **Source*** | - | **Tested By** | GK |
| **Location*** | Kurtamala, Muvattupuzha, Ernakulam District | **Method Variation** | None |
| **Test Methods :** | IS 2720 : Part 29 : 1975-(DRY DENSITY OF SOILS IN PLACE BY THE CORE-CUTTER METHOD)<br>IS 2720 : Part 2 : 1973 -(DETERMINATION OF WATER CONTENT) | | |

| Test No. | 1 | 2 |
|---|---|---|
| Sample ID | S11-1 | S11-2 |
| Test Location | Kurtamala, Muvattupuzha, Ernakulam District | |
| Weight of wet Material (g) | 1671 | 1668 |
| Volume of core-cutter ($cm^3$) | 992 | 1008 |
| In-situ Bulk Density ($g/cm^3$) | 1.68 | 1.65 |
| In-situ Water Content (%) | 23 | 23 |
| In-situ Dry Density ($g/cm^3$) | 1.36 | 1.51 |

SREELESH T.V
Head-Civil Laboratory

For and on behalf of MatterLab

**Comments**
*Informations provided by client

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MatterLab
Where Quality Matters

Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

# Solid Waste - Test Report

Report No: ML23W-02007/23
Issue No : 0
Report Date: 19/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Renatin Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kunnamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kunnamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/09/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02007(01) | Source*: | - |
| Date Sampled: | 09/09/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size/kgs: | 15 Approx |
| Sample Location*: | Kunnamala, Muvattupuzha, Ernakulam District | Date Tested : | 13/09/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GK | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Waste Materials retained on | | | |
|---|---|---|---|---|---|
| | | 80 mm | 37.5 mm | 10 mm | 4 mm |
| CPHEEO (2000) | Percentage of Plastic Waste, % | 16.9 | 7.7 | 3.0 | 5.9 |
| | Percentage of Cloth Waste, % | 69.7 | 0.2 | 0.8 | Nil |
| | Percentage of Glass Waste, % | Nil | 0.3 | 1.2 | 0.2 |
| | Percentage of Wood Waste, % | Nil | 4.0 | 8.2 | Nil |
| | Percentage of Construction Debris, % | Nil | Nil | Nil | Nil |
| | Percentage of Bio Fraction, % | Nil | Nil | Nil | Nil |
| | Percentage of Gravel, % | 13.4 | 84.8 | 85.8 | 93.4 |
| | Metals, % | Nil | 0.3 | 2.0 | 0.5 |

SREELESH T V

For and on behalf of Matter Lab

**Comments**

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Thiruvannur, Kozhikode, Kerala, 673028

# Solid Waste - Test Report

Report No: ML23/W-02007/01
Issue No: 1
Report Date: 19/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 629030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurlamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kurlamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | MSW (4mm Sieve Passing Fraction) |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/S10 | Source*: | - |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 10 Approx |
| Sample Location*: | Kurlamala, Muvattupuzha, Ernakulam District | Date Tested: | 13/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No./ Lot Size: | - | Lab Sample Desc.: | MSW (4mm Sieve Passing Fraction) |
| Tested By: | GK | Client Sample Desc.*: | MSW (4mm Sieve Passing Fraction) |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Silt & Clay, % | 44 | - |

SREELESH T.V
Chief Civil Engineer

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673029

# Moisture Content of Solid Waste - Test Report

Report No: ML23/Mi-020/7152
Issue No: 1
Report Date: 16/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 626030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kurtamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kurtamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-020/07 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-020/07/10 | Source*: | - |
| Date Sampled: | 09/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size/kg: | 15 Approx |
| Sample Location*: | Kurtamala, Muvattupuzha, Ernakulam District | Date Tested: | 09/08/2023 - 15/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | DK | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Moisture Content, % | 20 | - |

SREELESH T.V
Chief Chemist
Laboratory

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673029

# Solid Waste Size Analysis - Test Report

Report No: ML23/R-0000[illegible]
Issue No : 1
Report Date: 13/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Kunnamala, Muvattupuzha |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Kunnamala, Muvattupuzha, Ernakulam District |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-02007 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02007/010 | Source*: | - |
| Date Sampled: | 09/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 15 Approx |
| Sample Location*: | Kunnamala, Muvattupuzha, Ernakulam | Date Tested : | 13/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | MV | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results** — Test Method: [illegible] - 2009

| Type of Waste Material | 80 mm | | 37.5 mm | | 10 mm | | 4 mm | |
|---|---|---|---|---|---|---|---|---|
| | Minimum Size of a Single Waste Material, m² | Maximum Size of a Single Waste Material, m² | Minimum Size of a Single Waste Material, m² | Maximum Size of a Single Waste Material, m² | Minimum Size of a Single Waste Material, m² | Maximum Size of a Single Waste Material, m² | Minimum Size of a Single Waste Material, m² | Maximum Size of a Single Waste Material, m² |
| Plastic Waste | 0.7134 | 0.9744 | 0.1480 | 0.5676 | 0.0187 | 0.0703 | 0.0012 | 0.0040 |
| Cloth Waste | 0.7695 | 1.0600 | 0.1446 | 0.2384 | 0.0140 | 0.0406 | - | - |
| Glass Waste | - | - | 0.1617 | 0.2016 | 0.0178 | 0.0325 | 0.0018** | |
| Wood Waste | - | - | 0.1443 | 0.3360 | 0.0182 | 0.0348 | 0.0026 | 0.0035 |
| Metals | - | - | 0.0039** | | 0.0014 | 0.0024 | 0.0029** | |

DINESH T.V.

For and on behalf of Matter Lab

**Comments**

*Information provided by client.
** Only one piece of glass waste & metals included in the waste composite

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Tests results marked (not) in the compliance (scope).



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TC-6589

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/130/2023 (ULR NO:TC658923000000013OF) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 17/06/2023 |
| | Date of monitoring | 01/06/2023 |
| | Date of sample received | 02/06/2023 |
| | Date of analysis Started | 03/06/2023 |
| | Sample description | Ambient air –Muvattupuzha-Kunammama |
| | Sample Code | G/F/130/2023 |
| | Sample Location | Gps Reading : N- 9 °59'35.663"<br>E -76°33'41.236" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 60.5 µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 21.7 µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 8.6 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 14.2 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 0.8 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
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SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/4861/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 17/06/2023 |
| | Date of monitoring | 01/06/2023 |
| | Date of sample received | 02/06/2023 |
| | Date of analysis Started | 03/06/2023 |
| | Sample description | Ambient air –Muvattupuzha-Kunammama |
| | Sample Code | G/F/130/2023 |
| | Sample Location | Gps Reading : N- 9 °59'35.663"<br>E -76°33'41.236" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | <1 µg/m$^3$ | 400 µg/m$^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m$^3$ | 1 µg/m$^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 6 ng/m$^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 20 ng/m$^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m$^3$ | 180 µg/m$^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m$^3$ | 5 µg/m$^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m$^3$ | 1 ng/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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QUALITY MANAGER

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TC-6289

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/129/2023 (ULR NO:TC658923000000012 9F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 17/06/2023 |
| | Date of monitoring | 01/06/2023 |
| | Date of sample received | 02/06/2023 |
| | Date of analysis Started | 03/06/2023 |
| | Sample description | Ambient air –Muvattupuzha-Kunammama |
| | Sample Code | G/F/129/2023 |
| | Sample Location | Gps Reading : N- 9 °59'37.439"<br>E -76°33'40.071" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 136 µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 34.7µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 11.5 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 18.3 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 0.9 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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QUALITY MANAGER

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/4860/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 17/06/2023 |
| | Date of monitoring | 01/06/2023 |
| | Date of sample received | 02/06/2023 |
| | Date of analysis Started | 03/06/2023 |
| | Sample description | Ambient air –Muvattupuzha-Kunammama |
| | Sample Code | G/F/129/2023 |
| | Sample Location | Gps Reading : N- 9°59'37.439"<br>E -76°33'40.071" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | <1 µg/m$^3$ | 400 µg/m$^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | <0.1 µg/m$^3$ | 1 µg/m$^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 6 ng/m$^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 20 ng/m$^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m$^3$ | 180 µg/m$^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | <0.1 µg/m$^3$ | 5 µg/m$^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | <0.1 ng/m$^3$ | 1 ng/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/SD/4856/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 17/06/2023 |
| | Date of monitoring | 01/06/2023 |
| | Monitoring Location | Muvattupuzha-Kuriamnamma<br>GPS Reading : N- 9 °59'35.663"<br>E -76°33'41.236" |
| | Sample Description | Ambient Sound Level |

| HOURLY INTERVAL | | RESULT | HOURLY INTERVAL | RESULT |
|---|---|---|---|---|
| 01.06.2023 | 15.00 Hrs | 51.6 dB (A) | 08.00 Hrs | 55.5 dB (A) |
| 16.00 Hrs | | 51.5 dB (A) | 09.00 Hrs | 62.0 dB (A) |
| 17.00 Hrs | | 50.9 dB (A) | 10.00 Hrs | 55.8dB (A) |
| 18.00 Hrs | | 47.4 dB (A) | 11.00 Hrs | 53.4dB (A) |
| 19.00 Hrs | | 46.7 dB (A) | 12.00 Hrs | 59.3 dB (A) |
| 20.00 Hrs | | 49.6 dB (A) | 13.00 Hrs | 50.5 dB (A) |
| 21.00 Hrs | | 46.1dB (A) | 14.00 Hrs | 53.6 dB (A) |
| 22.00 Hrs | | 46.5 dB (A) | | |
| 23.00 Hrs | | 46.4 dB (A) | | |
| 02.06.2023 | 00.00 Hrs | 46.5 dB (A) | | |
| 01.00 Hrs | | 44.9 dB (A) | | |
| 02.00 Hrs | | 44.4 dB (A) | | |
| 03.00 Hrs | | 44.5 dB (A) | | |
| 04.00 Hrs | | 45.0 dB (A) | | |
| 05.00 Hrs | | 50.2 dB (A) | | |
| 06.00 Hrs | | 48.2 dB (A) | LeqDay | 51.6 dB (A) |
| 07.00 Hrs | | 49.6 dB (A) | LeqNight | 45.9 dB (A) |

Limits: Industrial Area Day Time-75dB(A),Night Time- 70dB(A),Commercial area Day Time -65 dB(A),Night Time55dB(A), Residential area Day Time -55 dB(A),Night Time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am

*End of the Report *

For Poluchem Laboratories (P) Ltd.

Authorized Signatory

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

# POLUCHEM LABORATORIES PVT LTD

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## TEST REPORT



**Ref.No: PL/RT/SW/1462/2023** **Date of Issue: 17/06/2023**

(ULR NO:TC658923000000001462F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- Muvattupuzha-Kurianmama
Sample Location : Down Stream
Gps Reading : N- 9°59'40.166"
E -76°33'31.094"
Sample code : F/1462/2023
Date of Sample Collected : 02/06/2023
Date of receipt of sample : 02/2023
Date of analysis started : 03/06/2023
Date of completion of analysis : 16/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 –1983RA2017 | 6.52 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 –1983RA2017 | 20 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 4.3 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 90 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 58.5 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 15 mg/l | --- | -- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 20 mg/l | 200 mg/l | -- |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 20 mg/l | -- | -- |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 13.30 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 4.26 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 –1989RA2014 | 1.6 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 1.38 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 3.60 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.08 mg/l | 1.5 mg/l | 1.5 mg/l |

For Poluchem Laboratories (P) Ltd

SREEJA RAMESH
QUALITY MANAGER

Authorized Signatory.

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Continuation of Test Certificate No: 1462/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 300 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | — | — |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorised Signatory.

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/SW/4665/2023** **Date of Issue: 17/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- Muvattupuzha-Kurianmama
Sample Location : Down Stream
Gps Reading : N- 9 °59'40.166"
E -76°33'31.094"

Sample code : F/4665/2023
Date of Sample Collected : 02/06/2023
Date of receipt of sample : 02/06/2023
Date of analysis started : 03/06/2023
Date of completion of analysis : 16/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | --- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | --- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27$^{O}$ C ) | IS 3025 (P) 44 -1993RA2014 | 4.6 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 14 mg/l | --- | -- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 1.2 mg/l | --- | -- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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TC-4586

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## TEST REPORT



**Ref.No: PL/RT/GW/1461/2023** **Date of Issue: 17/06/2023**

(ULR NO:TC658923000000 1461F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Ground water-1
Sample Location : Muvattupuzha-Kurianmama
Gps Reading : N- 9 °59'37.061"
E -76°33'39.772"

Sample code : F/1461/2023
Date of sample collected : 02/06/2023
Date of receipt of sample : 02/06/2023
Date of analysis started : 03/06/2023
Date of completion of analysis : 16/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.96 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 5 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 0.8 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 140 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 84 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 26 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 30 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 16.15 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 7.70 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.14 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 2.60 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.78 mg/l | 1.0 mg/l |

For Poluchem Laboratories (P) Ltd

SREEJA RAMESH
QUALITY MANAGER

Authorized Signatory.

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Continuation of Test Certificate No: 1461/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 240 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | Shall not be detectable in any 100 ml sample |

For Polachem Laboratories (P) Ltd

Authorized Signatory.

SINDHU VIJAYAKUMAR
Technical Manager (Microbiology)
Polychem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/4660/2023** **Date of Issue: 17/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Ground water-1
Sample Location : Muvattupuzha-Kurianmama
Gps Reading : N- 9 °59'37.061"
E -76°33'39.772"

Sample code : F/4660/2023
Date of Sample Collected : 02/06/2023
Date of receipt of sample : 02/06/2023
Date of analysis started : 03/06/2023
Date of completion of analysis : 16/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P)54-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P)41-1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P)47-1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P)42-1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P)59-2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P)48-1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P)49-1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025(P)58-2006RA2017 | 10 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025(P) 34-1988RA2014 | 2.86 mg/l | --- |
| Total Chromium as Cr | IS 3025(P)52-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P)37-1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Conti..

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Continuation of Test Certificate No: 5268/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAN[illegible]

QUALITY MANAGER

[illegible]

*End of the report*

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TC-6589

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## TEST REPORT



**Ref.No: PL/RT/GW/1462/2023** **Date of Issue: 17/06/2023**

(ULR NO:TC658923000000l462F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Ground water-2
Sample Location : Muvattupuzha-Kuriannama
Gps Reading : N- 9 °59'31.612"
E -76°33'41.459"
Sample code : F/1462/2023
Date of sample collected : 02/06/2023
Date of receipt of sample : 02/06/2023
Date of analysis started : 03/06/2023
Date of completion of analysis : 16/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.06 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 0.5 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 210 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 136.5 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 14 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | BDL(MDL-1 mg/l) | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 44.65 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 1.08 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.25 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 5.97 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

For Poluchem Laboratories (P) Ltd

SREEJA RANESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

Authorized Signatory.

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Continuation of Test Certificate No: 1462/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 280 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | Shall not be detectable in any 100 ml sample |

For Polachem Laboratories (P) Ltd

Authorised Signatory

SINDHU VIJAYAKUMAR

Technical Manager (Microbiology)

Polychem Laboratories (P) Ltd

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## TEST REPORT



**Ref.No: PL/RT/GW/4661/2023** **Date of Issue: 17/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Ground water-1
Sample Location : Muvattupuzha-Kurianmama
Gps Reading : N- 9 °59'31.612"
E -76°33'41.459"

Sample code : F/4661/2023
Date of Sample Collected : 02/06/2023
Date of receipt of sample : 02/06/2023
Date of analysis started : 03/06/2023
Date of completion of analysis : 16/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P)54-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P)41-1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P)47-1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P)42-1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P)59-2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P)48-1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P)49-1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025(P)58-2006RA2017 | 8 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025(P) 34-1988RA2014 | BDL(MDL- 1mg/l) | --- |
| Total Chromium as Cr | IS 3025(P)52-2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P)37-1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

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Continuation of Test Certificate No: 5268/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER

*End of the report*

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## TEST REPORT



Ref.No: PL/RT/4596/2023 Date of Issue: 17/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Leachate- Muvattupuzha-Kurianmarna
Sample Location : **Gps Reading : N-9 °59'23.582" E -76°33'51.031"**

Sample code : F/4596/2023
Date of sample collected : 02/06/2023
Date of receipt of sample : 02/06/2023
Date of analysis started : 02/06/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Results |
|---|---|---|
| pH | IS 3025(P) 11 –1983 RA2017 | 6.65 |
| Total Dissolved Solids (Inorganic) | IS 3025(P) 16 – 1984 RA2017 | 143 mg/l |
| Total Suspended Solids | IS 3025(P) 15 – 1984 RA2017 | 12 mg/l |
| Chloride as $Cl^-$ | IS 3025(P) 32 – 1988 RA2014 | 24.1 mg/l |
| C O D | IS 3025(P) 58 -2006 RA2017 | 150 mg/l |
| B O D (3 days at $27^O$ C) | IS 3025(P) 44 – 1993 RA2014 | 16.4 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025(P) 34 – 1988 RA2014 | 11.3 mg/l |
| Ammoniacal Nitrogen as N | IS 3025(P) 34 – 1988 RA2014 | 8.14 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025(P) 43-1992 RA2014 | BDL(MDL- 0.01 mg/l) |
| Fluoride as F | IS 3025(P) 60 -2008 RA2014 | 0.54 mg/l |
| Cyanide as $CN^-$ | IS 3025(P) 27-1986 RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025(P) 54– 2003 RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025(P) 41– 1992 RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025(P) 47– 1994 RA2014 | BDL(MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025(P) 42– 1992 RA2014 | BDL(MDL- 0.01 mg/l) |
| Mercury as Hg | IS 3025(P) 48 – 1994 RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025(P) 49 – 1994 RA2014 | BDL(MDL- 0.01 mg/l) |
| Total Arsenic as As | IS 3025(P) 37– 1988 RA2014 | BDL(MDL- 0.01 mg/l) |

BDL- Below Detection Level, MDL- Minimum Detection Level

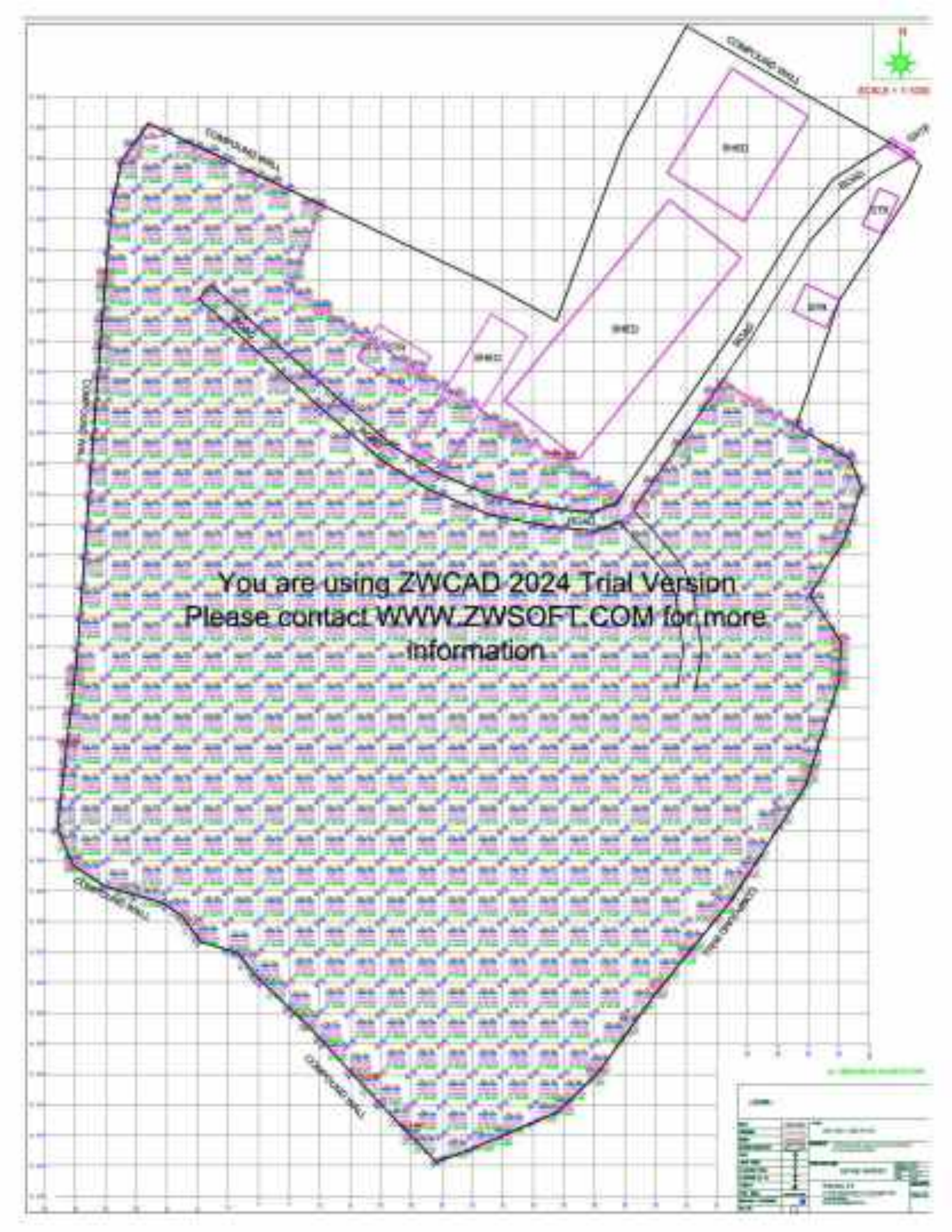
For Poluchem Laboratories (P) Ltd

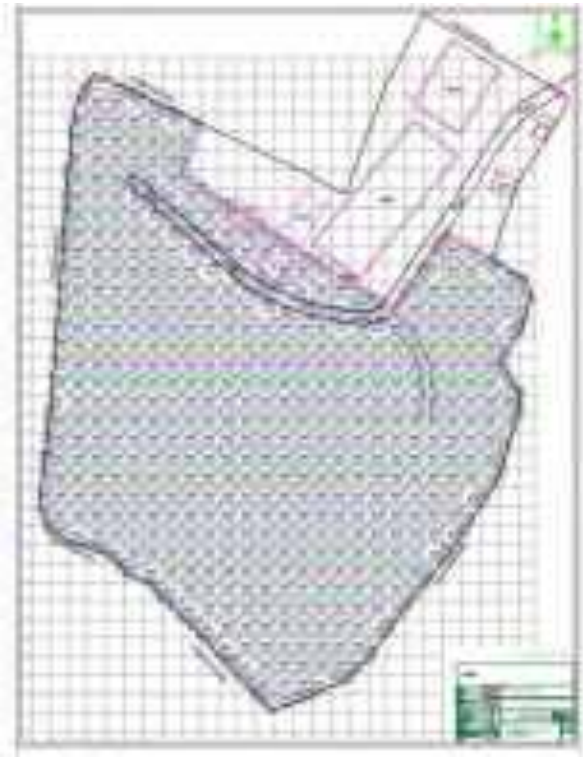
Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER

*End of the report*

The above results are related only to the sample submitted for analysis. This test report shall not be reproduced except in full, without the written approval of the laboratory.


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Contour Map- Muvattupuzha Dumpsite




Proposed Operation Plan

Land shall be reclaimed i.e. all the legacy waste will be removed till it reaches the surface of the earth/ soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the contractor to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to bi-weekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site.

**Part B**

**Social Impact Assessment**



**VALAKKUZHI DUMPSITE**
**MUVATTUPUZHA MUNICIPALITY**

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## 1. Introduction

Social safeguard aspects during dump site remediation mainly focusing on meaningful stakeholder engagement, understanding stakeholder's risk perception, and restoring them to a safe and environmentally sustainable state. It involves a series of systematic social actions which include social inclusion, effective labor management, and prevention of gender violence during the process, successive rehabilitation of the affected people and reduction of health risk of the host community. The bio mining process of Muvattupuzha municipal dumpsite has been included in the World Bank supported KSWMP

## 2. Muvattupuzha Municipality

Muvattupuzha is a town in the midlands directly to the east of Kochi in Ernakulum district, Kerala. It is located about 36 km from downtown Kochi, and is a growing urban center in central Kerala. Muvattupuzha is bordered by the Kottayam district on the southern side and the Idukki district on the eastern side. Muvattupuzha lies on the intersection between MC Road and National Highway 49. Muvattupuzha town is also the starting point of the Muvattupuzhayar (Muvattupuzha river), which is a confluence formed by three rivers, the Thodupuzhayar, Kaliyar, and Kothayar. The municipality has an area of 13.18 sq km and is divided into 28 electoral wards. Total population of the ULB is 30,397 (as per Census 2011). At present, the jurisdiction of Muvattupuzha town has 4 nos. day care, 35 nos. Anganwadi, 4 lower primary school, 3 upper primary school, 5 high school, 5 higher secondary school, 2 Degree College, 1 government hospital and some private nursing homes and also private doctor clinics. Socio-Economic profile of Muvattupuzha is presented below in the **Table** 1

Table 1 Socio Economic Profile Data

| **Socio Economic Profile Data** | |
|---|---|
| District Name | Ernakulum |
| Sub District Name | Muvattupuzha |
| Town Name | Muvattupuzha |
| Total Population of Town | 30397 |
| Total Male Population of Town | 15010 |
| Total Female Population of Town | 15387 |
| Total Scheduled Castes Population of Town | 1588 |

| | |
|---|---|
| Total Scheduled Castes Male Population of Town | 821 |
| Total Scheduled Castes Female Population of Town | 767 |
| Total Scheduled Tribes Population of Town | 139 |
| Total Scheduled Tribes Male Population of Town | 79 |
| Total Scheduled Tribes Female Population of Town | 60 |

Table 2 Socio Economic Profile Data ***Source: Census handbook of Ernakulum 2011***

## 3. Muvattupuzha Dumpsite

The dumpsite is in Valakkuzhi specifically in Ward 25. Total land owned by the Municipality is 5.47 Acres in which 3.2 Acres are covered by waste. The site falls within the jurisdiction of Muvattupuzha Municipality in Ernakulum district, Muvattupuzha Taluk. The GPS coordinates of the site are 9.993628 "N 76.561114"E. Dumping was started approximately 50 years back and closed in 2022 due to public protest. Estimated quantity of legacy waste to be removed is 31995.18 cum based on the study conducted by the ULB. The dumpsite is located inside the existing common solid waste management facility of ULB. An MCF and an RRF are working inside this facility. The MCF is situated in the dump site area with a safe distance of 50m from the site. Remediation process will not affect the physical assets of the MCF.

## 4. Socio economic baseline of Host community

It is identified that there are 27 households, 1 shop, 1 Godown and a workshop situated within the 200 meters from the dumpsite. 23 migrant laborers of KRIS GLOBAL are engaged in the waste management units located in the dump site. 12 HKS workers are also engaged in the segregation process in the MCF. The dumpsite has enough road access and thus there will not be any disruption to the public properties and commercial establishments nearby the site. There are no scheduled tribes, rag pickers and other vulnerable communities living near the dumpsite.

## 5. Vulnerability mapping of Host community

There are no scheduled tribes, rag pickers are living near the dumpsite. The dumpsite is near 5 households which are the vulnerable communities. 23 migrant laborers of KRIS GLOBAL are working there, in which 17 workers are female. 12 HKS workers (all are female) are also engaged in the segregating process here.

| Sl.No | Particulars | Number |
|---|---|---|
| 1 | Number of Senior citizen residing Near dumpsite | 30 |
| 2 | Number of single women staying near the dumpsite | 1 |
| 3 | Number of persons with disabilities | 2 |
| 4 | Number of persons with severe disease | 0 |
| 5 | Number of persons with respiratory issues | 3 |
| 6 | Number of Kids | 20 |

*Source: Secondary data from ward level health officer*

## 6. Data Collection

### 6.1 Social Screening Checklist

The social screening has been conducted with a social and tribal screening checklist to identify the potential social risks anticipated during dumpsite remediation. Major findings during the screening process are shown below.

- The dumpsite is located inside the existing common solid waste management facility of ULB. An MCF and RRF are working inside this facility.
- A bio waste processing unit is also functioning inside the compound which is being operated by a private agency Kris Global.
- Municipality is planning for establishing a bio medical waste collection unit also in the same compound after remediation process.
- Solid waste dumping at this place is currently stopped now due to the public protest. It is identified that there are chances of public protest at the initial stage against dumpsite remediation
- The dumpsite remains in close proximity to five houses within a 50-meter distance.
- There will not be any adverse social impacts on dwellings, land, labour, livelihood, and community resources of host communities.
- Land acquisition or land loss is not applicable here for the execution of the work.
- There are no scheduled tribes, rag pickers living near the dumpsite.

- Since there is not much risk with respect to the social and economic conditions of the host communities, the dumpsite can be categorized into “Moderate Risk”.

### 6.2 Transect walk

A transect walk was conducted in and around the dumpsite on 31.05.2023. The aim of the transect walk was to assess the site and gather information about its location, potential social risks, existing infrastructure, and the impact on surrounding communities. The group exercise that entails walking between two points to intentionally cross or transect a community. The group explores environmental and social resources, conditions, and systems by observing, asking, listening, looking and producing a transect diagram. Information collected can be used to reveal land use practices, hazards, and vulnerabilities to inform disaster mitigation and water management.

### 6.3 Site specific Observations from Transect walk and social screening

- 27 households are found with the diameter of 200 meters from the dumpsite, also observed five houses within a 50-meter distance. The residents living in these houses are still exposed to potential health risks associated with waste disposal activities.

- 23 migrant laborers, deputed by the agency Kris Global and 12 HKS workers are working here in the waste processing units located in this site.

- There is no complaints registration system functioning in the dumpsite.

- No rag pickers are associated with the dumpsite so that there are no livelihood risks for rag pickers in this context.

- There is no requirement for government, forest, or private land acquisition for the dumpsite remediation project. The currently designated plot or right-of-way has enough space for the transportation of inert waste or mobilization of machineries and materials.

- The total scheduled tribal population in the ULB is 139, but there are no scheduled tribes staying near the dumpsite, and no impact on their land, customary rights, or livelihoods of tribes is observed.

- It is understood from the interaction with the host community that, public Protest against the dumpsite remediation may be expected during the bio mining process.

- It is informed that, there was a severe public protest happened from the nearby resident’s association and the Dumping yard Virudha Samithi, against the functioning of dumpsite.

### 6.4 Focused Group Discussion

FGD was conducted on 10-11-2023 in the Municipal Hall with the residents living near to the dumpsite. Concerned social and Communication experts from TSC, DPMC, and DPMU along

with dumpsite remediation expert participated. Communication expert from TSC presented the detailed activities that are going to be done as part of remediation. In the discussion that followed, people shared their concerns. Concerned expert cleared the doubts and all the anticipatory risks and precautionary measures we are planning explained.

## 7. Stakeholder Analysis

There are 27 households, 1 shop, 1 Godown and a workshop situated within the 200 meters from the dumpsite. ULB has received lot of complaints against this site since 2010 onwards. Complaint is mainly from the secretary of Royal Residents Association, Mudavoor P.O, and Muvattupuzha. Another association is also formed in the Municipality in the name of "Dumping Yard Viruddha Janakeeya Samithi" consisting of 8 members. They have also filed lot of complaints against the site. These protests are mainly against the odor spreading out from the site and against issues due to the flies. The remediation process requires collaboration with these stakeholders, ULB officials and workers.

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| **Service Providers** | | |
| 1 | ULB Council | Providing ground support to the remediation process |
| 2 | Govt institutions like PCB, KSEB, KWA etc | To deliver necessary approvals and provide necessary services for remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | DPMU | Monitoring and Evaluation |
| 5 | TSC/PMC | Technical support and consultation |
| 6 | Contractor | Execution of the Remediation process |
| 7 | Service providers/HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| **Community** | | |
| 8 | 23 Workers in the RRF, MCF and Bio waste processing unit appointed by Kris Global and 12 HKS workers | Support and cooperation for the remediation process |

| | | |
|---|---|---|
| 9 | Members of 27 HHs in the 200 m radius of the dumpsite | Support and cooperation for the remediation process |
| 11 | Labors of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |
| 12 | Rag Pickers | Participation in informal collection to strengthen the collection process to prevent further dumping |
| 12 | Waste Generator in Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |
| 13 | Owner of the Workshop and Grocery shop | Cooperating with the remediation process |
| 14 | Scrap dealers | Informal participation in NBD waste management to prevent further dumping after remediation |
| 15 | End recyclers | Process the inert and legacy waste safely after remediation |

Table 3 Stakeholder Details

## 8. Positive social impacts after remediation

**a) Enhanced quality of life**

The remediation can restore the aesthetics of the area, reducing visual blights, foul odour and improving air and water quality. According to the opinion of people residing nearby the dumpsite, the project can contribute to an improved sense of well-being. Also it results to a clean and hygienic work environment for the workers engaged in MCF and RRF.

**b) Livelihood and employment of vulnerable community**

It is identified that no rag pickers are currently engaged in collecting waste from the dumpsite or making a living from it. Therefore, the proposed dumpsite rehabilitation project will have no impact on housing or livelihood of any rag pickers.

**c) Economic opportunities**

After remediating the site, the Municipality is planning to enhance the capacity of the MCF and RRF to process more non bio degradable waste and to set up a centralized waste management unit to process the bio degradable waste. These projects will create more job opportunities to the people who are looking for employment in waste management sector. Remediation create new opportunities for economic development in the area. The cleaned-up land can potentially be used

for new construction, commercial development, or recreational activities. Remediation process will help to increase property values for surrounding residents.

**d) Access to service**

It is observed that the project will not affect access to any facilities, services, or natural resources as there is enough space/land available in the exiting site.

## 9. Expected social impacts during the dumpsite remediation

- There are 27 Households found within the diameter of 200 meters from the dumpsite. Among them, 5 Households are observed 50 meters near to the site. Health and safety issues may arise to the households during the process. Also, there are chances of occurrence of GBV/SEA incidents as there is an influx of labors for remediation.

- 23 contract labors (16 males and 17 females) and 12 HKS workers are working in the MCF, RRF and Bio composting unit located in the Dump site compound. Health risk are there to these workers during the remediation process unless they adopt proper health and safety measures. Also chances of GBV/SEA incidents prevails.

- Chances social protest during the execution of remediation from Royal resident's association and 'Dumping yard Virudha Janakeeya Samithi', exclusively constituted against the functioning of dumpsite.

- Chances of Spreading of communicable diseases

## 10. Suggestions/recommendations

- Effective FGD'S should be conducted with the host community, political leaders, community influencers, ULB councilors, members of action council regarding the remediation process and the benefits of dumpsite remediation.

- Visiting similar project site with the selected members from the host community will be helpful to create a positive thinking about remediation process among the local people.

- A bio waste processing unit, MCF and RRF are currently functioning in the dump site compound. The remediation process will not affect these facilities in any way as there is enough space for vehicle movements and machinery fixing. So there will not be any livelihood loss for the workers engaged in these units.

- Arrangements shall be made for proper fencing and Noise barriers to safeguards the 5 households which is at the Close proximity of the dumpsite

- Safe and gender friendly washrooms and changing rooms should be made available to safeguard the women workers.

- A detailed and effective IEC plan needs to be prepared to address the social safeguard requirements and the expected social protests from the host community.

## 11. Scoping of Social Impact Assessment and required Action plans

All the social risks were identified through the social screening and Transect walk conducted at site. Since there are families and institutions in the close proximity of the dumpsite, below shown action plans have been formulated to be followed at site

- Labour Management Plan

Maximum of 15 labors are expected to be engaged in remediation process at a time. A detailed labor Management plan has been prepared and attached as Annexure.

- Labor Influx Management Plan

Since 27 families are residing in 200 m Households there are chances of influx issues. A detailed labor Influx Management plan has been prepared and attached as Annexure.

- Preventive GBV Action plan

Since an MCF, RRF and Bio waste processing units are functioning inside the dumpsite and close proximity to households there are high chance of occurrence GBV incidents. A detailed GBV action plan has been prepared and attached as Annexure.

- Citizen Engagement Plan

Being a socially sensitive area with past protest history, public protest might have happened during the execution period of the project. A detailed citizen engagement plan has been prepared and attached as Annexure.

## 12. Conclusion

The report on Social Screening and Transect walk covers a comprehensive analysis on existing conditions and potential social impacts that may arise during the remediation of the Valakkuzhi dumpsite in Muvattupuzha Municipality. The vulnerabilities identified, the risks to be mitigated, observations and suggestions raised during screening and transect walk are elaborated in this report. As there are 27 households residing within 200 meters of the site, there are chances of residential impact. The history of fire incidents highlight the need for careful planning and implementation to ensure the safety and well-being of the community. The dumpsite has enough road access, thus there will not be any disruption to the public properties and commercial establishments nearby the site. Since there is not much risk with respect to the social and economic conditions of the host communities, the dumpsite can be categorized into “Moderate Risk”. The assessment of social screening indicates that the dumpsite remediation can create a positive impact in the living conditions of the host community.

**ANNEXURE-1**

# CITIZEN ENGAGEMENT PLAN

## 1. Stakeholder identification

As part of social safeguard initiatives for the Bioremediation of dumpsite at Muvattupuzha, the social experts of TSC, DPMC and DPMU conducted brainstorming exercises with locals, functionaries of Muvattupuzha Municipality, Suchithwa Mission. A detailed list of primary and secondary stakeholders is prepared on the basis of these exercises.

### 1.1 Waste Generators

The dumpsite is located in Valakkuzhi specifically in Ward 25. It covers an area of 4 acres. The dumpsite is located inside the existing common solid waste management facility of ULB. An MCF and an RRF are working inside this facility. Municipality is planning to establish a bio medical waste collection unit also in the nearby area. The identified waste generators are as follows.

| Sl.No | Waste Generators |
|---|---|
| 1 | General Households |
| 2 | Shops |
| 3 | Institutions |
| 4 | Commercial establishments |

**Table 4: Waste Generators**

### 1.2 Service Providers

The identified service providers of the dumpsite are as follows:

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| Service Providers | | |
| 1 | ULB Council | Providing ground support to the remediation process |
| 2 | Govt institutions like PCB,KSEB,KWA etc. | To deliver necessary approvals and provide necessary services for remediation purpose |
| 3 | ULB Officials | Support and Monitoring of the process |
| 4 | DPMU | Monitoring and Evaluation |

| | | |
|---|---|---|
| 5 | TSC/PMC | Technical support and consultation |
| 6 | Contractor | Execution of the Remediation process |
| 7 | Service providers/HKS | Proper collection and waste segregation to prevent further dumping after remediation |
| Community | | |
| 8 | 23 Workers in the RRF,MCF and Bio waste processing unit appointed by Kris Global and 12 HKS workers | Support and cooperation for the remediation process |
| 9 | Members of 27 HHs in the 200 m radius of the dumpsite | Support and cooperation for the remediation process |
| 11 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |
| 12 | Rag Pickers | Participation in informal collection to strengthen the collection process to prevent further dumping |
| 12 | Waste Generator in Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |
| 13 | Owner of the Workshop and Grocery shop | Cooperating with the remediation process |
| 14 | Scrap dealers | Informal participation in NBD waste management to prevent further dumping after remediation |
| 15 | End recyclers | Process the inert and legacy waste safely after remediation |

## 2. Need of the plan

Citizen engagement as part of the proposed bioremediation of dumpsite in Muvattupuzha municipality aims to facilitate two-way communication between the project and its stakeholders to make better informed decisions. Such an engagement will certainly pave the way for better implementation of the project, and it will ensure public participation in trouble shooting at all the stages of the implementation of the project.

## 3. Objective of the plan

The citizen engagement plan for the proposed dump site remediation is prepared with following objectives.

- To create a conducive environment for the smooth implementation of the proposed bioremediation of the dumpsite by promoting constructive dialogues between the project and its stakeholders.
- To ensure stakeholder participation in the planning, implementation, and monitoring of the sub-project.
- To suggest appropriate activities with a monitoring plan and an expected budget for engaging the stakeholders with the motive of enhancing their ownership in the project through increased participation.

## 4. Stakeholder concern

### 4.1 Waste Generators

- The waste collection may get delayed/stopped due the remediation process.

### 4.2 Service Providers

- Major concerns of the service providers which must be addressed by the citizen's engagement plan can be summarized as follows.

- Livelihood of SWM workers currently working in the dumpsite may get affected.
- The policy makers and decision leaders of the Muvattupuzha Municipality are unaware about the urgency and importance of remediating the dumpsite. Their improved involvement through proper sensitization is essential to the effective implementation.

- SWM related Service providers/HKS of Muvattupuzha Municipality should be trained and motivated for proper timely collection, segregation and transportation of waste to appropriate processing units to prevent the formation of such dumping yards in the future.

## 5. Activities proposed

### 5.1 Community/citizen Awareness

- Focus group discussions to host community
- Organize exposure visit for the identified members from host community and council members
- Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency.
- Sensitization programs to nearby vendors
- Periodic FGD's with the Royal resident's association and 'Dumping yard Viruddha Janakeeya Samithi' members

### 5.2 Awareness to Service providers

- Sensitization on the bio-remediation activity is to be conducted for the Muvattupuzha Municipal Council and officials prior to the commencement of the actual bio-remediation process.
- Meeting with Contractor to understand their plan of operations/No labors involvement/timeline etc.
- Orientation to the Service providers/HKS of Muvattupuzha Municipality
- Sensitization meetings to the local and district level police officials on the proposed bioremediation of dumpsite and anticipated issues and action required.
- Sensitization programs to Fire Force, and PCB regarding dumpsite remediation.
- Orientation regarding the dumpsite remediation process and its benefits to local community

## 6. Citizen Engagement Plan Matrix

| S. No | Engagement Challenge | Impacts on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| 1 | Lack of Awareness on Project activities | Non co-operation from Community/stakeholders | Awareness campaigns / sensitization programs to the stakeholders | ULB/PIU/DPMU/DPMC/ TSC |
| 2 | Delay in decision making and timely support from the ULB | To establish transparency and building confidence in the project commitments to ULB | Sensitization on bioremediation activities for the | PIU/TSC |

| | | | | |
|---|---|---|---|---|
| | | elected members and officials | Muvattupuzha Municipality council and staffs before the commencement of the remediation | |
| 3 | GRM committee | Delay in the execution of remediation work | Constitution of a project level GRM Committee to take-up any social issues raised at site level | PIU/ULB/DPMU/TSC |
| 4 | To understand the actual operational plans (Time of operations,Mechineries involved, number of workers, actions to be initiated for dust /odor/and sound pollution, vehicle movements) | To inform actual plan of operation to the host community and prevent any social & environmental issues and plan mitigation measures | Meeting with the contractor to understand the plan of operation, number of labors going to involve, duration of the work | PIU/TSC/DPMU |

**Budget**

| S. No | Activity | Specifications | Quantity | Cost |
|---|---|---|---|---|
| 1 | Sensitization on the bio-remediation activity is to be conducted for the Municipal Council and officials prior to the commencement of the actual bio-remediation process | Half day Programme for Councilors and Health Staff | 1 | [redacted] |
| 2 | Sensitization meeting to host community | Half day Programme by incorporating all host community members | 2 | [redacted] |
| 3 | Formation of GRM committee at local level | Committee formation | 1 | [redacted] |

| | | | | |
|---|---|---|---|---|
| | to take up any issue raised at site level and help to resolve an emergency. | | | |
| 4 | Meeting with Contractor to understand their plan of operations/No labors involvement/timeline etc. | One to one interaction | As required | [redacted] |
| 5 | Organize exposure visit incorporating the GRM members and council members | Exposure visit to Alappuzha | 15 participants-1programme | [redacted] |
| 6 | Orientation to the Service providers/HKS of Municipality and | Half day programme | 2 | [redacted] |
| 7 | Issue based one to one meeting with Govt institutions like PCB,KSEB,KWA, Health Department | One to one | As required | [redacted] |
| 8 | Orientation to the Media persons on the proposed remediation dumpsite. | Half day programme | 1 | [redacted] |
| 9 | Sensitize the local and district level police officials on the proposed bioremediation and anticipated issues and action required | One to one interaction | As required | [redacted] |
| 10 | Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency. | Committee formation | 1 | [redacted] |
| **Total** | | | | [redacted] |

# LABOUR MANAGEMENT PLAN

## 1. PROJECT TITLE:

Project for the remediation of Valakkuzhi dumpsite in ward 25 of owned by Muvattupuzha Municipality

## 2. PROJECT AREA

The dumpsite is located in Valakkuzhi specifically in Ward 25. It covers an area of 4 acres and falls within the jurisdiction of Muvattupuzha Municipality in Ernakulum district, Muvattupuzha Taluk. The GPS coordinates of the site are 9.993628 "N 76.561114"E.

## 3. SCOPE AND STRUCTURE OF THE LABOUR MANAGEMENT PLAN

The scope of the LMP shall be as outlined in the World Bank's ESMF. The engagement will be planned as an integral part of the project's social assessment and project design and implementation. This document has 10 chapters. This chapter viz., chapter 1 served as introduction. Scope and structure of LMP is provided in chapter 2. An overview of labour use in the project is presented in chapter 3. Key potential labour risks are listed in chapter 4. Legislative framework governing labour employment in India/Kerala is discussed in chapter 5. Implementation Arrangements, policies and procedures follow in the subsequent chapter. Grievance redressal mechanism, contractor management are presented in the last chapters.

## 4. OVERVIEW OF LABOUR USE ON THE PROJECT

### 4.1 Details of Labors

The proposed remediation process at Valakkuzhi requires following category and number labors

| Sl.No | Equipment | Category of labors | Required No.of labors |
|---|---|---|---|
| 1 | One trammel | Labors for waste segregated purpose | 5 |
| 2 | One excavator | Operator | 1 |
| 3 | One JCB | Operator | 1 |
| 4 | Two small tippers | drivers | 2 |
| | | Helpers | 2 |

| | | | |
|---|---|---|---|
| 5 | | Supervisor | 1 |
| **Total Labors** | | | 12 |

**4.2 Working Hours**: 8 hours per shift

**4.3 Type of Engagement**: Contract

## 5. ASSESSMENT OF KEY POTENTIAL LABOUR RISKS

### 5.1 Project Activities:

The bioremediation of the dumpsite at Valakkuzhi includes the following activities;

- Mobilization of plant and machinery for bio-mining
- waste excavation and forming of windrow
- Spraying with inoculum and waste stabilization
- Waste segregation and refinement
- sorting materials into recyclable, RDF, compost and inert
- Transport to the authorized recyclers and end users

### 5.2 Key Labor Risks

It is assessed that key labour risks would be associated with health and safety risks related to the construction activities such as exposure to physical hazards during construction activities such as: use of heavy equipment, exposure to noise and dust, falling objects, exposure to hazardous materials and exposure to electrical hazards from the use of tools and machinery, lack of proper sanitation facilities, availability of separate toilet for women workers. As the construction activities will involve hazardous work, persons under the age of 18 will not be employed by the Project. Many workers will be exposed to occupational health and safety hazards, primarily including but not limited to:

- Injuries/accidents/ fatalities leading to even death, while at work.
- Inadequate accommodation facilities at work force camps, including inadequate sanitation and health facilities.
- Non-payment of wages by Employer.
- Non-payment of benefits (compensation, bonus, maternity benefits etc.) by Employer
- Discrimination in Employment (e.g., abrupt termination from employment, working conditions, wages or benefits etc.)
- Engagement of child labour.
- Sexual harassment at work sites.
- Forced labour or trafficking.

- Security of women workforce.
- Inadequate facilities for pregnant women and lactating mothers.
- Inadequate facilities for the children of the workforce at workforce camp sites
- Possibility of Gender based violence as the work is mostly carried out within the premises of the existing facilities like MCFs/ RRFs etc where female SWM workers are engaged.
- Absence or inadequate or in accessible emergency response system for rescue of labour/workforce.
- Health risks of labour relating to HIV/AIDS and other sexually transmitted diseases.
- Unclear terms and conditions of employment.
- Discrimination and denial of equal opportunity in hiring and promotions/incentives/training opportunities.
- Denial for workers' rights to form workers organizations, etc.
- Absence of a grievance redressal mechanism for labour to seek redressal of their grievances/issues.

## 6. BRIEF OVERVIEW OF LABOUR LEGISLATION: TERMS AND CONDITIONS

| Sl No | Applicable Acts | Details |
|---|---|---|
| 1. | Employees Compensation Act 1923: | The Act provides for compensation in case of injury, disease or death arising out of and during employment |
| 2. | Contract Labour (Regulation & Abolition) Act 1970 | The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. |
| 3. | Minimum Wages Act 1948: | The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. |
| 4. | Payment of Wages Act 1936: | It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the workers. |

| | | |
|---|---|---|
| 5. | Equal Remuneration Act 1976: | The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training, and promotions etc. |
| 6. | Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: | The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc. |
| 7. | Child Labour (Prohibition & Regulation) Act 1986: | The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in the Building and Construction Industry. |
| 8. | Employees State Insurance Act 1948: | The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the Central Government. The Act also provides for benefits to dependents of insured persons in case of death because of an employment injury. |
| 9. | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: | This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee |
| 10. | Industrial Disputes Act 1947: | the Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing the establishment. |
| 11. | Trade Unions Act 1926: | The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. |

## 7. RESPONSIBILITY MAPPING

The ULB (Urban Local Body) will award the proposed work to the contractor through competitive bids. The contractor will be responsible for hiring laborers for both civil and skilled work. In the recruitment process, the contractor is obligated to provide opportunities to members of the host community who possess the necessary skills and willingness to engage in the activities available at the dumpsite for remediation.

The contractor is required to adhere to existing labour laws in the state of Kerala while employing laborers, ensuring compliance with all applicable welfare measures mandated by the relevant labour legislation and rules. Additionally, the contractor is responsible for implementing measures to protect and assist vulnerable groups of workers, including individuals with disabilities, migrant workers, and women workers. These protective measures should be explicitly outlined in the work agreement.

Furthermore, the contractor must prioritize occupational health and safety measures for the laborers. The ULB will actively monitor the contractor's compliance with legal and welfare requirements. The ULB will also organize training sessions for the workers and establish a forum at the ULB level to address any grievances raised by the workers.

It is a prerequisite for the contractor to possess a valid Labor License, and all laborers working on the site must be registered with the appropriate authorities. This comprehensive approach ensures the well-being and fair treatment of workers throughout the remediation project.

## 8. CODE OF CONDUCT

A code of conduct needs to be incorporated with the contract under the project. The contractor should conduct continuous awareness generation and training activities to ensure that the workers abide by the code of conduct. While preparing the code of conduct, following aspects should be ensured;

- Compliance with applicable laws, rules, and regulations of the jurisdiction
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment (PPE), preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment)
- The use of illegal substances
- Non-Discrimination (for example based on family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction)
- Interactions with community members (for example to convey an attitude of respect and non-discrimination)
- Sexual harassment (for example to prohibit use of language or behavior, towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate)

- Violence or exploitation (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favours or other forms of humiliating, degrading or exploitative behavior)
- Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behavior with children, limiting interactions with children, and ensuring their safety in project areas)
- Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by their employer and not open areas)
- Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favours, are not provided to any person with whom there is a financial, family, or personal connection)
- Respecting reasonable work instructions (including regarding environmental and social norms)
- Protection and proper use of property (for example, to prohibit theft, carelessness, or waste)
- Duty to report violations of this Code
- No retaliation against workers who report violations of the Code, if that report is made in good faith.

## 9. SYSTEMATIZING THE CODE OF CONDUCT

Awareness raising: The Contractor is required to conduct ongoing awareness-raising and training activities to ensure that workers consistently adhere to the Code of Conduct. Additionally, the Contractor must take measures to ensure that local communities are well-informed about the Code of Conduct, enabling them to report any concerns or instances of non-compliance. This proactive approach aims to foster a shared understanding of ethical standards and accountability within both the workforce and the surrounding communities.

## 10. TRANSPARENCY IN CONTRACT SPECIFIC TERMS AND CONDITIONS

All contracts must contain

- Wages: Specific wages and payment modality, timeline
- Working Hours: hours of work, maximum number of hours that can be worked on the project, overtime, compensation
- Leaves: rest per week, annual leave, maternity leave, sick leave
- Benefits: medical treatments in case of accidents or otherwise
- Notice of termination of employment and details of severance payments in a timely manner
- Collective agreements that apply to the project, other specific terms, and conditions
- Details of the grievance redressal mechanism

**LABOUR MANAGEMENT PLAN MATRIX**

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To complete the registration by the Principal Employer, the ULB, as per the provisions of the Contract Labour (Regulation & Abolition) Act 1970 (CL Act), Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979 (ISML Act) and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 (BOCW Act) and procure certificate to that effect. | 3 Registration Certificates to be procured by the ULB under CL Act, ISML Act and BOCW Act respectively. | Before Awarding works | Registration Certificate issued by District Labour Officer under CL Act, ISML Act and BOCW Act | PIU |
| To Procure license under CL Act, ISML Act and registration under BOCW Act by the contractor | 2 Licenses and One registration under CL Act, ISML Act and BOCW Act respectively. | Before commencing the work at site | License and registration certificate issued by the competent Authority. | Contractor |
| To procure Workmen Compensation insurance policy | One insurance policy. | Before commencing work at site | Copy of insurance policy | Contractor |

| | | | | |
|---|---|---|---|---|
| proportionate to the number of labour force deployed. (By the Contractor) | | | | |
| To display a copy of the certificate of registration at the conspicuous place at the premises where the building and other construction work is being carried on.<br><br>To establish a labour information signboard at camp site by including following details like, date of payment of wages, working hours, holidays, wages rates for different categories of labours and name and contact details of local labour inspector and his/ her office and emergency contact numbers. | One notice board<br><br>One notice board | As soon as the work is started.<br><br>Do | Photographs of the notice board where the license is displayed.<br><br>Do | Contractor |
| To conduct pre-employment medical examination (as per the provisions of BOCW Act)- to ensure medical fitness of the employee. | All workers must be examined | No of workers employed by the contractor | Pre-Medical Examination certificate issues as per Rule 223(C) of BOCW Act (Form No. IX) by the Registered Medical Practitioner. | Contractor |

| | | | | |
|---|---|---|---|---|
| To conduct Periodical Medical Check-ups (once in every six months) | All workers must be examined. | No of workers employed by the contractor | Medical Examination certificate issued by a registered medical practitioner. | Contractor |
| To provide safe drinking water- the contractor must provide safe drinking water at worksite as well as camp site* (Guideline is provided along with this document) | As per requirement | During the entire contact period | Photographs of supply of potable water, Bill of water purchase. | Contractor |
| To arrange first Aid facility at work site as well as camp site (Specifications and items to be maintained in the box is mentioned in this document) | As per requirement | During the entire contract period | First Aid Register, Bill of purchase, photographs of First Aid kit | Contractor |
| To arrange separate First Aid room at work site | Allot one specified room | To be made available during the construction period | Photographs of the facility | Contractor |
| To provide first Aid training to selected labourers or staff members through an authorized agency. | One training with authorized agency | Within one month of commencement of the work | Training records & Photographs | Contractor |
| To establish linkage with local hospitals/ health care institutions for emergency medical assistance | Tie up with at least one hospital | Within one month of the commencement of the work | Letters issued by the hospital or correspondence and agreement with the hospital. | Contractor |

| | | | | |
|---|---|---|---|---|
| To establish rest room at work site or camp site | | Before the commencement of the work | Photographs of the rest room | Contractor |
| To establish Canteen facility for labours if the contractor engages more than 250 labours | | Before the commencement of the work | Photographs of the facility, canteen register etc | Contractor |
| To maintain essential registers and records like Form A (Registration of employees), Attendance Register, Wages Register, and other registers like incidents registers including Accident register, Harassment complaints, recovery register, Maternity leave, Termination etc | | As and when the work starts | Copy of registers. | Contractor |
| Constitute GRC for labours (maximum members to be six. Number of members from employer and employee to be equal. Female members should be minimum 50%. ) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| Constitution of ICC (minimum members to be four. The presiding member should be | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |

| | | | | |
|---|---|---|---|---|
| a senior female employee) | | | | |
| To publish the abstract of labour laws within the premises of the labour camp.<br>1. The Payment of Wages Act<br>2. The Employee compensation Act<br>3. The Building and Other Construction Workers (RECS) Act<br>4. The Contract Labour (A&R) Act<br>5. The Child and Adolescent Labour (P&R) Act<br>6. The Maternity | Abstract of Six acts | As and when the camp is established | Photos of the notices published. | Contractor |

| | | | | |
|---|---|---|---|---|
| Benefit Act ☑ | | | | |
| To establish code of conduct and provide induction trainings | | As and when new employees are joined | Training reports and other documents | Contractor |
| Conduct HIV/AIDS awareness programs | As per requirement | Once in six months | Reports, photographs etc | Contractor |
| All the Drivers should possess effective and valid Driving License | Drivers should be selected after verification of DL | As and when drivers are appointed | Photocopy of licence ids to be collected | PIU |
| All the vehicles involved in the project shall be insured to cover the third-party risk | Vehicle must be allowed to be plied in the project only after procurement of third-party insurance to the vehicle | As and when vehicles are plied in the project | Photocopy of insurance is to be collected | PIU |

**Budget for LMP**

| S.No | Item | Cost |
|---|---|---|
| 1 | Labour compliance as per LMP | [redacted] |

# PREVENTIVE GBV ACTION PLAN

## 1. Sub project information

Bioremediation of existing dumpsite in ward 25 of Muvattupuzha Municipality

### 1.1 Details of labors

The project is under pre planning stage. ULB has to finalize contactor/Agency for Remediation. So the exact number of Labors are not available. But approximately we can expect maximum of 15 labors

| | |
|---|---|
| Total number of labors | : 12(Approx.) |
| Category of labors (Age/sex/gender) | : Not available |
| Data of migrant labors, if any | : Not available |

## 2. GBV Issues likely to be identified at site

1. Issues against female workers at sit
2. Lack of safe and Gender friendly toilets at work sites
3. Disparity in work and wages based on gender
4. Threat of GBV or Sexual Exploitation Abuse (SEA) incidents to female members of the host community

## 3. Activities under GBV Action plan

1. **Formation of Internal Complaints Committee**
   The committee should be Presided by a senior women and more than half of the total Committee members should be women. There should be an external member who has experience in dealing with issues related to women. Preferably a Social Worker /Advocate/NGO Representative.

2. **Placing of ICC informatory boards at Work site**

| Insert Logos of KSWMP,WB,AIIB | | | |
|---|---|---|---|
| Project Name (KERALA SOLID WASTE MANAGEMENT PROJECT) | | | |
| Sub Project Name: | | | |
| Internal Complaints Committee | | | |
| Sl.No | Name | Designation | Contact Number |
| | | | |
| | | | |
| | | | |
| EMERGENCY CONTACT NUMBER | | | |

**Table 5 Model format for ICC**

3. **Gender Sensitization trainings for Labors**

The Project expect around 12 labors will be employed in a day and women participation in the labor force is limited, even the project is taking precaution to protect and prevent any GBV incidence at the site. Taking into consideration all these aspects, the project plan to conduct a half day sensitization program in the following subjects, viz. the type of GBV, the action to be taken by the victim, the laws and the support organizations which extend support to the victim of GVB and the role of ICC and their contact details etc.

4. **Sensitization for female host community members**

The citizen engagement plan has proposed an activity of host community meeting in which the importance and expected social risk of GBV will be discussed and the mitigation measures inbuilt in the project will be elaborated to the host community members especially to the women.

5. **Allocation of Gender friendly and safe toilet facilities for women**

Project has taken special care to arrange a separate toilet, wash and rest facility for female workers to protect their privacy and safety, and the same has to be arranged by the contractor.

6. **Keeping of wage register at site to restrict wage disparity based on gender**

The project actively opposes gender-based wage disparity at any site funded under the KSWMP-supported SWM project. To ensure gender parity in various aspects such as wages, division of labor, and facilities, an appropriate monitoring mechanism, such as a wage register, should be maintained for the scrutiny of the project implementers.

7. **Details of GBV Service Providers identified**

The government of Kerala has constituted a help desk under Kudumbasree to support or to prevent and extend support to the GBV victims, and their details are given below.

Kudumbasree Snehitha Gender Help Desk

Contact Number – 0484-2428745

Toll free number - 180042555678

**Preventive GBV Implementation plan Matrix**

| Sl No | Activity | Timeline | Primary Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 1 | Formation of Internal complaint committee | Pre-Construction Phase. | TSC/Contractor | DPMU |
| 2 | Placing of ICC informatory Board at worksite | Pre-Construction Phase. | Contractor | DPMU/TSC |
| 3 | Gender sensitization Training to labors | During Construction | Contractor/TSC | DPMU |
| 4 | Group Discussion with female host community members | Pre-Construction Phase. | TSC/ULB | DPMU |
| 5 | Ensuring Gender friendly and safe toilet facilities | Construction stage | Contractor | DPMU |
| 6 | Keeping Wage Register at site | Construction stage | Contractor | DPMU |

**Budget**

| Sl No | Particulars | Cost |
|---|---|---|
| 1 | Placing of ICC Informatory board on work site | [redacted] |
| 2 | Gender sensitization trainings to labor | [redacted] |
| 3 | FGD among female host community members | [redacted] |
| | **Total Cost** | [redacted] |

**Monitoring plan**

| Activity | Monitoring Indicators | Means of Monitoring | Reporting Period | Responsibility |
|---|---|---|---|---|
| Formation of Internal complaint committee | Minutes of Meeting/Bye Law of Committee/Reports | Verification of Minutes of Meeting and Reports | 15 days after commencement of work | DPMU |

| | | | | |
|---|---|---|---|---|
| Placing of ICC informatory Board at worksite | Photos of Board placed | Physical verification | 15 days after the commencement of work | DPMU |
| Gender sensitization Training to labors | Attendance and Photographs | Verification of Documents | 5 days after the commencement of work | DPMU |
| FGD among female host community members | Attendance and Photographs | Verification of Documents | 5 days after the commencement of work | DPMU |
| Ensuring Gender friendly and safe toilet facilities | Gender friendly signage's, Condition of latches, Floor Condition, Status of Flush | Physical verification | Before Commencement of work | DPMU/TSC |
| Keeping Wage Register at site | Photographs | Verification of Register | 5 days after the commencement of work | DPMU/TSC |

**LABOUR INFLUX MANAGEMENT PLAN**

| RISK | MITIGATION MEASURES | IMPLEMENTATION RESPONSIBILITY | MONITORING INDICATORS | MONITORING RESPONSIBILITY |
|---|---|---|---|---|
| Social and Commmunity wellbeing | 1. Joint Meeting with the community by ULB officials and Elected members | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Economic and Livelihood Issues | 1. Skilled /Unskilled jobs for the Community members in the sub-project | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Accommodation /labour camp | 1. Ensure basic amenities are provided to the labourers (Toilets, Water, Kitchen facilities etc.)<br>2. Daily briefing to the labourers | Contractor | • Risk identification report<br>• Proposed action/mitigation plan<br>• List of facilities in labour camp<br>• Details of labours | TSC/DPMU |

| | | | | |
|---|---|---|---|---|
| Communicable Diseases | 1. Access to Medical Check-up<br>2.Aaresness to the labours | Contractor | • SOP for prevention of communicable disease and health wellbeing on worksite and labour camp<br>• Report on medical check-up | TSC/DPMU |
| Crimes | 1. Intimation to the Local police about the camp | Contractor | Work site complaint register<br>Number of cases reported, and action taken | TSC/DPMU |
| Child Labour | 1. Ensure Adhar card of all labourers at the site<br>2. | Contractor & TSC | • Number of child labour issues reported<br>• Data of labours | ULB/DPMU |
| Gender-based violence, including sexual harassment child abuse and exploitation | 1.Gender sensitisation briefing to the labourers | Contractor/TSC | • Number of cases reported<br>• Action taken report<br>• Number of cases resolved<br>• Time taken for resolving complaints | ULB/DPMU |
| Labour licences | To be ensured by the contractor | Contractor/PIU | Number of labours having licence | DPMU |

**Summary of SMP budget**

| S.No | SMP Activity | Cost |
|---|---|---|
| 1 | Labour Management Plan | [redacted] |
| 2 | Labour Influx Management Plan | [redacted] |
| 3 | Preventive GBV action plan | [redacted] |
| 4 | Citizen Engagement Plan | [redacted] |
| **Total** | | [redacted] |

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

# NORTH PARAVOOR DUMPSITE

**SUBMITTED BY**

**KERALA SOLID WASTE MANAGEMENT PROJECT**

**(KSWMP)**

# Part A

# Environmental Impact Assessment

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# SUMMARY

**INTRODUCTION:** Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio mining of multiple Legacy Waste Dumpsites in various districts. The selected dumpsite is Vedimara which is located near Ward no 10 North Paravur municipality, Ernakulum District.

**RATIONALE FOR THE PROPOSED SUB-PROJECT:** North Paravur ULB proposes bio mining and bioremediation of the Vedimara legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

**PROPOSED SUB-PROJECT DETAILS:** North Paravur dumpsite is located at a distance of 2 km from the centre of North Paravur town in western side and encompasses a total area of 1.89 acres of land. The geographical coordinates of the dumpsite are 10.150518° N & 76.242212° E. The volume of legacy waste to be remediated in the dumpsite is 22896.86 Cu m. The legacy waste is presented about 6.75 m below and 2.33 m above the ground level respectively. Hence bioremediation of the dumpsite is essential to mitigate the environmental impacts.

**APPLICABLE NATIONAL, STATE LEGISLATIONS AND TECHNICAL GUIDELINES**: To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed.

**THE WORLD BANK SAFEGUARDS POLICIES, AND KSWMP ESMF**: The World Bank policies and directives on environmental and social safeguards have been adhered to the proposed dump site remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are ensured.

**SUB-PROJECT SCREENING AND ITS CATEGORIZATION:** As per indicative categorization for dumpsite bio mining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (1.89 acres) and waste spread (1.25 acres) and environmentally sensitive features around this subproject is individually considered as E2 and EIA is prepared accordingly.

**ENVIRONMENTAL BASELINE:** Physio-graphically, North Paravur in and around topographical features falls under relatively flat terrain, western side of the Municipality is bounded by lagoons and

backwaters, north is bounded by Paravur River. The favourable time for remediation is between October-2023 to March-2024 non-monsoon period. As per Wind rose, the predominant wind directions are blowing from SW and WSW direction throughout the year. As per the geotechnical investigation, the subgrade soil was encountered at 6.75 m below the waste depth of the dumpsite and the predominant soil is clayey Loam. In the South and West side of the dumpsite by predominantly of Dry cultivation land use and the same will act as odour attenuation during remediation. The cultural heritage zone near dumpsites is famous St. Thomas Kottakkavu Church 2.63 Km away, Paravur Lewish Synagogue 2.31 Km away, Paravur Market 2.42 Km, Paliyam Palace 3.0 Km away, Muziriz Heritage 6.71 Km from the dumpsite. Hence, no significant physical impact to the heritages sites is envisaged during remediation. As per the district disaster management plan-2015 and flood vulnerability map the dumpsite is not under flood prone zone.

**DESCRIPTION OF ENVIRONMENTAL PARAMETERS:** The analysed air pollution data indicates that the levels are within acceptable limits of NAAQs for all the parameters except $PM_{10}$ – 141µg/m3. Noise Level monitoring samples collected at entrance of the dumpsite. The ambient Noise levels Leq are above the National Ambient Noise standards for Residential area both day and night time. The ground water quality results indicate that the dumpsite has not caused any major increase of the parameters and the quality parameters are within the IS10500:2011, except the TDS and Electrical Conductivity which are found to be higher than the above said standard. Similarly, the surface water sample shows that it is not largely influenced by the dumpsite as the quality is within the limits of IS 2296, except for except TDS and Electrical Conductivity. The leachate monitoring data indicates, TDS is about 16900mg/l while the suspended solids is about 540mg/l, respectively.

**ANALYSIS OF ALTERNATIVES**: After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

**ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS:** Environment: During operational phase (bio-remediation), the main potential nuisances caused by a dump site are fugitive dust, odour, foul gases, smoke from the site (in case of fire), and leachate generation. Birds, vermin, and rodents, littering, noises both from machineries operating at the site and waste collection vehicles. Social: No specific social risk is identified for initiating the remediation process except the occupational hazards to the workers engaged in the remediation process. It can be overcome by using adequate protective measures properly. In connection with the dumpsite only one family is residing in an aerial distance of 200 m and the remediation process will not affect them in any way.

**ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN:** The management plan proposed are for pre-remediation as well as during remediation stage. The mitigation measures are recommended for impacts from air, noise, water, leachate, health and safety, OH&S aspects. The proposed monitoring plan includes leachate, surface and ground water monitoring for a period of once in three months. The cost of [redacted] is required for implementation and supervision of EMP.

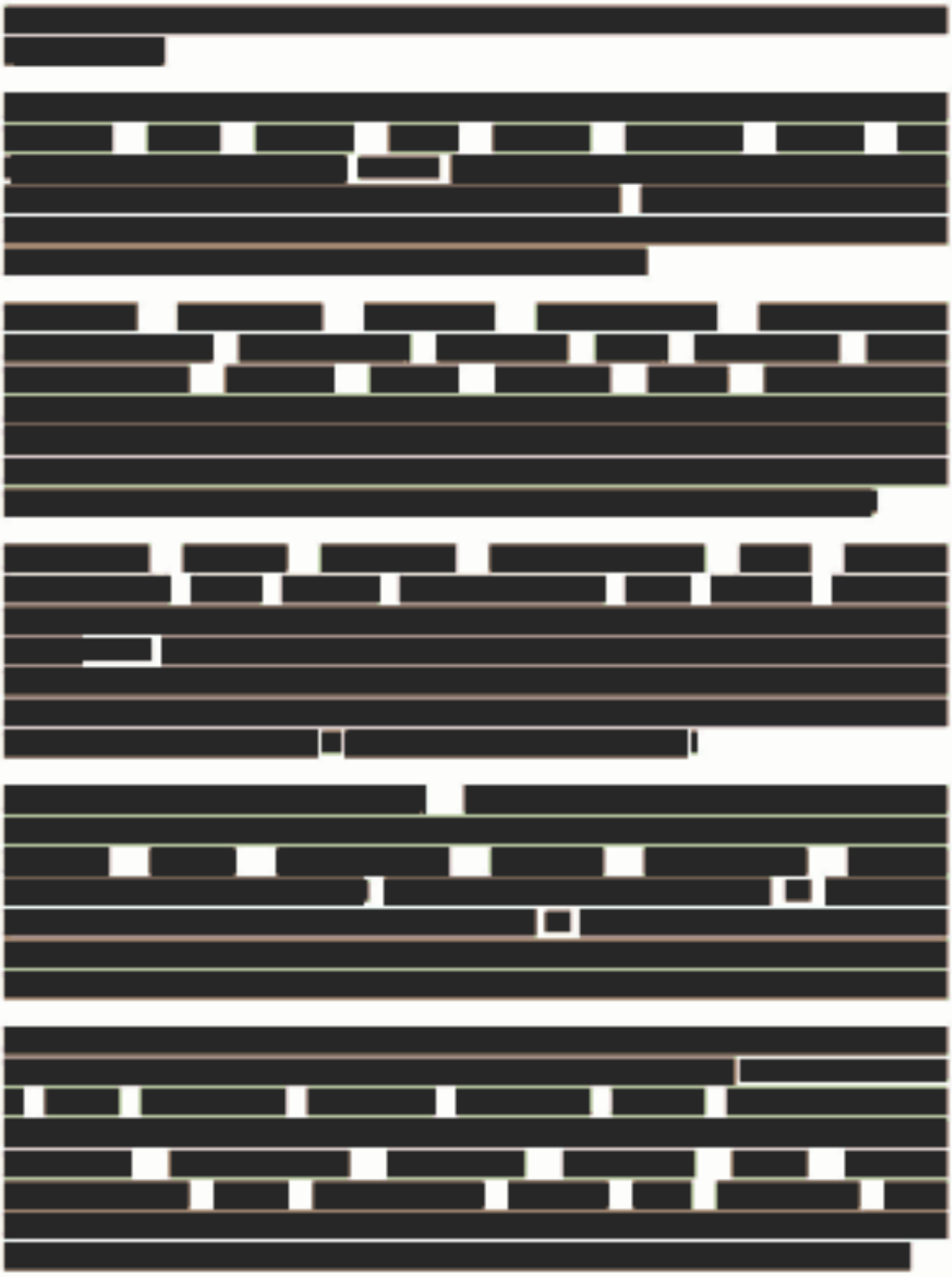
**EMERGENCY PREPAREDNESS PLAN:** The identified emergency situations which may arise from remediation activities are fire risk in summer, occupational health and safety related risks. The North Paravur police station at 1.5 km, Taluk hospital at 1.2 km, North Paravur Fire and Rescue station at opposite to the dumpsite are the nearest emergency services. Periodic Compliance monitoring system will be done by the contractor during remediation.

**PUBLIC CONSULTATION AND INFORMATION DISCLOSURE: A** Transect walk was carried out on 06.06.2023 covering the surrounding area of the dump site. Effective IEC drive to be initiated to engage with the community to build support as the activity will create positive impact. Warning sign boards and project information boards with full details of grievance redressal mechanism along with all related contact details will be installed at site during the process at the site. Site control measures should be enforced to prevent unauthorized personnel into the work site.

***Note: All the references to Social Impact Assessment and Social Management Plan may be referred to Part B- Social Impact Assessment which is a separate document attached along with this document.***

# സംഗ്രഹം

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# CHAPTER 1

# INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-Financing Framework agreement and as agreed Project Co-Lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake bio-mining of multiple Legacy Waste Dumpsites in various districts. There are 19 dumpsites identified for remediation under the Kerala Solid Waste Management Project. Several others have been taken up for remediation directly by the ULBs. Currently, 7 dumpsites considered within the three districts, which are (Ernakulum, Alappuzha and Idukki) falling under Package B are selected by Kerala Solid Waste Management Project (KSWMP) for remediation under the project. This report deals with the ESIA of Vedimara dumpsite, located near Ward no 10 of North Paravur municipality, Ernakulum District.

## 1.2 The Rationale for the Proposed Sub-Project:

Vedimara dumpsite has a total waste quantity of 22896.86 cum, spreading over 1.25 acres. The site is located between Lat- 10.150518° N and Long - 76.242212° E and has an elevation of MSL +10 (m), with a gentle slope towards the North West part. During monsoon season, due to the slope of the site, there is runoff towards the North-West side of site along the boundary of dumpsite, which is enclosed with compound wall. North Paravur ULB proposes bio-mining and bioremediation of the Vedimara legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite bio-mining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

## 1.3 Proposed Sub-Project Details

Vedimara dumpsite is located at a distance of 1.74 km from the center of North Paravur town in western side and encompasses a total area of approximately 1.89 acres of land, waste spread over an area of 1.25 acres, owned by the Municipality. The coordinates of the dumpsite are, $10.150518^0$ N & $76.242212^0$ E. It is located in ward no. 10 of the municipality. Aluva – Paravur Highway is at 60 m in southern side of the dumpsite, which enable connectivity to the rest of the municipal area. Dumpsite and main road is connected by 60 m long access road, which has 3m width.

Currently, the quantity of waste dumped at this site is about 22896.86 As of now 65 % of the area is covered with solid waste. Height of the waste heap is 2.33 m above and 6.75 m below the existing ground level. Hence bioremediation of the dumpsite is essential to mitigate the environmental impacts. Dumpsite reclamation involves excavation, screening, and separation of material from dumpsites into various components such as soil, recyclable materials, and residues, etc.

## 1.4 Objectives and Scope of the EIA & SIA:

As per indicative categorization for dumpsite bio-mining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (1.89 acres) and waste spread (1.25 acres) and absence of environmentally sensitive features around, this subproject is individually considered as E2, and EIA is prepared accordingly.

The EIA & SIA process involves the identification of the potential environmental and social issues in the project and trying to address them during design interventions. The EIA & SIA further carries out impact prediction and evaluation of residual environmental and social issues of a Project. It then goes on to outline the proposed mitigation measures for residual impacts and enhancement measures for positive impacts which the Project will implement. The objectives of this document are to:

## 1.5 Structure of the Report:

The Consolidated EIA & SIA report has been structured into the following Chapters:

- Introduction and Project Description.
- Policy, Legal and Administrative Framework presents a review of the existing Institutions and legislation relevant to the project at the National and the State levels
- Environmental Assessment Methodology discusses sequence of tasks carried Out in preparing EIA;
- Existing Environmental Scenario presents a consolidated picture of the existing Environmental setting of the project;

- Assessment of Potential Impacts identifies and quantifies the potential impacts on each of the environmental components due to the proposed project development;
- Analysis of Alternatives discusses the criteria for analysis of alternatives of technology for remediation.
- Mitigation Measures presents an elaborate listing of the nature of impacts on each of the environmental components and the avoidance and mitigation measures suggested.
- Public Consultation details the stages and types of public consultations carried out during the project preparation stage and people's perceptions of the project benefits and the Potential impacts;

# CHAPTER 2

# POLICY AND REGULATORY FRAMEWORK

## 2.1 Applicable National, State Legislations and Technical Guidelines

**National Environmental Rules and Regulations: -**

To understand the extent of the environmental and social assessment for the proposed sub-project works, applicable laws, legislation, and policies have been reviewed. A summary of environmental legislation/regulations relevant to the project is furnished in the following **Table-2.1**.

*Table 2.1 Summary of Environmental Legislation /Regulations*

| Sl. No. | Act / Rules | Purpose | Applicable (Yes / No) | Reason for Applicability | Authority |
|---|---|---|---|---|---|
| 1 | Environment Protection Act, 1986 | To protect and improve the overall environment. This is an umbrella Act | Yes | As all environmental notifications, rules and schedules are issued under this act | MoEF &CC, CPCB, SPCB |
| 2 | Solid Waste Management Rules, 2016 | To manage collection, transportation, Segregation, Treatment, and disposal of solid wastes (other than Hazardous waste, Plastic Waste, Bio Medical waste) | Yes | Dumpsite remediation/bio mining | MoEF &CC, CPCB, SPCB |
| 3 | Air (Prevention and Control of Pollution) Act, 1981 | To control air pollution by controlling emission of air pollutants as per the prescribed standards | Yes | Yes, Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 21 of Air (Prevention and control of Pollution) Act 1981 | State Pollution Control Board, Kerala |
| 4 | Water Prevention and Control of Pollution) Act, 1974 | To control water pollution by controlling discharge of pollutants as per the prescribed standards | No | No, Consent to Establish (CTE) and Consent to Operate (CTO) are required to be obtained from SPCB under section 25 of this Act | State Pollution Control Board, Kerala |
| 5 | The Noise Pollution (Regulation and Control) Rules, 2000 & amendments | The standards for noise for day and night have been promulgated by the MoEF&CC for various activities | Yes | This act will be applicable for all construction equipment deployed at worksite and its operation | State Pollution Control Board, Kerala |
| 6 | Public Liability and Insurance Act, 1991 | Protection from accidents | Yes | This act will be applicable for providing immediate relief to the persons affected by accident occurring during work | State Pollution Control Board, Kerala |
| 7 | Central Motor Vehicle Act 1988 | To check vehicular air and noise pollution | Yes | This rule will be applicable to vehicles deployed for | Motor Vehicle Department |

| | | | | | |
|---|---|---|---|---|---|
| | | | | construction activities and construction Machinery. | |
| 8 | The Plastic Waste Management Rules, 2016 | For the storage and disposal of plastic wastes through authorized vendors. | Yes | This act will be applicable for the storage and disposal of all the plastic wastes. | State Pollution Control Board, Kerala |
| **Other applicable Rules** | | | | | |
| 9 | Construction & Demolition, Waste Management Rules, 2016 | | | | |
| 10 | Batteries (Management and Handling) Rules, 2001 | | | | |
| 11 | E- Waste (Management) Rules, 2016 | | | | |
| 12 | Kerala Municipality Act, 1994 & Rules | | | | |
| 13 | Hazardous & Other Wastes (Management And Transboundary Movement) Rules, 2016 | | | | |
| 14 | Bio-medical Waste (Management & Handling) Rules, 1998 | | | | |

**Applicable Social and Other Legislation**

**Other Legislations applicable to Sub-Project Activities Under the Project**

- Workmen's Compensation Act 1923 (the Act provides for compensation in case of injury by accident arising out of and during the course of employment);
- The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 is introduced to prevent and provide redressal of complaints of sexual harassment.
- Contract Labor (Regulation and Abolition) Act, 1970 (the Act provides for certain welfare measures to be provided by the contractor to contract labour);
- Minimum Wages Act, 1948 (the employer is supposed to pay not less than the Minimum Wages fixed by the Government as per provisions of the Act);
- Payment of Wages Act, 1936 (it lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers);
- Equal Remuneration Act, 1979 (the Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees);
- Industrial Disputes Act, 1947 (the Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment);
- Child Labour (Prohibition and Regulation) Act, 1986 (the Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labour is prohibited in Building and Construction Industry);

- The Building and Other Construction Workers Act (BOCW), 1996 is a social welfare legislation that aims to benefit workers engaged in building and Other construction Works.

## 2.2 The World Bank Safeguards Policies, and KSWMP ESMF

The World Bank policies and directives on environmental and social safeguards have been adhered to the proposed dump site remediation. The applicability of the relevant policies of the dumpsite remediation that are undergoing remediation are summarized in the following table.

**Environmental Codes of Practices (ECoP):** The ECoPs provide guidelines for environmental management of bio-mining and bio-remediation activities which are seen to be of limited extent of impacts/risk, temporary and reversible, and readily managed with good practices during the implementation. The following key points should be considered.

**Key Points of ECoP to be considered:**

- The bio-mining activities and preparatory activities shall follow the "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" published by CPCB in February 2019.
- Bio-mining methods include Tractor Tiller, Trench method, Cone Method, windrow, Thin Layer Method, etc. More appropriate may be the Cone method for legacy waste and window for relatively fresh waste.
- Leachate channelization and treatment facility shall be set up before starting the bio-mining works. Works shall take place only during the non-monsoon period; and there shall be suitable precautions to prevent any rainwater disturbing the operations (like seasonal unexpected rains, storm water, runoffs from other sources).
- Ballistic separator and trommel may be used for screening. Screened fractions into which waste is segregated include RDF, inert, Compost, and C&D wastes.

**Applicable World Bank Operational Policies**

OP 4.01 Environmental Assessment Help to ensure the environmental and social soundness and sustainability of investment projects. Support integration of environmental and social aspects of projects in the decision-making process

OP 4.04 Natural Habitats Promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions.

OP 4.09 Pest Management includes training to prevent risk to human beings or animals from Bio-culture, enzymes, insecticides and such formulations used for remediation.

OP 4.11 Physical Cultural Resources (PCR) includes resources of archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites),

aesthetic, or other cultural significance. Assist in preserving PCR and in avoiding their destruction or damage. PCR

WB General EHS Guidelines Recommendations of these guidelines would be incorporated in EMP & SMP and Bidding document for this sub-project.

The Environmental Management Framework (EMF) has been prepared to assist in the screening, assessment, and management of environmental risks of all solid waste management projects at an early stage during the planning and integration, mitigation hierarchy during the subproject design, implementation, and operation. The framework helps provide specific guidance on the policies and procedures to be followed for environmental assessment along with the roles and responsibilities of the implementing agencies.

# CHAPTER 3

# ENVIRONMENTAL AND SOCIAL BASELINE

## 3.1 Project Location of the site

North Paravur dumpsite is located at a distance of 2 km from the center of North Paravur town in western side and encompasses a total area of approximately 1.89 acres of land. Out of this, 1.25 acres of land is covered with solid waste. The coordinates of the dumpsite are 10.150518° N and 76.242212° E. It is located in ward no. 10 of the municipality. Aluva – Paravur Highway at 60 m in southern side of the dumpsite, which enable connectivity to the rest of the municipal area. In the surrounding area of the dumpsite around 40 Households are residing within 100m radius. St. Joseph Cottolengo Church at 180 m and KV LP School - about 322 m away from the project location. The google map image showing the location of Vedimara dumpsite is shown below in **Figure: 3.1.**




*Figure 3.1 Vedimara Dumpsite Location Map*

## 3.2 Methodology for Environmental Baseline Studies

The baseline appraisal should consider all aspects of the environment that may be altered by the proposed project. These can be categorized as physical, biological or socioeconomic attributes. The baseline should be based upon the findings of the screening and scoping studies. Surface water and sediments, groundwater, air quality, noise, soils and land use Biodiversity Socio-economic (social), cultural heritage, traffic and transport Physical Biological Socio-economic. The scope of the baseline study, including attributes that will be appraised, and the geographical extent of the analysis, will typically have been agreed with the relevant decision makers as an outcome of the scoping phase. It is important to re-emphasize that the scope (and detail) of the baseline study should be commensurate with the size and scale of the project and hence the potential changes that the project may have upon the environment and society. The baseline study will typically be developed in three stages:

**Desktop study:** Office-based exercise during which readily available existing information (i.e. that can be used to describe the existing environment) is collected and reviewed to ensure its appropriateness for use within the EIA & SIA;

**Field study:** The stage within which additional data is captured in the field, with the intent of addressing any gaps that have been identified in the existing knowledge base; and

**Reporting stage**: Collation of the captured information into the baseline report.
The below table indicates the environmental attributes and frequency of monitoring.

*Table 3. 1 Environmental Attributes*

| Sl. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | Upwind direction in North East boundary of the dumpsite. Along the boundary of dumpsite.<br>Downwind direction in West South West (WSW) along the boundary of the dumpsite | The AAQ locations were chosen based on the Windrose data obtained for North Puravur. The most predominant wind direction are from West and WSW. |
| 2 | Noise (1 Location) | Ambient Noise level [E(P)] for 24 hours | At the Entrance of the dumpsite. | Most vulnerable point in the site in regards of Noise quality is due to entry and exit of the waste loading and unloading vehicle. Please note that the site is devoid of |

| Sl. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| | | | | proximity to any sensitive receptors within a 200 m radial circle. |
| 3 | Surface water (1 Location) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, CN, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, Ecoli and Total coliforms (IS 10500-2012). | Surface water sampling location at 300 m distance in Northern direction. | Surface water sample points are selected based on the water flow from upwards to downwards and for this site, it is-West to East |
| 4 | Ground water<br><br>(3 Locations) | Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, CN, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total coliforms (IS 10500-2012). | Groundwater sampling location within the dumpsite in the eastern side.<br>Groundwater sampling location at 25 m distance in South West direction.<br>Groundwater sampling location at 45 m distance in South West direction. | In our study area, the electrical conductivity of the groundwater samples varied between 280- 1100 µS/cm during monsoon, which is higher than the permissible limit. The Ground water sample within the dumpsite for TDS is 715mg/L which is above the permissible limit. High values of TDS in groundwater are generally not harmful to human beings but high concentration of these may affect persons, who are suffering from kidney and heart diseases. |
| 5 | Bore Hole (1 location) | Permeability test-IN-2 hectares (as per CPHEEO Manual); standard penetration test SPT and collection of UDS-Soil investigation - classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coeff of permeability, Strength | Centre of the dumpsite | Volume of legacy wastes were found to be higher in the center part of the dumpsite during investigation. So the bore hole test was performed in the center. |

| Sl. No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| | | compressibility (vertically- 3 samples per borehole). | | |
| 6 | Waste & Environmental Analysis | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016); Suspended solids, Dissolved solids(inorganic) Ph, Ammonical nitrogen (as N), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | South east side of the dumpsite | The test results shows that PH is 4.77 which shows high concentration of volatile fatty acids (VFAs). |
| | | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | Within the dumpsite at 2 locations, one at East direction and at one at West direction. | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. So the two locations were considered for sampling. |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor | 1sampling location | The legacy waste was found to be older and no access to the vehicular movement, when compared to other parts of the dumpsite. |

## 3.3 Environmental Audit of the Existing Facilities

There is two functional MCFs for dry waste within the Vedimara dumpsite.

There are 2 MCFs. Windrow composting and Vermin composting within the dumpsite, which are not supported under KSWMP subproject. However, an environmental audit of the facility is important as this may be used as an associated facility to which some recyclables may be channelized to and is situated at the same site and might be impacted during the bio-mining activities.

*Table 3. 2 Environmental Audit of Existing facilities*

| Sl. No. | Aspects | Remarks |
|---|---|---|
| 1 | Structural Characteristics | **1. MCF**<br>Area - approx. 37.2 (in Sq. m)<br>Buffer/setback around the MCF – 3 ft<br>Distance from waste pile of dumpsite- 5 m.<br>Roof: (GI Sheet Roof, Good condition)<br>Floor (Cement Floor, Good Condition)<br>Walls: (Concrete, Good Condition)<br>Doors & windows: Not Available, dust emission and odor can impact the MCF facility.<br>**2. MCF**<br>Area - approx. 81.8 (in Sq. m)<br>Buffer/setback around the MCF – 3 ft<br>Distance from waste pile of dumpsite- 5 m.<br>Roof: (GI Sheet Roof, Good condition)<br>Floor (Cement Floor, Good Condition)<br>Walls: (Concrete, Good Condition)<br>Doors & windows: Not Available, dust emission and odor can impact the MCF facility.<br>**3. Windrow Compost**<br>Distance from waste pile of dumpsite - adjacent.<br>Roof: (GI Sheet Roof, Good condition)<br>Floor (Cement Floor, not in good Condition)<br>Walls: (Concrete, Good Condition)<br>Doors & windows: Not Available, dust emission and odor can impact the Windrow compost facility.<br>**4. Vermin compost**<br>Distance from waste pile of dumpsite- 10 m.<br>Roof: (GI Sheet Roof, Good condition)<br>Walls: (Concrete, Good Condition)<br>Doors & windows: Not Available, dust emission and odor can impact the Vermin compost facility. |
| 2 | Functional Characteristics | Activities in the MCFs, Windrow and Vermin Composting Unit: Functional<br>Materials and condition of stacking: NIL<br>Activities spilling out onto the dumpsite: Yes<br>Access: Common access for MCFs, Windrow Composting, Vermin Composting & Dumpsite. All are in the same premises.<br>Total No: of workers – 10 |
| 3 | Facilities | Parking area-NIL<br>Loading/unloading Area- NIL<br>Storage room & area: Yes |

| | | |
|---|---|---|
| | | Worker snack/rest areas: Yes<br>Worker / other washrooms & sewerage: Yes<br>Water supply for Cleaning, Washroom: Yes<br>Greenbelt: NIL |

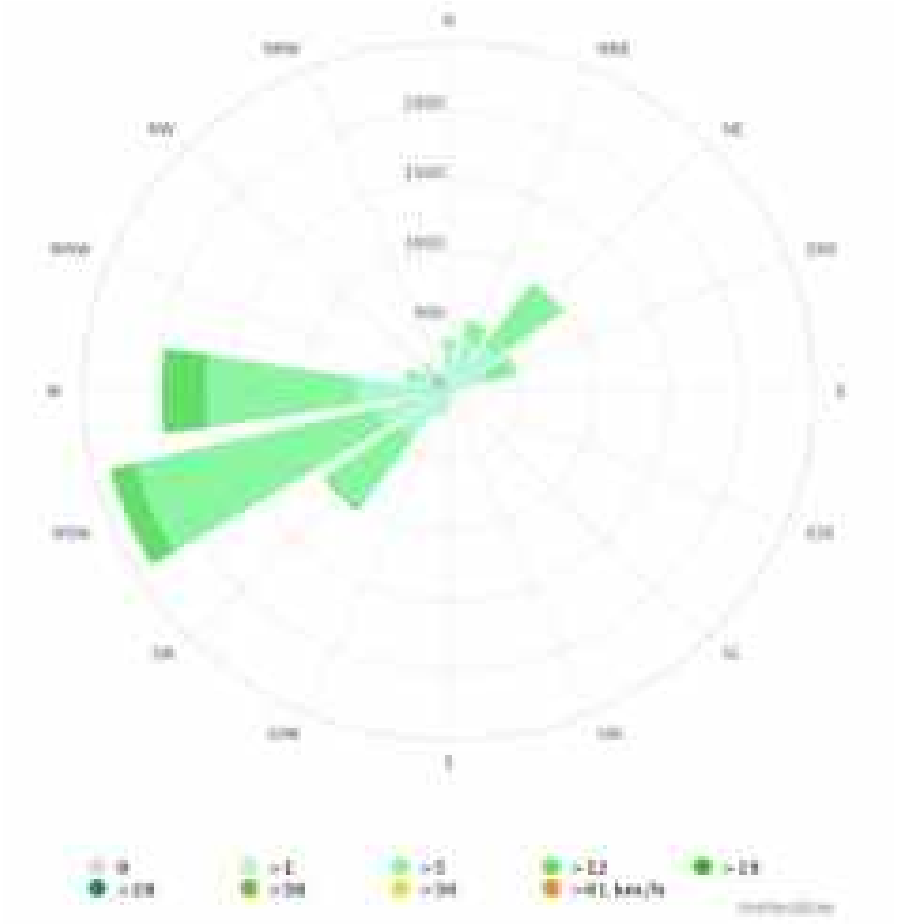
## 3.4 Physiography and Climate

**Physiography**

The entire municipal area is relatively flat terrain, western side of the Municipality is bounded by lagoons and backwaters, north is bounded by Paravur River. The land in and around the dumpsite is a relatively flat and low-lying area.

**Climate**

North Paravur is a coastal town located in the Ernakulam district of Kerala. It experiences a tropical climate characterized by high humidity, warm temperatures, and significant rainfall. The average annual temperature is 27.5 °C in North Paravur. Precipitation here averages 357 cm. Most of the precipitation here falls in June-July. The warmest month of the year is March with an average temperature of 32 °C. January the coldest month, with temperatures averaging 23 °C. So, the favorable time for remediation is between October-2023 to March-2024 non-monsoon period. The figure 3.2 shows the average temperatures and precipitation. The predominant wind directions are blowing from WSW and West direction. The Wind Rose Diagram for Ernakulam is shown in **Figure 3.2.**



**Source:** meteoblue

*Figure 3.2 Wind Rose Diagram*

## 3.5 Hydrology, Hydrogeology, and Soil

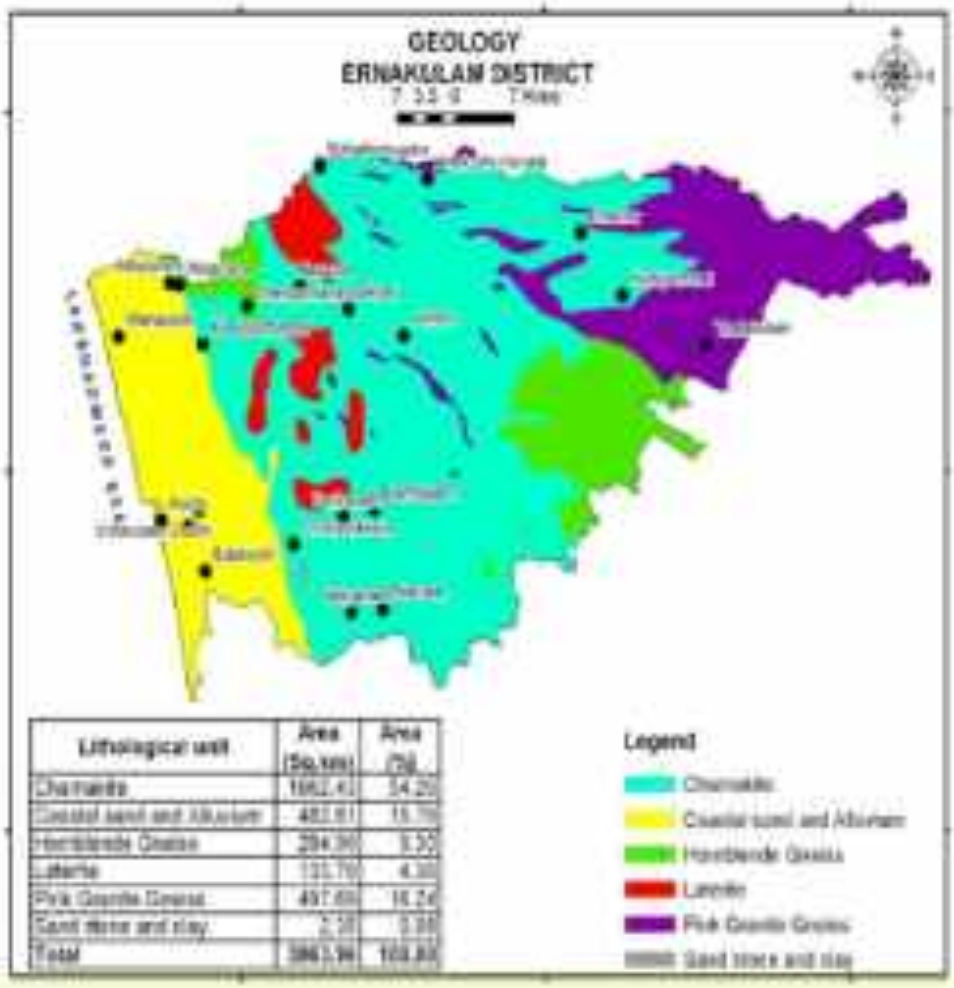
### Hydrogeology

The occurrence and movement of groundwater is mainly controlled by factors like physiography, geological setting, etc. The aquifer type is phreatic aquifer and groundwater table level ranging from 3.5 to 6.5 m during most of the year.

### Geology

The geology of North Paravur is predominantly of Coastal sand and Alluvium group. The geology map of Ernakulam District is shown in **Figure: 3.3.**

*Figure 3.3 Geology Map of Ernakulam District*



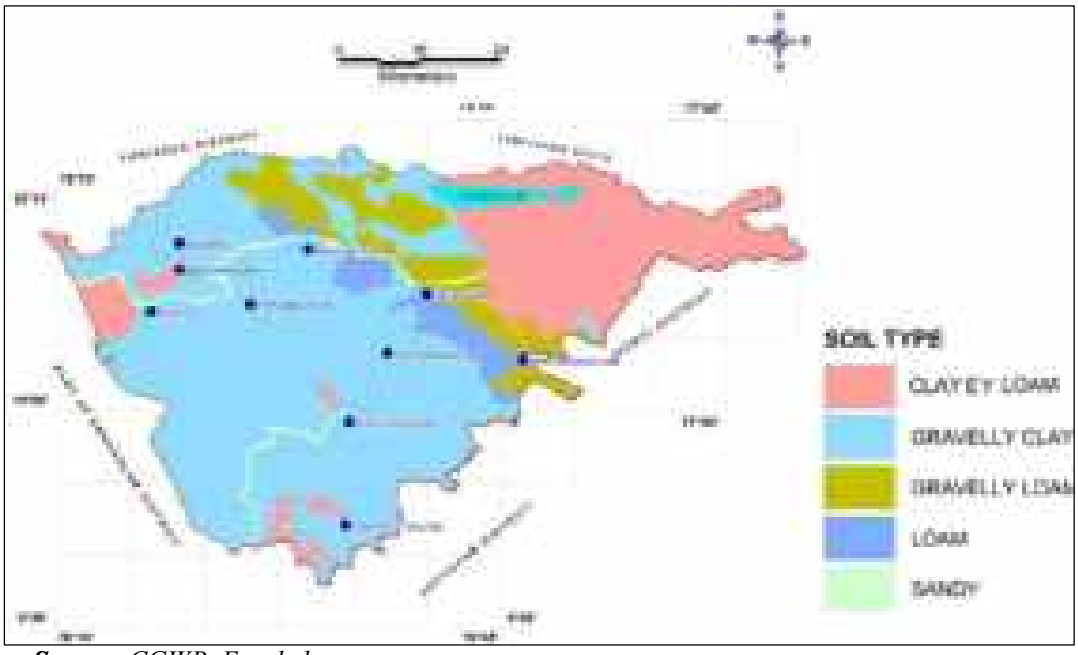

| Lithological unit | Area (Sq.km) | Area (%) |
|---|---|---|
| Charnockite | 1662.41 | 54.20 |
| Coastal sand and Alluvium | 482.61 | 15.70 |
| Hornblende Gneiss | 284.30 | 9.30 |
| Laterite | 133.70 | 4.30 |
| Pink Granite Gneiss | 497.60 | 16.24 |
| Sand stone and clay | 3.28 | 0.26 |
| Total | 3063.90 | 100.00 |

*Source: Aquifer mapping and management plans for hard rock terrains, Ernakulam district, Kerala (agp: 2018-19)*

**Soil**

As per the geotechnical investigation, the soil was encountered at 6.75 m below the waste depth of the dumpsite and the predominant soil is clayey Loam. The detailed geotechnical investigation report is enclosure in the FR. The map showing soil type of Ernakulum is shown in **Figure: 3.4.**

*Figure 0.4 Map showing Soil Type of Ernakulam District*




***Source:*** *CGWB, Ernakulum*

## 3.6 Land Use & Land Cover

The land use survey of 2010 revealed that the predominant land use of North Paravoor Municipality is residential. 64.52% of the total area is under residential use. The land use Map is shown in Figure 3.5. The glaring aspect of existing land use of North Paravur municipality is blessed with potential resources such as agriculture land and water bodies.

Paravur was once famous in the district for its traditional industries like coir, handlooms and agriculture. Paravur was small countryside hamlet famous its unique variety of rice known as Pokali as well as extensive backwater fishing. The western parts are coastal areas with cultivations like Prawn and Pokkali Rice. The eastern parts are fertile lands. The Dumpsite is in the mixed commercial area with residential buildings around the site connected by Vedimara Fire Station Road on the northern side and Aluva-Paravur Road on the southern side.




*Figure 3.3 North Paravur Landuse Map*
*Source: Local Self Government Department Planning: lsmsplanning.kerala.gov.in)*

## 3.7 Cultural Heritage

North Paravur is considered as a significant place in terms of cultural, social and economic importance of Kerala history, famous St. Thomas Kottakkavu Church, Paravur Jewish Synagogue, Paravoor Market, Puliyam Palace, Muziriz Heritage area are the few examples. The Muziris Heritage Project encompasses monuments, archaeological sites and the very landscape that illustrates a significant era in the history of Kerala. The evolution of the Muziris Heritage Site has been greatly influenced by its natural environment. The Muziris Heritage Site (MHS) stretches across from the municipality of North Paravur in Ernakulam district to that of Kodungallur in Thrissur district. Palium Palace, also known as Palium Nalukettu, is a historic palace located in Chendamangalam, near North Paravur in the Ernakulam district of Kerala. Chendamangalam is situated about 4.5 kilometers north of North Paravur. The palace is a significant historical and cultural landmark in the region, along with some important religious sites like Mookambika Temple, Kannakulangara Temple, St. Thomas Jacobite Syrian Church, Nonniyakavu Temple etc. But there are no such sites located within 1-meter radius from the dumpsite, hence, no significant physical impact to the heritages sites is envisaged during remediation.




*Figure 3.6 Heritage Map of North Paravur*

*Source- https://townplanning.kerala.gov.in/2022/02/14/ernakulam-notified-heritage-area/*

## 3.8 Ecology and Biodiversity

The land has one of the highest densities of coconut trees. The land also boasts a wide range of other birds and animals. The kingfisher is a common bird in this land and others include black bulbul (depending on the season), brown falcon, woodpecker, sparrow, ravens, pigeons, African fish eagle and cuckoos. The land also has goats, dogs, rodents and flies seen near to the dumpsite. The flora includes shrubs, tubers, and trees.

## 3.9 Site Connectivity

The Dumpsite is adjacent to the Fire Station Road. The existing road to the dumpsite is only 3 meters wide, which is insufficient for accessing large transportation vehicles required for the remediation project. However, there is an alternative road on the north side of the dumpsite, which is 7 meters wide. It is recommended to reopen this road before commencing bio mining operations to facilitate the transportation of construction materials. The approach roads to the dumpsite are municipality roads and the width of the roads are 3.00 m. The dumpsite can be accessed from both north (Fire Station Road) and south (Aluva - Paravur Road) side.

## 3.10 Natural Disasters

As per the district disaster management plan-2015 and from flood vulnerability map the dumpsite location is not under flood prone zone.

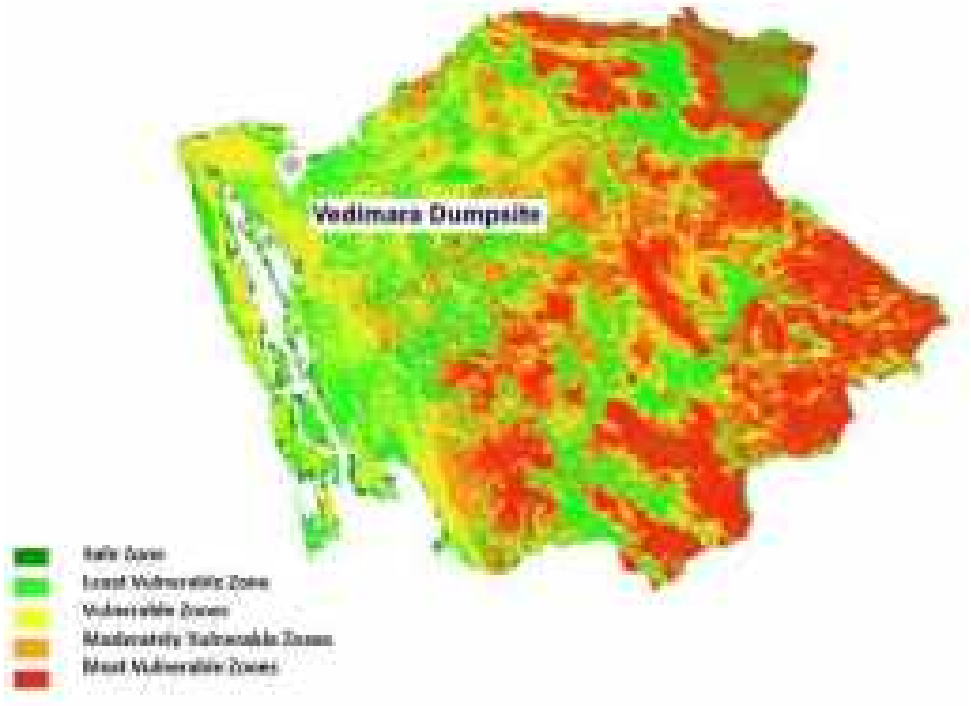



*Figure 3.7 Map Showing Flood Vulnerability Map of Ernakulam District*

## 3.11 Description of Environmental Parameters

***Table- 3.3 Description of Environmental Baseline Parameters***

| Sl. No. | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | Water Supply<br>a) Surface water<br>b) Ground Water | A) Surface water: Paravur River is 300 m from the site in North direction and Surface water sample was collected and the test results showed – all parameters are well within limits except TDS and Electrical Conductivity.<br>B) Ground Water collected from 3 different locations (Residences within 200m radius)– all parameters are well within limits except for TDS and Electrical Conductivity. | Site Drainage & leachate Impacts due to bio-mining activity (esp during any seasonal rain) is important as far as the nearby soil & water environment are concerned. |

| Sl. No. | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| .2 | Leachate | The data indicates that the TDS is about 16900mg/l while the suspended solids is about 540mg/l. The chlorides are high at 6267.50 mg/l. The heavy metals are found to be low, hence the soil is unlikely to be contaminated by heavy metals from the waste. | |
| .3 | Air Quality | Air samples were collected from 2 locations within the dumpsite and results found to be well within the permissible limits except $PM_{10}$ – 141µg/m3 | The Air Quality Index (AQI) value of 127 falls within the "Moderate" range (101-200), in location A1, which indicates that air quality might cause discomfort to sensitive groups such as people with respiratory issues, heart disease, children, and the elderly. |
| .4 | Noise Level | Noise Level monitoring samples collected at entrance of the dumpsite. The ambient Noise levels Leq are above the National Ambient Noise standards for Residential area both day and night time. The noise levels are influenced by the public roads passing nearby, also the population within the vicinity. | Proper remedial measures for increased noise level shall be ensured by the contractor while bio mining activity. |

# CHAPTER 4

# ANALYSIS OF ALTERNATIVES

## 4.1 Alternative 1: Zero or No Project Alternative (without Dumpsite Remediation)

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevent further contamination of the site.

If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows.

1. Foul Odor Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.

2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.

3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.

4. Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the surrounding environment, disrupting natural habitats and causing long-term ecological imbalances.

5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

## 4.2 Alternative 2: Mode of Execution / Management Alternative

North Paravur Municipality intends to complete the remediation project as earlier. However, considering the time required for mobilization, installation, sieving and handling recoverable etc., a time frame of about six months will be considered. The broad timeline chart for the execution of this project is given below **Table – 4.1.**

*Table 4.1 Timeline Chart for Execution*

| S. No. | Task Name | M 1 | M 2 | M 3 | M 4 | M 5 | M 6 |
|---|---|---|---|---|---|---|---|
| 1 | Planning & Mobilization | ■ | | | | | |
| 2 | Foundation & Civil Works (Cover Shed installation) for machineries, Hiring & Installation of Machineries, Electrical Works | ■ | | | | | |
| 3 | Excavation of Legacy Waste | | ■ | ■ | | | |
| 4 | Site Development for Windrows & Leachate Collection | | | ■ | ■ | | |
| 5 | Windrow Formation & Spraying of Bio culture | | | | ■ | ■ | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | Sieving Operations | | | | | |
| 7 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | | | | |
| 8 | Project Closure Activities:<br>• Levelling of Reclaimed Land using Bio-soil<br>• Handover the available infrastructure at site to the ULB<br>• Closure Report Submission to ULB, | | | | | |
| 9 | Buffer Period (Rainy Season) | | | | | |

## 4.3 Alternative 3: Technology Alternatives

The selection of the appropriate method or technique for remediation is determined by considering several parameters. These include the significant aspects and suitability of remediation types such as

1. Capping without land recovery,
2. Bio-mining – reclamation/recovery of 100% land
3. Capping with partial land recovery.

Additionally, factors like available resources such as manpower, machinery, finances, and physical site conditions, including the quantity and characteristics of legacy waste, Environmental baseline, social concerns, regulatory compliance (KSPCB/NGT), the need for complete land recovery, and opportunities for utilization of processed aggregates/by-products are taken into account.

After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

# CHAPTER 5

# ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

Bio mining and bioremediation of existing legacy dumpsites brings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more man-days at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, bio-mining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration) are important in this case. In addition to the below mentioned,

(i) Drainage and leachate flow into regional waterbodies (& esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies,

(ii) Pollution on land/soil, dust and odour nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks,

(iii) Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and

(iv) Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at this stage, while some would be known only based on the project details that would be known from the work plan of the contactor once on board.

## 5.1 Impact Assessment Methodology

Impacts are assessed based on Magnitude, Duration, and Significance of the impacts and sensitivity of the receptors present within the 500 m aerial distance of Vedimara dumpsite.

### 5.1.1 Magnitude and Duration of Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Bio-mining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;
- The spatial extent of the potential impact;
- Reversibility of the Impact;

- Legal standards and established criteria.
- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table 5.1. Magnitude is assessed as medium, considering shorter duration of the activity. However, magnitude of cumulative impacts of various dumpsite remediation might be High.

Table 5.1: Aspects for Determining the Magnitude of Impacts

| Aspects | Large | Medium | Small | Negligible |
|---|---|---|---|---|
| **Duration of the potential impact** | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or Less than the lifespan of the program | Temporary with no detectable potential impact |
| **Spatial extent of the potential impact** | Regional – much beyond project boundaries | Beyond immediate Program components, site boundaries or local area | Within program boundary (but cumulative impact of various dumpsite biomining activities will be on larger extent) | A specific location within program component or site boundaries with no detectable potential impact |
| **Reversibility of potential impacts** | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months | Baseline remains constant |
| **Legal standards and established professional criteria** | Against national/approved standards and or international guidelines/obligations | Complies with limits given in national standards but not confirming to international lender guidelines in one or more parameters | Meets minimum national standard limits or international guidelines | Not applicable |
| Likelihood of potential impacts occurring | Commonly occurs under typical operating or construction conditions (Certain) | Usually seen occurring under most situations (Likely) | Occurs under abnormal, exceptional or emergency conditions (Occasional) | Unlikely to occur |

NOTE: Anticipated Project Duration - 5 to 6 months

### 5.1.2 Sensitivity of Receptor

The sensitivity of a receptor shall be determined based on a review of the population (including proximity/ numbers/ vulnerability) and the presence of features on the site or the surrounding area.

In the surrounding area of the dumpsite around 40 Households are residing within 100m radius (with 10 Households within 10 m). St. Joseph Cottolengo Church at a distance of 180 m, KV LP School at a distance of 322 m, Fire & station at a distance of 20 m. Hence sensitivity of receptors may affect the bioremediation process of the dump site and can be categorized as High Vulnerable receptor capacity to absorb proposed changes or/and moderate opportunities for mitigation.

### 5.1.3 Significance of the impact

The significance of the project impact is tabulated below: -

| Project Details | Sensitivity | Vulnerability of Resource | Importance of Resource |
|---|---|---|---|
| No project Impacts | Medium | Medium | Medium |
| Project with Bio Remediation (Biomining) | High | Low | Low |

Overall, Bio mining will have a medium impact, with more of a positive Impact on the Environment and Human health in the longer term.

**Source-Pathway-Receptor Analysis**

A) **Source**: The source of contamination is the legacy waste remaining and being deposited at the Vedimara closed dumpsite, more specifically the landfill gas and leachate generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. In this case the waste is +20 years old, as dumping had started in year 1997(Non-functional). The total waste volume is 22896.86 cu. m with the dumpsite spread over 1.25 acres and the legacy waste is seen about 2.33 m above and 6.75 m below from the existing ground level. In addition to the landfill gas and leachate, windblown dust and litter are also considered as sources of contamination.

B) **Pathways**: The following pathways for migration of contaminants have been identified: Wind- The main pathway for litter and dust dispersion is the wind. As long as the waste is kept uncovered, the dust and litter will continue to be blown off the dumpsite to the surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. The rainwater flowing off the dumpsite along the slope towards North west direction acts as a pathway for the uncovered waste to flow along the boundary of the dumpsite in the North eastern side. Since, the dumpsite is enclosed by boundary, runoff to the nearby river is not possible unless there is any leakage.

The leachate flows with groundwater and acts as the pathway. Surface water contaminants like run-off from the dumpsite, leachate and windblown dust and litter that

reach nearby surface water bodies like canals and rivers are further transported by surface waters and in this case the surface water acts as the pathway.

**C) Receptors:**

Receptors are air, surface water (drain passing through residential areas) and ground water. For drinking purpose, they mainly use municipal water supply (40 nearby Households within 200 m and 10 households at 10m distance), soil, flora, fauna and humans. In the case of remediated dumpsite, the most prominent group of receptors are the nearby residences. As the dump is not contaminated by hazardous wastes, remediation would improve the pollution scenario provided the bio-earth used is pollution free and of good quality. However, other impacts are expected on the final destinations of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF/MRFs in the region. Depending on the locations of end use of fractions retrieved from bio-mining, the contractor shall assess the impacts on communities and workers on site & nearby; and near locations of end-use. Key impacts may result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after bio-mining activity, activities in bio-mined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post biomining activity.

## 5.2 Impacts on Air Environment

Key impacts on air include:

- Emission of Methane and other Greenhouse gases; and its impacts on scavengers, workers on site/other facilities on site (MCFs in this case), nearby communities of Ward 10.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odour, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.

## 5.3 Impacts on Water Environment

**Ground water**

- Borehole data indicates waste depth is of 6.75m with clayey strata after that. Hence it is expected that the ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. With the slope of the dumpsite, this tends to get accumulated at low-lying gradients and flows into drain up to 300 m and joins at Paravur river. Oozing & pooling of leachate & it draining to nearby areas during rains would be an important aspect to be managed during bio-mining to prevent ground water contamination

- Leachate samples: BOD, COD, TDS exceeding limits may impact the ground water quality in nearby residences, wells, and long term soil pollution.
- Borehole data: Dump below water table may impact water resources and wells nearby.
- Ground beneath the dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. There are no parameters exceeding the permissible limits for heavy metals.

**Surface water**

- The dumpsite experienced flooding during 2018 floods and the site is not vulnerable to flooding as per KSDMA Map. The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas. Paravur River is at a distance of 300 m from the dumpsite.
- Predominant slope is in the North west Direction. At eastern and southern direction, (end direction) there are residential households and dry vegetation. It is important to contain and treat leachate from the proposed bio-mining activities on site. Treated leachate may be recirculated or used for other purposes.

## 5.4 Impact due to Odour

Dumpsite of organic, or partly organic waste, always results in anaerobic degradation of the waste and consequently, the production of landfill gas, consisting mainly of methane, H2S, Ammonia, and carbon dioxide. If not properly managed the gas can cause odor problems in the neighborhood and since landfill gas is a highly potent greenhouse gas it will also contribute to the increased level of greenhouse gases (GHG) in the atmosphere. Dumpsite gas may also increase the risk of fires or explosions at the landfill site and surroundings.

## 5.5 Impact on Noise

A potential nuisance is a noise from transport of vehicle and machinery operating during remediation phase of the Dumpsite and transports of waste to the Dumpsite. The topography is favorable to attenuate noise to the surroundings. The distance to nearby residential areas is at 10m with 10 households. Hence, the impact will be higher during remediation to the residents.

## 5.6 Impacts on Soil

- Historic land use assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it shall be excluded from the site as bio-mining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.

- Spillover of activities to nearby road and land would result in pollution of all types on these areas. Hence it is important to restrict all activities to the site for legacy waste bio-mining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.

- Ground beneath dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. In Vedimara, all heavy- metals are falling within the limit as per Fertilizers Control Order 1985 and its amendments. Vedimara does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste (including legacy asbestos), e-waste or biomedical waste is found while bio-mining, same shall be retrieved, transported, treated and disposed as per specific waste guideline of the Central Pollution Control Board, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste), Feb 2019) and World Bank EHS Guidelines. A plan shall be prepared to auditing of all wastes, management, eliminating pollution & OHS risks; and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.

## 5.7 Other impacts on Biodiversity - Fauna/Flora

- Since the project involves transport of wastes, it is important to consider the impact beyond the project boundaries. Within 29 Km from the site, there is a Malayatoor Reserve Forest and Cherai - Vypin Belt at 8 Km from the dumpsite.
- Fauna: impacted by direct consumption of the solid wastes, sharps, entanglement, or by consumption of plants and/or animals contaminated by wastes, or as a result of leachate effects on groundwater and surface water.
- Flora: Plants near open dumpsites can be impacted directly by the waste, dust or smoke from burning. Disturbance to vegetation due to machinery, trampling by foot, vehicle or animals, or contamination by waste or leachate, the migration of landfill gas, or as a result of burning or smoke.
- Disturbance to other fauna and flora on site: onsite activities including those related to MCFs may also impact fauna/flora through high noise levels of pre-construction / construction activities.
- Biodiversity of existing site: Available biodiversity of existing site is mentioned in the Environmental Baseline session and there is no key species identified which are listed by IUCN.

## 5.8 Other Impacts on existing or proposed activities on site/s

- There may be approvals from various agencies for bio-mining activities and associated facilities; depending on utilities and uses on site & associated activities. These permits shall be obtained prior to initiating activities on site.
- Impacts of bio-mining on existing facilities on site such as the MCFs and composting units, etc. (disturbance to activities & people due to dust, leachate, noise, odour; additional load of wastes to these facilities, vibration impacts & structural damage, etc).
- Post bio-mining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped, or if this is dumped elsewhere or not processed, it will lead to health and environmental issues. This alternate location, being associated facility need mitigation measures to avoid/minimize pollution, Health & Safety impacts on workers, communities. Also, forward linkages are considered as associated facilities/linked activities. Impacts of transportation of these fractions (traffic increase, odor, leachate, dust), impacts during rains & emergencies, handling, storage at the identified locations, reuse etc. shall be mitigated.

# CHAPTER 6

# ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN

## 6.1 Proposed Environmental and Social Management Plan

The detailed anticipated impacts and corresponding mitigation measures/management of the impacts are given below.

Table 6.1: *Proposed Environmental Management Plan*

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| *A* | **Planning and Pre-Construction Stage** | | | |
| *1* | | *Planning for biomining facility* | | |
| 1 | Bio-mining & Bioremediation Plan & Capacities | • Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / bio-mined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these bio-mined material in line with the agreements with such facility owners and National, State regulations and WB EHS<br>• Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate Management Plan.<br>• The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers.<br>• Contractor to get all required licenses & permits before start of any activity on site | Contractor | SPMU/DPMU/ ULB |
| 2 | Site Access Closure | • The total cessation of dumping in the site will be implemented before any works.<br>• All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public.<br>• The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance to indicate that the waste dump has been closed from the operation.<br>• To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br>• Grading shall be performed where necessary to provide a neat appearance | ULB or Contractor as per Bidding mechanism | SPMU/DPMU/ ULB |
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – *impact on air* | • Carry out site assessments as per Guidelines for Bio-mining of Legacy Waste Dumpsites of CPCB<br>• Consider safe bio-mining & gas / leachate generation from existing capped portion of the site<br>• Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means | TSC, ULB, Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | *quality, odor, water contamination due to leachate, health and safety impacts of the people working in the site assessment* | ▪ Provision of appropriate PPE's to the team undertaking the site assessments<br>▪ Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>▪ Plan for machinery operated which will be operated by skilled operators at all times.<br>▪ Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures.<br>▪ Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | | |
| 4 | Absence / Delay in Permissions for Developing the biomining facility and associated works as per National regulations | ▪ Required permissions for undertaking biomining at the existing dumpsite and assessments conducted for undertaking biomining as per existing Laws, Regulations; including for associated infrastructure, DG Sets, Consent to Establish; and other licenses including those as per Labor Laws, before the start of works on site | Contractor, ULB | SPMU/DPMU/ ULB |
| 5 | Dust impacts due to Site works, screening & stacking of retrieved wastes<br>*(Air Pollution) and Visual Blight due to excavation* | ▪ Plan to Provide temporary high screen, buffers around the site before the start of work to curtail dust emissions<br>▪ Arrange a green belt as early as possible on the area of the site with no / less dump. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers)<br>▪ PPEs to be used by workers<br>▪ Awareness to communities & suggest to use PPEs | Contractor and or ULB depending on agreement on bidding mechanism/DPR | SPMU/DPMU/ ULB |
| 6 | Material sourcing, transport, and stacking of construction materials<br>*(Occupational Health and Safety issues and Air noise pollution)* | ▪ Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism<br>▪ Prior intimation to nearby Primary Health Centre on work activities need for medical support, emergency support needs, type of laborers on-site and labor camp if any<br>▪ Materials shall be sourced only from approved quarries<br>▪ Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions.<br>▪ The driver should be with required license and follow speed regulations<br>▪ Materials shall be transported preferably through well-surfaced roads. If road it kuchcha, water sprinkling shall be done to prevent dust emission before and after truck passes<br>▪ Material transport and unloading activities should not result in noise disturbance to locals and should be during daytime<br>▪ Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors.<br>▪ Provide vehicle wheel wash area on site<br>▪ Workers to be provided with Personnel Protection Equipment (PPE) including safety boots, jackets, ear muffs, gloves. | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | ▪ Proper rest area on site shall be provided with water, first aid, toilets | | |
| 7 | The layout of Labour camp *(Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)* | ▪ Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp<br>▪ Nearby health center shall be informed about the labor camp & appropriate medical checkup shall be arranged periodically<br>▪ Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters)<br>▪ It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with landowners wherever the labour is accommodated<br>▪ Camp must not be provided in an area prone to Hazards<br>▪ Camp should be adequately at higher plinth levels to prevent water intrusion<br>▪ Rooms shall be of appropriate sizes with adequate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG)<br>▪ Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female labourers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc.<br>▪ The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security<br>(Refer ECOP section 06 and section 11 of EMF for KSWMP) | Contractor | Site engineer of SPMU, Labour Commissioner, PCB |
| 8 | Nearness/disturbance to sensitive areas such as forests, wildlife habitations, etc. especially in case of providing support facilities *(Impacts on Fauna / Flora)* | ▪ Ensure site selection for any support facilities or activities (such as vehicle storage etc. if no in biomining site) based on the screening checklist and the master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate, Reduce. Obtain requisite permissions from respective authorities such as Pollution Control Board, ULB etc.<br>▪ Identify appropriate government site to avoid land acquisition and resettlement impacts<br>▪ Covered and well-marked storage area with cut off drains & odour/fly/dust/ fire prevention shall be ensured for excavated wastes and washing, segregation of the same are to be arranged with due consideration to nearby residences, slope and other landuses | Contractor | SPMU/DPMU/ ULB |
| 9 | Contamination of groundwater due to leaching. Leachate parameters; BOD, COD, TDS, Ecoli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution | ▪ During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant<br>▪ Depending on the contractors plan for bio-mining of the site, adopt plans to manage leachate | Contractor | SPMU/DPMU/ ULB |
| 10 | Impacts on flora, fauna" consumption of wastes, leachate impacts, dust smoke burning, trampling/machinery | ▪ Movement routes of vehicles to be planned to avoid key fauna/flora on site<br>▪ Leachate collection & storage/treatment and recirculation shall be planned to avoid impacts on flora, fauna | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 11 | Nuisance hazards to neighboring areas | • Ensure proper design and adequate compound wall, high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements<br>• In case of waste mound and site edges are sloping or unsafe, provide engineered retention walls. | Contractor | SPMU/DPMU/ ULB |
| 12 | Treatment & Disposal of wastes and rejects | • Contractor to Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & inert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventoried and quantified, including Biearth, rejects, inerts. These shall be treated and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertilizer Control Order 1985 and their amendments. Asbestos Management Plan shall be prepared for management if Asbestos wastes retrieved if any<br>• Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period. | | |
| **B** | **Implementation or Biomining & Bioremediation stage and Construction of ancillary facilities such as access road improvements, compound walls, greenbelts, drainage etc.** | | | |
| | | **Implementation of bio-mining of the dumpsite** | | |
| 1 | Impact due to the vehicular movement<br>*(Air and noise environment & Vehicular - Vehicular & Vehicular - Pedestrian Conflicts)* | • Vehicles and machinery are to be maintained so that emissions conforms to National Ambient air quality standards.<br>• All vehicles and machinery should obtain Pollution Under Control Certificates.<br>• HORN PROHIBITION signpost to be erected.<br>• Rumble strips/speed breaker to be provided on access roads.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed.<br>• Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle<br>• Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements<br>• Avoid heavy vehicle movement through Vishnupur road roads during peak hours 7 a.m to 10 a.m (entrance/exit hrs / peak hrs, and during important period / festivals when people use the road to access temple<br>• Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents | Contractor, ULB | SPMU/DPMU/ ULB |
| 2 | Impact due to the use of heavy vehicle and equipment *(Air and Noise environment)* | • Mining equipment (in case of construction of ancillary facilities) should be well tested and be equipped with a dust-removal device.<br>• Equipment Operators & labourers should wear dust masks, ear protection, and hard hats.<br>• Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load.<br>• Labor to be provided masks / PPEs<br>• Construction / Bio-mining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spreading into neighboring sensitive land uses | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | ▪ Noise standards at operation machines are to be strictly monitored to prevent exceeding of GOI noise standards.<br>▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck drivers and equipment operators to switch off idle engines.<br>▪ Using modern, well-maintained and regularly serviced vehicles.<br>▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>▪ Provision of earmuffs and ear protection to workers and employees in high noise areas.<br>▪ Workers in the vicinity of strong noise to wear protectors and their working time should be limited as a safety measure.<br>▪ As North Parvoor dumpsite has sensitive receptors and settlement areas within 150m (10 houses within 10 m radius) of it, noisy works shall be stopped from 22:00 to 06:00.<br>▪ Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum.<br>▪ Avoid noisy activities/machines near South side of the site where settlement exist within 50m. Noise barrier shall be provided at all noise-sensitive locations / for noise generating equipment such as DG sets, mixers (for ancillary facilities) especially near South side of the dumpsite<br>▪ Adopt required measures as per CPCB guidelines, and site & work specific safety requirements | | |
| 3 | Impact during the construction activities<br>*(water environment)* | ▪ Labour camps if any (depending on Contractors work plan & arrangements) are to be located away from water bodies.<br>▪ Vehicle washing or maintenance near water bodies are to be avoided.<br>▪ Contaminated water from construction / biomining activities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated on site. | Contractor | SPMU/DPMU/ ULB |
| 4 | Leachate and Runoff from biomining activities<br>*(Soil contamination and groundwater contamination)* | ▪ Provide site cut off drain around the site to divert off storm water from entering the site, and to prevent contaminating downstream resources with run off from the dumpsite<br>▪ Depending on the contractors plan for biomining of the capped area on site, implement leachate management to cause no harm to communities & environment<br>▪ Ensure storm water drains will lead to drain outlets<br>▪ Provide leachate drains lined from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area<br>▪ Provide proper treatment of leachate and storm water that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by bio-mining activities like excavation and waste segregation and stabilization<br>▪ The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB.<br>▪ The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata | Contractor | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | ▪ Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff and hence reduce infiltration<br>▪ Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism<br>▪ Plan the works on-site only during non-rainy seasons and to complete the works before rains<br>▪ Store leachate preferably in aboveground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide for emergency containment additionally | | |
| 5 | Soil decontamination from accumulated waste levels *(Impact on leachate, odor)* | ▪ Decontaminate the soil / stabilized layers remaining after sieving out wastes using windrow and bioculture of appropriate quality in line with standards / regulations or appropriate means as per CPCB Guidelines<br>▪ Vegetative layer using contaminant absorptive root varieties like Vetiver may be tried on soil and along the edge of the green belt or floating wetlands may be deployed in water channels nearby to maximize absorption of leachate in the soil by root-zone phytoremediation<br>▪ Soil and water testing shall be done and changes in contamination shall be noted. | Contractor | SPMU/DPMU/ ULB |
| 6 | Excavation of waste from the waste mound *(Health and safety impacts)* | ▪ The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound.<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided<br>▪ Machinery operated for excavation should be operated by skilled operators at all times.<br>▪ Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on wastes.<br>▪ Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound<br>▪ In case of the waste mound and site edges are sliding or unsafe; provide engineered retention walls or string boundaries.<br>▪ When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection & treatment mechanism. | Contractor | SPMU/DPMU/ ULB |
| 7 | Transportation of wastes or retrieved or other material in overloaded and open vehicles *(Air, Odour nuisances; spills and littering impacts on Air, Water, Land)* | ▪ All vehicles shall carry only approved load of weight<br>▪ Regular cleaning of roads & drains and removal of spills if any.<br>▪ All waste transport vehicles shall be covered and movement shall be during non-peak hours.<br>▪ Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities.<br>▪ Adopt required measures as per CPCB guidelines, and site specific safety requirements. | Contractor | SPMU/DPMU/ ULB |
| 8 | Occupational health and safety impacts of the workers during | ▪ Avoid direct & double handling of wastes through avoidance measures (suitable planning & equipment), engineering controls & use PPEs<br>▪ Work area & Labour camps shall be provided with First Aid and other related activities. | Contractor, ULB | SPMU/DPMU/ ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | the biomining & construction of support facilities:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage of chemicals/other materials, biocultures or wastes etc; by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | ▪ Emergency Preparedness plans shall be prepared and implemented for all manpower working centers and its field extension centers.<br>▪ An Environment Health & Safety policy shall be prepared and implemented<br>▪ Adequate manpower shall be provided & manager & staff shall listen and act upon the manpower related grievances.<br>▪ Workers will be provided with PPE such as face mask, gloves, shoes, nose masks & goggles<br>▪ Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed without slip, trip, fall especially on waste, leachate or trenches<br>▪ Proper training will be provided regarding the maintenance of health<br>▪ Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks & water supply), food, and water in a hygienic environment (with proper hand wash). Provide clean eating areas where workers are not exposed to contaminated, hazardous or noxious substances.<br>▪ First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus<br>▪ Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health checkups. Arrange daily health checkup for workers working on waste heaps<br>▪ Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals.<br>▪ Measures such as deferred timings and stretch break to be adopted<br>▪ Secure all installations from unauthorized intrusion and accident risks;<br>▪ Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every day start of works / activities. Key hazards would be (but not limited to) are flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and leachate from existing capped area on site, electric shocks, works with heavy machines & equipment, slips of men & material (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc.<br>▪ EHS specialist with adequate experience & third party supervision are important for bio-mining activity<br>▪ Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites<br>▪ Provide visitor orientation if visitors to the site need to gain access to areas where hazardous conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible<br>▪ Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;<br>▪ Ensure moving equipment is outfitted with audible back -up alarms & flag men with whistles or speakers;<br>▪ Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will | | |

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| | | reduce the accidents due to electrical short circuit.<br>▪ Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenance to be marked well & safe kept before activity start near those In close proximity to this location, there is a transformer. Disallow worker exposure to noise level greater than 85 dBA for more than 8 hours a day without hearing protection<br>▪ All workers shall be registered as per prevalent labor laws (including a workforce of subcontractors) and provided insurance cover & others as per existing acts/laws<br>▪ Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractor's person/insurance agent<br>▪ While using heavy machinery like JCB, cranes, etc, inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle.<br>▪ While using heavy machinery like JCB, cranes, etc, inform communities to prevent children and others from going near operating / movement areas including roads.<br>▪ Flagmen shall be arranged if work is near schools, hospitals, major roads, and traffic control is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if possible<br>▪ A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs;<br>▪ No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor<br>▪ All works related to working at heights will be undertaken only during the daytime when sufficient sunlight is available;<br>▪ Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done;<br>▪ All excavation activities to be conducted in supervision of the site contractor;<br>▪ Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured.<br>▪ All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans prepared and implemented, as per Banks Incident Reporting Tool | | |
| 9 | Risk of fire due to conditions leading to spontaneous combustion<br>*(Air environment, disturbance to communities and workers, health impacts, safety issues)* | ▪ Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for Implementation of SWM Rules 2016 – regdg Fire Incidents at MSW Dumpsites (https://cpcb.nic.in/openpdffile.php?id=UHVibGljYXRpb25GaWxlLzQyNDRfMTY1NDE2Mzk3N19tZWRpYXBob3RvNzYxMi5wZGY= ), LSGD Kerala Government GO on Fire Safety of MRF, MCFs (for the MRF on site if used for storage of wastes)and other Regulations, guidelines applicable<br>▪ Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3; and National/State regulations & WB EHS<br>▪ Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes<br>▪ Avoid conditions that can lead to spontaneous combustion such as: | Contractor, ULB | SPMU/DPMU |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | ○ Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard<br>○ Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.<br>▪ Design the facility for access by firefighting equipment, including clear aisles among waste heaps or work areas and access to adequate water supply.<br>▪ Ensure workers are briefed of fire hazard & its management<br>▪ No unauthorized entry shall be permitted to the site; including of workers during holidays, nighttime, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating "trespassers not allowed"<br>▪ The following activities should be implemented to prevent fires from occurring at the facility<br>○ adequate fire-fighting equipment should be made available on-site and stored in an accessible manner,<br>○ all operating staff should be trained and able to manage fire outbreaks at any part of the facility.<br>○ clear signage should be established to inform workers and the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area.<br>○ Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows.<br>○ all fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the bio mining, storage, and processing areas.<br>○ all flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating storm water.<br>▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the bio mining activity in line with National State regulations, guidelines and international good practices<br>▪ Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.<br>▪ Contain all local smokes/small fires inside the dump asap. Fire brigade help shall be sought on all smokes/fires outside the dump<br>▪ Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured.<br>▪ Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers | | |
| 10 | Construction of new facilities in retrieved land | ▪ The excavated site shall be protected from any dumping during or after the bio mining activity and shall be reserved for SWM activities in line with SWM Rules 2016<br>▪ Any new facility under KSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations | ULB | SPMU/DPMU |
| 11 | Pest / Vermin Control & Visual impacts | ▪ Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center | Contractor, ULB | DPMU, SPMU |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | (Odour, flies, rodent / other pest menaces) | ▪ Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups<br>▪ Bio-pesticides / biological control shall be followed. However, bio-pesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used<br>▪ Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate management | | |
| 12 | Odour nuisance | ▪ Waste with a strong odor to be covered immediately they are emptied from vehicles.<br>▪ Control and manage leachate treatment to minimize odor.<br>▪ Provide buffers screens to curtail odor from reaching surrounding communities especially to North side of site.<br>▪ Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor. | Contractor, ULB | DPMU, SPMU |
| 13 | Storage, Collection, Transport, Treatment & Disposal of wastes and rejects | ▪ Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste<br>▪ Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters<br>▪ Waste handling shall be inline with existing regulations & guidelines & avoid health & safety impacts<br>▪ No material is allowed to remain on site after the contract period<br>▪ Adequate fire safety arrangements & awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported<br>▪ Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/inserts in designated or agreed area & are in line with schedule; using GPS.<br>▪ Given that the access road is used by the public, it is imperative to implement the required safety precautions and environmental protection measures when transporting the waste. | Contractor, ULB | DPMU, SPMU |
| 14 | Other activities | ▪ No activity other than bio mining shall take place on site & any activity shall cause no adverse impacts on the environment or people<br>▪ If existing MCF shall be used for storing bio mining wastes, its safety shall be ensured in terms of fire & structural safety before starting to use the facility. Further usage of the MCF after bio mining works shall be after proper cleaning / washing & disposal of all rejects/inserts & tools to ensure good housekeeping & no H&S impacts<br>▪ If existing MCF shall be used by the ULB for storing dry wastes from Town, during bio mining period, alternate access shall be arranged & workers shall be adequately protected against any health & safety impacts | | |
| 15 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & bio mining / construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees<br>▪ Waste water and Leachate to be treated & recycled/reused | Contractor | ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| C | **Future Site Usage (EMP shall be updated in line with EMF & need if future site usage is proposed under KSWMP). This section is not the responsibility of the Contractor for Bio mining, but of the future facility operator & ULB** | | | |
| 1 | Future use of the bio mined site: Green Park, MCF, MRF, RRF, Treatment plants, landfill cell or any other, preferably for SWM | • ULB to ensure that the site will not be used for future dumping.<br>• Activities at existing MCF to be upgraded to ensure that no waste (even dry wastes) gets dumped around.<br>• ULB shall plan the future use of the site shall be in consultation with the communities.<br>• Phase 1 Environmental Assessment to be carried out, EA for existing facilities & EIA for proposed development in line with EMF in case that is proposed to be developed under KSWMP<br>• All applicable clearances, permits shall be arranged in line with applicable regulations for the proposed new use of the site, and appropriate designs/plans to be prepared & implemented | Future Facility Developer/ Operator & ULB | ULB (SPMU in case it is under KSWMP) |
| 2 | Vehicle movement for new activities: MCF/MRF, RRFs, Treatment plants, landfill cell<br><br>*(Air, water environment, a nuisance to biodiversity, communities, Health impacts)* | • The movement route shall be scheduled for each vehicle.<br>• Enforce speed limits applicable and make drivers aware of this.<br>• Vehicles movement shall be tracked by Health Supervisors to ensure keeping up to schedule; preferably using GPS.<br>• Any adulterated fuel shall be avoided. There shall be periodic emission tests for vehicles.<br>• Provision of Personal Protective Equipment such as face mask, gloves, nose masks & goggles to all workers in C&T vehicles, Maintenance yards.<br>• Proper lubrication shall be provided to minimize squeaking noise due to friction.<br>• Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br>• The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public.<br>• Traffic will be managed at the site by providing adequate space for parking of vehicles.<br>• Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design.<br>• No waste or material shall be disposed in any place other than the designated area; including water bodies, coasts/forests, or sensitive areas. | Future Facility operator | ULB |
| 3 | Exhaust emissions<br>*(Air impacts)* | • No idling of vehicles on site.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed | Future Facility operator | ULB |
| 4 | Plying of vehicles through kutcha / unsurfaced roads and idling<br>*(Air pollution- SPM, CO, CO2)* | • Vehicle movement shall be well planned – through topped roads. In case of necessity to move through Kutcha roads, ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Future Facility operator | ULB |
| 5 | Impact on the ambient noise quality during the operations<br>*(Noise, nuisance to sensitive receptors, health impacts)* | • Strictly adhering to designated working hours (day time); Sensetizing construction truck drivers and equipment operators to switch off idle engines;<br>• Using modern, well-maintained and regularly serviced vehicles;<br>• Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>• Provision of earmuffs and ear protection to workers and employees in high noise areas. | Future Facility operator | ULB |

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 6 | Occupational health and safety impacts of the workers:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | ▪ All OHS and CHS measures to be followed in line with applicable regulations, guidance<br>▪ Workers & communities shall be made aware of OHS, CHS risks and impacts & mitigation measures adopted<br>▪ Emergency management plan to be prepared & followed<br>▪ Workers shall be appropriately trained or OHS during construction & Operation of all future facilities | Future Facility operator | ULB |
| 7 | Pest / Vermin Control (Odour, flies, rodent / other pest menaces) | ▪ Regular cleaning and approved pest control measures to be adopted<br>▪ Biopesticides / biological control shall be followed.<br>▪ Banned pesticides/insecticides shall not be used.<br>▪ Workers shall be made aware of storage and use of pest control measures and PPEs to be used | Future Facility operator | ULB |
| 8 | Fire Safety | ▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented in line with National State regulations, guidelines and international good practices | Future Facility Operator | ULB |
| 9 | Energy Efficiency & Water Use efficiency | ▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & construction techniques<br>▪ Landscaping & green belts to use local / indigenous plants & trees<br>▪ Waste water to be treated & recycled/reused | Future Facility Operator | ULB |

### 6.1.1 Disposal phase of By-products from Bio-mining process:

The bio-earth and coarse fraction soil recovered from dumpsite will be used for filling low lying areas. The RDF material recovered from dumpsite will be transported to nearby cement factory and recyclable material will be handed over to the authorized recycling agency. If the by-products are not removed from the site within a three-month period, penalties will be imposed on the contractor.

## 6.2 Disaster Management and Emergency Preparedness

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care, and other necessities of life. In the case of Dumpsite remediation, Disaster Management Plan is aimed to ensure the safety of life, protection of the Environment, protection of installation, restoration of the remediation process, and salvage operations in this order of priorities.

For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel training is to be provided through rehearsals/drills. The disaster management Plan consists of Onsite Emergency Plan and an offsite Site Emergency plan, which is outlined here for Emergency Preparedness. The list of emergency helpline services is mentioned in the Table below.

**TABLE: 6.2 LIST OF EMERGENCY HELPLINE SERVICES**

| Sl. No. | Emergency Services | Distance from the dumpsite |
|---|---|---|
| 1 | North Paravur Police Station | 1.5 Km |
| 2 | North Paravur Fire and Rescue Station | Opposite to dumpsite |
| 3 | Paravur Taluk Headquarters Hospital | 1.2 Km |

### 6.2.1 Approach to Disaster Management Plan (DMP)

The objective and approach of the Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effect the rescue and medical treatment of casualties;
- Safeguard other people;
- Minimize damage to property and the environment;
- Initially contain and ultimately bring the incident under control;
- Identify any dead;
- Provide for the needs of relatives;
- Provide authoritative information to the news media;
- Secure the safe rehabilitation of the affected area;

- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency.

In effect, it is to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy. Disaster Management Plan should include Emergency Preparedness Plan, Emergency Response Team, Emergency Communication, Emergency Responsibilities, Emergency Facilities, and Emergency Actions.

#### 6.2.1.1 Identified Emergency Situations

Major disasters which can affect the remediation process are as follows:

- Floods due to heavy rainfall
- Fire risk in summer
- Occupational and health risks during the remediation process
- Safety-related accidents during the remediation process

#### 6.2.1.2 Proposed Organizational Structure for Disaster Management Plan

**Response team:** Setup an Emergency Organization. Emergency Organization includes the senior executive (head of EO as a Site controller), Manager Safety (Incident controller), Shift in charge, and Emergency Coordinators.

- All Incident control would be reported to the Site Controller. Each Incident Controller organizes a team responsible for controlling the incident with the personnel under his control.
- **Shift In-charge** would be the reporting officer, who would bring the incident to the notice of the Incidence Controller and Site Controller.
- **Emergency Coordinators** would be appointed who would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential and support services. For this purpose, security in-charge, personnel department, essential services personnel would be engaged. All these personnel would be designated as key personnel.
- In each shift, the electrical supervisor, in charge, and other maintenance staff would be drafted for emergency operations. In the event of power or communication system failure, some of the staff members in the office/facility would be drafted and their services would be utilized as messengers for quick passing of communications. All these personnel would be declared as essential personnel.

## 6.3 Proposed Monitoring Plan

The proposed monitoring plan is presented in table below,

| TABLE -6.3 PROPOSED MONITORING PLAN AND FREQUENCY | | | |
|---|---|---|---|
| **Monitoring media/parameters** | **Items and parameters** | **Frequency** | **Location** |

| | | | |
|---|---|---|---|
| **Ambient Air Quality** | PM10, PM2.5, NOx, CH4, CO, Ammonia | Quarterly (1 sample) | 2 point |
| **Noise** | Leq Day and Night | Monthly | 2 point |
| **Health safety Hazards** | Medical records, documentation of injuries and accidents. Health and safety assessments | As and when accident/injury occurs | Incident reports |
| **Leachate** | • pH<br>• Biological Oxygen Demand- BOD<br>• Chemical Oxygen Demand-COD<br>• Nitrogen (Ammonia, Nitrate, Nitrite)<br>• Oxidation-Reduction Potential- ORP<br>• Electrical Conductivity-EC<br>• Total Organic Carbon (TOC)<br>Dioxins<br>• Heavy Metals (As per the schedule II of SWM rules 2016) | Quarterly | 2 point |
| **Groundwater quality** | Parameters will be defined and sampling, preservation, and analysis of water will be carried out following those stipulated in the subsections below and Standards Methods for Testing Water and wastewater, 21st edition, published by American Public Health Association (2005). | Quarterly | 8 points |
| **Surface water quality** | | Quarterly | 6 points, 2 upstream and 4 downstream |

## 6.4 Estimated Budget for Implementation and Supervision of EMP

The estimated capital cost of [redacted] is required for budget provision for implementation and supervision of EMP. The remediation will be only during shorter time duration and hence the recurring cost won't be incurred. The estimated budget for implementation & supervision of EMP is shown in the table below.

| Sl. No. | Particulars | Capital Cost (lakhs) |
|---|---|---|
| 1 | Dust Mitigation measures including site barricading, Water sprinkling, wheel washing and leachate management | [redacted] |
| 2 | Mobile toilet, Pest Control, Disinfectant | [redacted] |
| 3 | Medical cum First Aid Facility | [redacted] |
| 4 | PPE Workers & Welfare, Firefighting Equipment | [redacted] |
| 5 | Monitoring & Testing (Air, Noise, Water, Soil, Leachate) | [redacted] |
| | **Total** | [redacted] |

# CHAPTER 7

# INSTITUTIONAL ARRANGEMENTS

## 7.1 Proposed Institutional Arrangements

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of ToR for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation. The Support Organisation will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments. Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level. The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances. The PIU will submit the compliance reports on clearances, permits, and environmental and social safeguards to D-ESDU.

## 7.2 Capacity Building

- Sensitize and orient different stakeholders of the project with adequate communication of benchmark standards on various project components. Ensure up gradation of awareness generation at different levels. Special focus: Health Hygiene and sanitation Sub Activity
- Training program for HKS (Health & Hygiene, source level waste segregation and source level treatment, Fire and Safety)
- Training program for ULB Councilors and Ward convener (Proposed SWM project plan of KSWMP)
- Training program for Political and trade union leaders (Health, Hygiene and source level waste segregation, Fire and Safety)

- Training program for Residence Association leaders (Health, Hygiene different composting methods and source level waste segregation, littering of waste, Public Health, Fire and Safety)
- Training program for workers of Municipal Sanitary workers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for school / college students (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for ULB officials (Proposed SWM project plan of KSWMP, proposed policies, existing policies etc... to improve the existing pattern into zero waste concept of the municipality)
- Training program for School children, Parents and Teachers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Massive awareness campaign on 5R (Reuse, Recycle, Repurpose, Reduce and Refuse)

**Importance of Capacity Building**

Capacity building is defined as the "process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in the fast- changing world. It is the development of knowledge, skills and attitudes in individuals and groups of people relevant in the design, development and maintenance of institutional and operational infrastructures and processes that are locally meaningful. It is generally defined 'capacity building' as the creation of an enabling environment with appropriate policy and legal frameworks, institutional development, including community participation, human resources development and strengthening of managerial systems. It is a long-term, continuing process, in which all stakeholders participate. The main aim of capacity building under solid waste management is to build a basic understanding regarding the solid waste management project at each step of value chain (waste generation, segregation & storage at source, primary collection, secondary collection, transportation, processing and disposal) and importance of their work and develop a sense of belonging towards the work.

## 7.3 Grievance Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizen can lodge complaint either directly to ULBs, toll free number or through digital platforms (website/email – grmkswmp@gmail.com / Toll free number-18004250238). The complaint will automatically be recorded in login of ward level official of ULB and an escalation system is constituted according to the category of each complaint to close the complaint in time. The complainer can close the complaint through a feedback form according to their satisfaction.

# ANNEXURES

## ANNEXURE I : INITIAL ENVIRONMENT AND SOCIAL EXAMINATION

### 1. Environmental Screening Form

Checklist to be followed for Environmental Screening during the Initial Environmental Assessment Stage has been provided below:

**Subproject Details**

| | |
|---|---|
| **Name of Subproject:** | Vedimara Solid Waste Dumpsite Reclamation by Bio mining |
| **Subproject Components:** | Dumpsite remediation using Bio-mining approach |
| **Subproject Location (City / Town/ Village with ward numbers):** | Vedimara, North Paravur Municipality, Ward 10 |

**Stage 1: Exclusion List**

**Is the Project Excluded from Consideration due to the following:**

| *Sl No:* | *Non-permissible Activities* |
|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i) any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides |

*(This space can be used to add details on the above, reason for exclusion from the Project etc.)*

This dumpsite remediation project involves 1. (i) no construction in demarcated Forest areas or protected areas or their buffers, (ii) no construction of landfills, not confirming to siting criteria as per SWM Rules 2016, or (iii) no treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible). 2. NO activities which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas, 3. No activities with (i) any impact on or due to Dams or embankments (ii) and projects will not purchase, store and use Banned Pesticides.

Hence, not excluded :
Proceeding to Stage 2 Screening

**Stage 2: Environmental Screening Checklist**

| Project Details | | |
|---|---|---|
| **Sl.No** | **Components** | **Details** |
| 1 | Project components | Solid Waste Dumpsite Reclamation by Bio-mining |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste management, centralized non-biodegradable waste management facilities, centralized biodegradable waste management facilities, sanitary landfills, biomining of dumpsites, including for Linked activities / associated facilities) | North Paravur Solid Waste Dumpsite Reclamation by Bio-mining -<br>A total station survey and geo technical survey was conducted to determine the quantity of legacy waste, revealing a total of 22896.86 cubic meters. |
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project; including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination)<br>Site Survey No:/s (attach map) with ownership details, Geographical co-ordinates of the site location [including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | **Location:** Vedimara, North Paravur Municipality, Ward 10<br>**Ownership –** North Paravur Municipality<br>**Landuse –** Existing Solid Waste Management facility<br>**Geographical Coordinates:** Latitude: 10° 9'2.46" N<br>Longitude: 76°14'31.73" E<br>**Earthquake zone**: III<br>**Cyclone:** Moderate<br>Access road of width 4m (Vedimara Fire Station Road)<br>Dumpsites have existed since 1997 |
| **4** | Land Area proposed to be used: Location wise (in sq km/sq m) | Utilized for Dumpsite: ~5100 sq. m |
| **5** | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | For domestic usage 2 KLD will be met from a private supplier |
| **6** | Power Required and Source of Power | No DG set requirement for this sub-project. Electricity connection is available within the site. Source: KSEB |

***Baseline Environmental Conditions***

| *Sl. No* | *Environmental Aspects* | *Yes* | *No* | *Details (include distance in Km, info on its importance)* |
|---|---|---|---|---|
| 1 | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers) | | | |
| *(i)* | Critically Vulnerable Coastal Areas (CVCAs), Eco-sensitive Areas (ESAs) | | ✓ | No Critically Vulnerable Coastal Areas and Eco sensitive Areas in the study area |
| *(ii)* | Cultural Heritage site, Protected monuments - listed by ASI/State | | ✓ | Paliam Palace – about 2.5 Km away |
| *(iii)* | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensitive area, with any schedule 1 species?<br>If Yes, which is the area? | | ✓ | No Eco-Sensitive Areas in the study area |
| *(iv)* | Other Wetlands/ Mangrove/ Estuarine Region | | ✓ | There is no Wetlands/ Mangrove/ Estuarine Region in the study area |
| *(v)* | Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves | | ✓ | There is no Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves in the study area |
| *(vi)* | Other Sensitive Environmental Components listed in EMF | | ✓ | There is no other Sensitive Environmental Components in the study area as listed in EMF |
| *(vii)* | Drinking water source, upstream and downstream uses of rivers, etc.. | ✓ | | Open Well - 10 m away in the household adjacent to the dumpsite. GWL – 3m from the ground level.<br>Paravur River – 300 m away from the dumpsite |
| *(viii)* | Low-lying areas/areas of Tidal Influence (provide CRZ details) | ✓ | | Site is in low-lying area with the gentle slope tend towards NW side, site does not falls in CRZ area |
| *(ix)* | Sensitive Receptors – a) Habitations / Households / Hostels, other special areas, etc. b) School c) Religious Places d) Tourist Areas | ✓ | | within the radius 200m there are households(with 10 Households at 10m), St. Joseph Cottolengo Church 180 m Residential units – Adjacent the dumpsite ab KV LP School - about 322 m |
| *2* | Is the site in Critical / Overexploited GroundWater Block. Provide the level of the groundwater table | | ✓ | As per groundwater booklet average ground water level 3m |
| *3* | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other (specify) | | ✓ | The site is not vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, etc. |
| *4* | Describe the type of soil and vegetation on site | | | Alluvial Soil, presence of vegetation (trees, shrubs) |
| *5* | Is the site present in the flood plains as recorded in the last 100 years? Provide the HFL level of the site/region | | ✓ | Site is not located in a flood prone area. |
| *6* | Existing pollution/contamination or degradation on site | ✓ | | Dumpsite existing from 1997, 20 years legacy waste is accumulated causing degradation in sitesite Facingg leachate issue. |

| *Sl. No* | *Environmental Aspects* | *Yes* | *No* | *Details (include distance in Km, info on its importance)* |
|---|---|---|---|---|
| *7* | Any other remark on baseline condition | | ✓ | Based on the baseline study data for AAQ, except Particulate matter all other parameters are within the permissible standards, surface and groundwater, indicating that the respective results are well within permissible limits except TDS and Electrical conductivity. The noise analysis indicates, during night time the Noise was found to be marginally higher than the standards |

***Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology, and Soils***

| *Sl. No* | *Impacts on Land / Soil Environment* | *Yes* | *No* | *Remarks* |
|---|---|---|---|---|
| *8* | Total extend of land to be covered/built | | | Total Land: 1.89 Acres, 1.25 Acres to be remediated |
| *9* | Total extend of land where the waste will be dumped openly / or expected to get contaminated by waste or leachate/material storage | | | Quantity of legacy waste: 22896.86 cum. |
| *10* | Extend of Land to be remediated | | | 1.25 Acres |
| *11* | Extend of land expected to be under green belt | | | Green belt of 20m should be provided |
| *12* | Will the proposed project cause the following on Land / Soil: | | | After bio-mining the land will be remediated and will have a positive impact on the land and soil. |
| *(i)* | Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains | | ✓ | No Impact on Surrounding Environmental Conditions |
| *(ii)* | Substantial removal of Top Soil (mention area in sqm) | | ✓ | Presence of solid waste beneath the ground level combined with soil is to be excavated for the bio-mining process.<br>Total Area - ~5100 sq. m |
| *(iii)* | Any degradation of land / eco-systems expected due to the project? | | ✓ | No land use change or ecosystem change due to implementation of this project since the land will be reclaimed. |
| *(iv)* | Loss or impacts on Cultural/heritage areas/properties | | ✓ | No impacts or loss of cultural/ heritage areas/properties due the implementation of the project since the existing one is at a distance of 2.5 Km from the dumpsite. |
| *(v)* | Does the project activity involve cutting and filling/ blasting etc? | | ✓ | It is bio-mining of existing solid waste only |
| *(vi)* | Will the project cause physical changes in the project area (e.g., changes to the topography) due to excavation, earthwork, or any other activity? | | ✓ | Waste heap is 2.33 m above and 6.75 below Ground Level which is to be excavated. |
| *(vii)* | Will the project involve any quarrying/ mining etc? | | ✓ | The project does not involve quarrying/ mining |
| *(viii)* | Will the project / any of its components contaminate or pollute the Land? | | ✓ | The land remains unaffected by the process of bio-mining, as evidenced by the absence of any discernible impacts observed during our assessment |

| *Sl. No* | *Impacts on Land / Soil Environment* | *Yes* | *No* | *Remarks* |
|---|---|---|---|---|
| *(ix)* | Will the project contribute to any long term significant adverse (negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | ✓ | Positive impact to the environment. |
| *(x)* | Will the Project or related activities cause negative impacts on the land in combination with other anticipated / existing projects in the region? | | ✓ | Bio-mining will be conducted following the necessary mitigation measures. Hence, no impacts |

| *Sl. No* | *Impacts on Air and Noise Environment* | *Yes* | *No* | *Details/Remarks* |
|---|---|---|---|---|
| *13* | Will the project cause or increase air pollution due to dust and / or vehicle emissions? | ✓ | | The process of bioremediation may cause dust emission from process and vehicle movement which shall be managed using effective mitigative measures |
| *14* | Will the project cause or increase pollution due to GHG emissions? | ✓ | | Chances of GHG emissions due to un-stabilised waste. |
| *15* | Will the project cause or increase odor nuisance? | ✓ | | The process of bioremediation may cause odour which shall be managed using effective mitigation measures |
| *16* | Is there a potential for release of toxic gases or accident risks (eg: potential fire outbreaks) | ✓ | | Chances of GHG emissions due to un-stabilised waste. |
| *17* | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | ✓ | | Project activity stage (during the process of bioremediation due to vehicular movements& working of machineries). |

| *Sl. No* | *Impacts on Water Environment* | *Yes* | *No* | *Details/Remarks* |
|---|---|---|---|---|
| *18* | Will the activities proposed at the site(s) impact water quality (surface or ground) – leachate, runoff, wastes deposition, erosion? | | ✓ | The proposed remediation will only enhance the groundwater/surface water quality in the long term. |
| *19* | Will the activities proposed at the site(s) impact water resource availability and use - leachate, runoff, wastes deposition, erosion? | | ✓ | The proposed remediation will only enhance the groundwater/surface water quality in the long term. |
| *20* | Chances of Pollution of Water bodies/groundwater wells, nearby or downstream | | ✓ | Open well is about 10m away. Hence, proper leachate treatment and waste disposal is necessary |
| *21* | Will the activities proposed at the site(s) hinder natural drainage | | ✓ | No, the proposed remediation activity does not hinder natural drainage. |
| *22* | Will the activities proposed at the site(s) decrease permeability/rainwater percolation | | ✓ | No impacts to the permeability/rainwater percolation of site |

| *Sl. No* | *Impacts on Biodiversity and Host Communities* | *Yes* | *No* | *Details/Remarks* |
|---|---|---|---|---|
| *23* | Will the project necessitates cutting of Trees / Loss of Vegetation | | ✓ | Cutting of trees is not required. |
| *24* | Will the project necessitate substantial removal of Top Soil (mention area in sqm) | | ✓ | Presence of solid waste, no topsoil.<br>Excavation of legacy waste – |

| *Sl. No* | *Impacts on Biodiversity and Host Communities* | *Yes* | *No* | *Details/Remarks* |
|---|---|---|---|---|
| | | | | 22896.86 cum |
| *25* | Any degradation of land / eco-systems expected due to the project? | | ✔ | The process of bio-mining ensures that there will be no degradation of the land. |
| *26* | Will the project result in Health & Safety Risks in the neighborhood including the release of toxic gases, leachate, accident risks | | | Residential areas, and open wells etc. are very near to the project site. Proper leachate treatment is necessary to avoid any future risk. |
| *28* | Potential Noise, Light Pollution/movements causing disturbance to nearby habitats/communities | ✔ | | Residential area, school, open well etc. are very near to the project site |
| *29* | Potential disruption to common property, accessibility, traffic disruptions, conflicts, or disruption to the local community within the subproject area? | ✔ | | St. Joseph Cottolengo Church 180 m,<br>Residential units -about 10m. no operation will not take place in night time. |

**Enclosures:**

| General view of waste deposit | Constructions |
|---|---|
|  |  |

**KML map of Dump site**

| Map (from google) |
|---|
|  |

## *Project Categorisation and Need for Safeguards Instruments, Oversight*

| *Project Category* | □ *E1* □ ✓*E2* □ *E3* |
|---|---|
| **Key Reasons (for categorisation)** | During screening, it has found that the proposed subproject is moderately causing impact to the base line environment, land/ soil / water /noise environment, biodiversity or to the community. Site is not close to any Environmental Sensitive Receptor. Moreover, Project results positive impacts on Environment. The Environmental Baseline analysis reveals that dumpsite not having any Heavy metal contamination. Hence it is categorized as E2. |
| **Safeguards Instruments Required** | a) E1: Project-specific EIA (impact assessment considering the project details & location) by Independent Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>b) E2: Project-specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>**c)** E3: signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities |
| **Additional Responsibilities Expected** (such as i) Specialists to be hired for Physical/Cultural resources, Natural Habitats/others, etc for EIA preparation, and/or supervision), ii) Consultations, iii) any other aspect | |

| *Status* | *Agency / Official* | *Name, Signature with Date and Seal* |
|---|---|---|
| **Prepared by** | PIU or ULB (project in-charge) | |
| | Environmental Engineer | |
| **Checked, Categorised as ___ (E1, E2, E3) & ToR issued by:** | DESDU / SESDU | |
| | Environmental Specialist | |

# ANNEXURE II: FIRE RISK ASSESSMENT

## Objectives

The important elements of fire risk Management planning can be classified as:

- Identifying the disaster potential scenarios and advance planning to combat and minimize the damage.
- Vulnerable zone delineation.
- Assessment of loss probability and its severity.
- To deal with such emergencies expeditiously.
- •. Warning, protective actions like evacuation of personnel.
- To contain the disaster by isolating the area, firefighting etc.
- To make efforts to return to normal condition when the situation is controlled.

*Table 8.4 Causes of Fire and Risk*

| Ignition (heat) sources | Fuel Sources | Oxygen Sources |
|---|---|---|
| Lit cigarettes/ butts, matches, lighters<br>Improperly stored batteries<br>Bushfire<br>Self-heating piles<br>Hot loads/contaminated waste<br>Hot work operations<br>Arson<br>Lightning<br>Fires from neighbouring activities<br>Faulty electrical wires | Flammable liquids, gases and solids<br>Combustible goods and waste (e.g. CRWM[1])<br>Contamination in CRWM storage<br>Dry and unmanaged vegetation | Oxidising chemicals such as oxy-acetylene sets, bleach, hydrogen peroxide, nitrates<br>Physical introduction of oxygen through unbaling or turning of loose piles |

## Fire Prevention & Management Plan

It is a strategy well evolved, organized and rehearsed to contain the adverse effects of a possible disaster. It aims to mobilize the internal resources and use these with minimal dependence on external agencies for the following purposes:

To control and contain incidents.

- To safeguard employees and people in the vicinity.

- To inform employees, the general public and the authorities about the hazards/risks assessed, safeguards provided, residual risk, if any, and the role to be played by them in the event of disaster.
- To effect rescue and treatment of casualties.
- To prevent recurrence of such a disaster.
- To establish machinery for review, rectification/modification of the emergency
- To ensure safety of workers before personnel re-enter and resume work.
- To work out a plan with all provisions to handle and to provide for emergency preparedness and the periodic rehearsal of the plan.

## Pre-Disaster Stage

The prevention of disaster is of vital importance and is the moral responsibility of each and every individual employed in the dumpsite site. It can be prevented by observance of precautionary and preventive measures. During pre-disaster stage following points will be followed to avert the occurrence of disaster:

The emergency operation procedures of the dumpsite site will be written down so that no confusion is caused in the event of an emergency taking place.

- To reduce the probabilities of accidental leakage of methane.
- Smoking will be prohibited in the areas where handling of dumpsite will be done. NO SMOKING boards will be prominently displayed in Local Language ie Malayalam and English languages.
- All electrical wiring, fittings, cables, equipment will be checked periodically. Temporary wiring will not be permitted to be installed inside the dumpsite area. No inflammable material including papers, Oils, wooden racks will be stored within 1 meter of any electrical fittings. No unauthorized person will be allowed to tamper with electrical fittings.
- Welding, Burning, cutting, Chipping, Soldering work, etc will only be carried out by authorized persons.
- Necessary compliance with various Statutory Guidelines and other relevant instructions as issued from time to time will be done.
- The Safety Department will arrange to educate all concerned regarding operational hazards of non-compliance of the safety guidelines. They will also provide necessary

guidance and support in proper implementation of the program. They will also arrange mock exercises periodically.

- The Safety Department will display important telephone numbers and instructions, in Mizo & English languages. The Security Control Room located at the dumpsite site will be equipped with the following –
- Sufficient number of copies of On-Site Disaster/Emergency Management Plan.
- Master plan of the dumpsite site indicating vital locations and possible sources of disaster.
- Important Telephone numbers
- Emergency lights (portable) and Wireless sets if required and possible).
- First Aid boxes
- Stretchers, blankets and other essential items at the fire station under the charge of Fire Services Dep't

## Disaster Stage

The most probable disaster which may occur at the dumpsite site is because of accidental leakage and fire. To control leakage and fire the following measures/precautions will be taken at the dumpsite site:

The guidelines as given below for the protection of fire will be followed:

- The dumpsite's fire protection will consist of structural solutions, fire extinguishing systems and fire alarm systems. The fire extinguishing system will consist of the fire system with fire pumps, distribution pipelines, hydrants and fire hoses and the portable extinguishers.
- The fire alarm system will be a part of the primary systems and take care of the places which are unmanned or will not have any fixed fire extinguishing system.
- The major operation areas shall be equipped with fixed smoke detectors, CO2 extinguishers near the door in the control room.
- All the rooms in the office shall be equipped with fixed smoke detectors.
- The ventilation rooms shall be equipped with fixed smoke detectors. One CO2 extinguisher will be located near the door to the ventilation room.
- The fire alarm and detection system shall be designed, installed, maintained and tested according to relevant standards.
- The water for firefighting shall be stored in the fire water tank (water reservoir).

- $CO_2$ fire extinguishers contain extinguishing carbon dioxide which either by it or under expected conditions of use gives off $CO_2$ to prevent fire.
- Dry fire extinguishers contain an extinguishing medium which either by itself or under expected conditions of use will give fine powder to prevent fire to get oxygen.
- As soon as a fire takes place inside the premises of dumpsite, action to be taken by various persons/officials

## Post Disaster Stage

After the incident a report will be prepared regarding occurrence of event/losses incurred and recommendations thereof for restoration of normalcy

## Reporting of Accidents

Situation in totality will be studied thoroughly, investigated with respect to the cause of the incident, extent of loss of life and property and a detailed report prepared by the individual/team nominated by dumpsite site authorities for this purpose. Based on the investigation report, rescue team would finalize time bound programmes for implementation of corrective measures proposed and regularly monitor the progress thereafter. Rescue, medical and welfare operations would be continued by the concerned agencies.

## Conclusion:

Removing the current legacy waste at the dump site via bio-mining will be extremely useful to the residents of the area. This can also eliminate the threat of summer fires and protect water supplies from contamination caused by excess leachate during the wet season. This will undoubtedly improve the quality of life for local communities while avoiding health problems caused by pollution. It is planned to conduct an awareness class for all these neighboring institutions and houses on the process of bio mining.

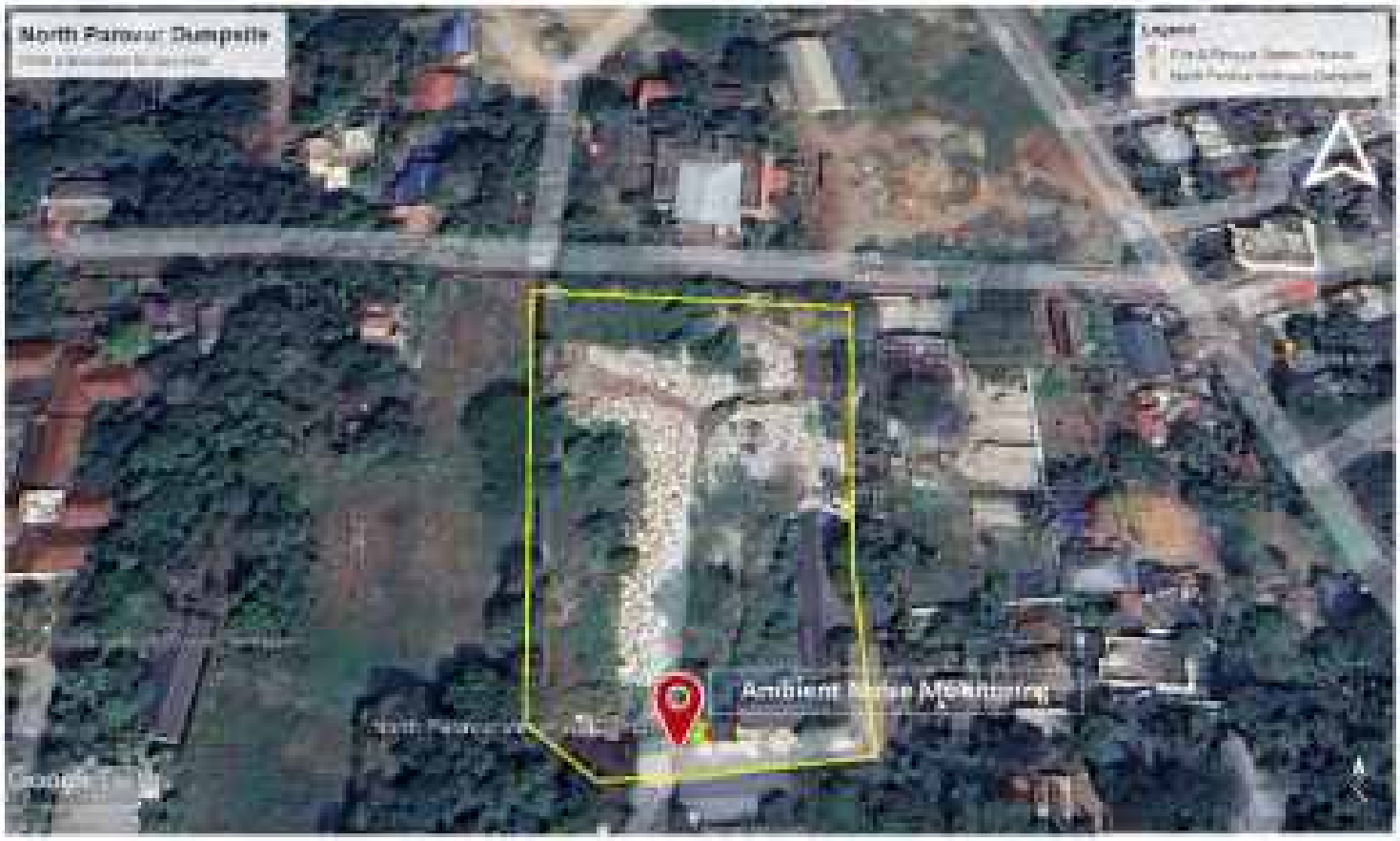


*Figure 8.2 Vedimara Dumpsite*

## ANNEXURE – III: MAP SHOWING BASELINE MONITORING LOCATIONS OF VEDIMARA DUMPSITE




Google Image Depicting the AAQ, Surface water, Ground water and Leachate Monitoring Locations at Vedimara Dump Site




Google Image Depicting the Noise Monitoring Locations at Vedimara Dump Site

KSWMP

FEASIBILITY REPORT

# DUMPSITE BIOMINING AND BIOREMEDIATION, NORTH PARAVUR MUNICIPALITY




November 2023

KSWMP | LSGD | LSGD

State Project Management Unit
Kerala Solid Waste Management Project (KSWMP)

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## Executive Summary

North Paravur is a Municipality located in the western part of Ernakulam district. The primary environmental issue currently faced by municipal authorities revolves around a longstanding existing legacy waste dumpsite. Despite discontinuing the dumping activities, these dumpsites remain as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Consequently, these sites pose significant environmental, social, and economic challenges for the communities and ecosystems surrounding them. The SWM Rules 2016 directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the project for the remediation of legacy waste dumpsites in all the ULBs of Kerala. As part of the project, in phase I the existing dumpsite at North Paravur, Ward No. 10, Vedimara was proposed for remediation.

The North Paravur Municipality has an area of 9.02 sq.km with 29 wards. The municipality, with the financial and technical support of KSWMP, has proposed to remediate the existing legacy waste dumpsite located in around 1.5 acres of land in Ward No. 10, Vedimara and to recover land for future developmental activities. The Vedimara dumpsite was used for dumping municipal solid waste from the year 1985 to 2018. The dumping of solid waste was stopped once the ULB level windrow compost plant was set up. Considering the impending threat of fire hazards and leachate issues, the Municipal Council has proposed the remediation of legacy dumpsite as a priority and to utilize the remediated land for setting up other solid waste management facilities. Since the cessation of dumping activities in 2018, only sweeping waste from towns and streets were dumped at the facility daily and has now been discontinued.

The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes. To assess the quantity & composition of legacy waste & also evaluate the environmental baseline of the dumpsite, samples from representative locations were collected and analyzed for various parameters viz., physical and chemical analysis of Legacy waste, Soil, Air, Noise, leachate, Groundwater and Surface Water. As part of the study, detailed site investigations were carried out for; – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical and Environmental Analysis by M/s Poluchem laboratories.

From the results of the investigations, the total estimated quantity of legacy waste is around 23332.83 Cum. (Above GL 11860 Cum and Below GL 11472.83Cum)

As per the SWM Rules 2016, selection of an applicable method/type or technique for dumpsite remediation needs to be arrived from the Feasibility study carried out, and based on the detailed assessment of different parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by-products as per the requirements of the utilization/forward linkage. Based on the detailed assessment of the selection parameters, stationary trommel screening

machineries shall be optimum for processing the legacy waste within the stipulated timeline of 31st March 2024.

The project attracts E2 Environmental category based on the project activities and status of the environment baseline. The project attracts moderate social risks based on the social mapping, transect walk and consultation with the people living around the proposed project site to assess the problems associated with the legacy waste dumpsite and the impact during the execution of the project.

The activities of bio-mining will commence from Oct 2023 and are expected to end by March 2024. An area of 1.25 acres will be reclaimed and will be utilized for setting up other solid waste management facilities. Total cost of the project is [redacted]

## 1.0 Introduction

The issue of municipal solid waste management in Urban India has become one of the foremost concerns during the last couple of decades.

The primary environmental issue currently faced by the municipal authorities in Kerala revolves around a longstanding existing legacy waste dumpsite. It has a long history of more than three decades of continuous dumping of both bio- and non- biodegradable wastes. Though the waste dumping activity has been stopped, the dumpsite remains as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Improper management of such sites pose significant environmental, social, and economic challenges for the communities and ecosystems in the vicinity.

In view of the environmental and social issues connected with dumpsites, the SWM Rules 2016, directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the remediation projects of legacy waste dumpsites in all the ULBs. As part of the project, in phase -1, the existing dumpsite of North Paravur ULB was proposed for remediation.

For arriving at a methodology for remediating the legacy waste in the dumpsites, as per the Project Implementation Manual, a feasibility study outlining the technical, economic, and socio- environmental factors has been carried out. As a result of the feasibility study that involved detailed field investigations & assessment, and market sounding, the method proposed for remediation of legacy waste dumpsite is biomining, which will ensure long-term sustainability and environmentally sound treatment, which is found technically feasible, economically viable, and socially acceptable. The details of various steps involved in the feasibility study are described in the following sections.

## 2.0 General Description about the Project

North Paravur is experiencing the issues of treatment and disposal of Municipal Solid Waste. The entire common solid waste facilities of the North Paravur Municipality is located within 2.4 acres of land (10.150518N ,76.242212E). The legacy dumpsite is also located within this common solid waste processing facility. This is the only dumpsite present in the ULB.

This waste dumpsite at North Paravur needs to be remediated scientifically and the land is to be reclaimed for productive use. This feasibility report outlines the status including the environmental and social aspects. The feasibility report also examines various remediation options and suggests the most feasible option for the given context for the purpose of availing for the closure of the dumpsite by North Paravur Municipality.

## 3.0 Profile of ULB- North Paravur Municipality

### 3.1 Location

North Paravur Municipality is located at latitude 10.150518N ,76.242212E and is located on the northern part of the district as shown in **Figure 3.1**. Total geographical area of North Paravur Municipality is 9.02 sq.km with 29 wards.

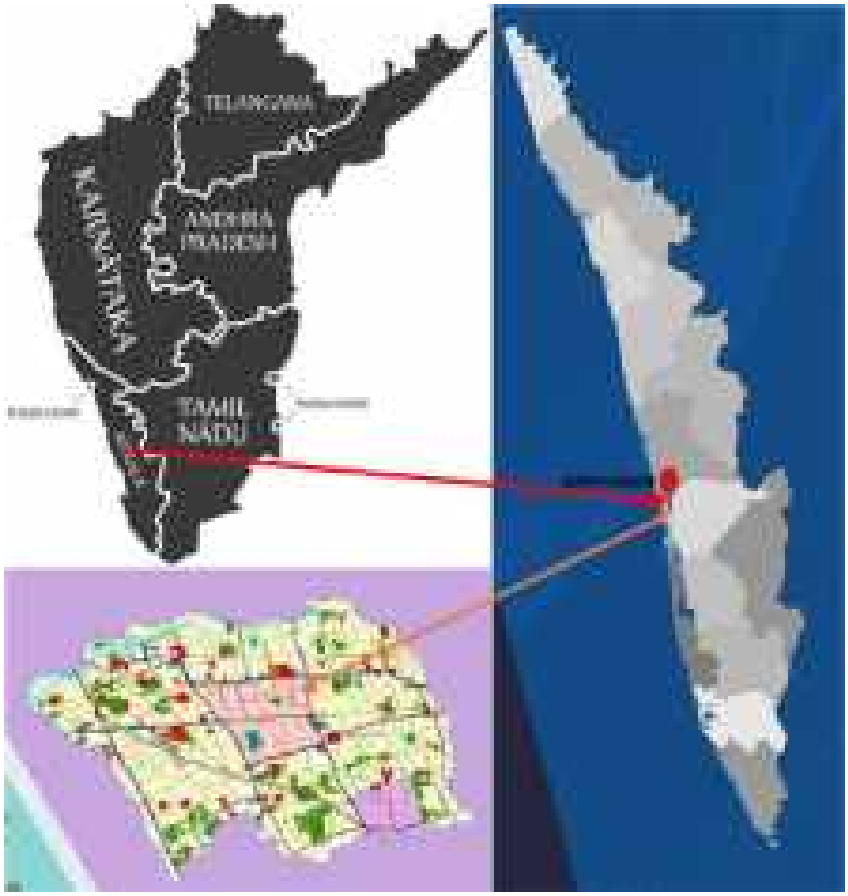



**Figure 3.1 Location Map of North Paravur ULB**

### 3.2 Demographic & Socio-Economic Status

The North Paravur municipality has a total population of 31,503 of which 15,060 are males while 16,443 are females as per report released by Census of India 2011 indicating a Female Sex Ratio is of 1,092 against state average of 1,084. The overall literacy rate of North Paravur Town is 96.8 %. The ULBs portrays a literacy rate higher than state average of 94.00 %. The workforce participation details of Kothamangalam ULB is presented in Table below;

*Source; Census Data 2011*

**Table 3.1 Workforce Participation Details, North Paravur**

| Category | Total | Male | Female |
|---|---|---|---|
| Main Workers | 9139 | 9139 | 9139 |
| Cultivators | 6924 | 6924 | 6924 |
| Agriculture Labourer | 2215 | 2215 | 2215 |
| Household Industries | 22 | 22 | 22 |
| Other Workers | 19 | 19 | 19 |
| Marginal Workers | 3 | 3 | 3 |
| Non-Working | 28 | 28 | 28 |

*Source: Census of India 2011*

## 3.3 Connectivity

North Paravur is an emerging suburb of Kochi City which is nearly 22 km from the city centre and 16 km from city. in Ernakulam district in Kerala. The city and its adjourning villages are famous for its legacy in ancient Chera Empire, being the erstwhile capital city.

The nearest railway station. Aluva railway station is located 14.66 kms from the town centre. which is second largest railway station in Ernakulam. And nearest airport is Cochin International airport located 19.88 kms away from the town. The town is well connected by water way network which brings a wide opportunity of inland navigation.

## 3.4 Climatic Condition

All parts of Ernakulam district including North Paravur have a wet monsoon type of climate. Entire district experiences heavy rainfall during the southwest monsoon season followed by northeast monsoon. During the other months the rainfall is considerably less. March, April and May are the hottest months. December to February are the coldest months. The overall meteorological condition of Ernakulam District is presented in Table 3.2

**Table 3.2 Meteorological Condition of Ernakulam District**

| Meteorological Parameter | Details |
|---|---|
| Temperature | The mean monthly maximum temperature ranges from 28.1 to 31.4°C and the minimum ranges from 23.2 to 26 °C. The maximum temperature occurs during March and April months and the minimum temperature occurs during December and January months. |

| | |
|---|---|
| Relative Humidity | The humidity ranges from 68 to 89% during morning hours and 64 to 87% during evening hours. The maximum humidity is observed during May to October months. |
| Evaporation | Evaporation is more during summer months of January to April and it is low during the rainy months May to August. The maximum rate of 4.8 mm per day is recorded in March and the lowest rate of 2.6 mm is recorded during July |
| Wind | The wind speed ranges from 6.7 to 10.9 km/hour with mean speed of 9.1 km/hour. The wind speed is high during the period from March to September |

**Source: Groundwater Information Booklet of Ernakulam District published by Central Ground Water Board**

## 3.5 Ground Water Level

The vicinity of the project area has few households. From monitoring wells dispersed across the state, the depth to water level is observed in the months of April, August, November, and January. According to information published by the CGWB, the Government of India, the water level in North Paravur fluctuates from 0.8 to 0.82 MBGL.

## 3.6 Land use

The land use map of the Paravur Municipality and the neighbouring Panchayats is shown:

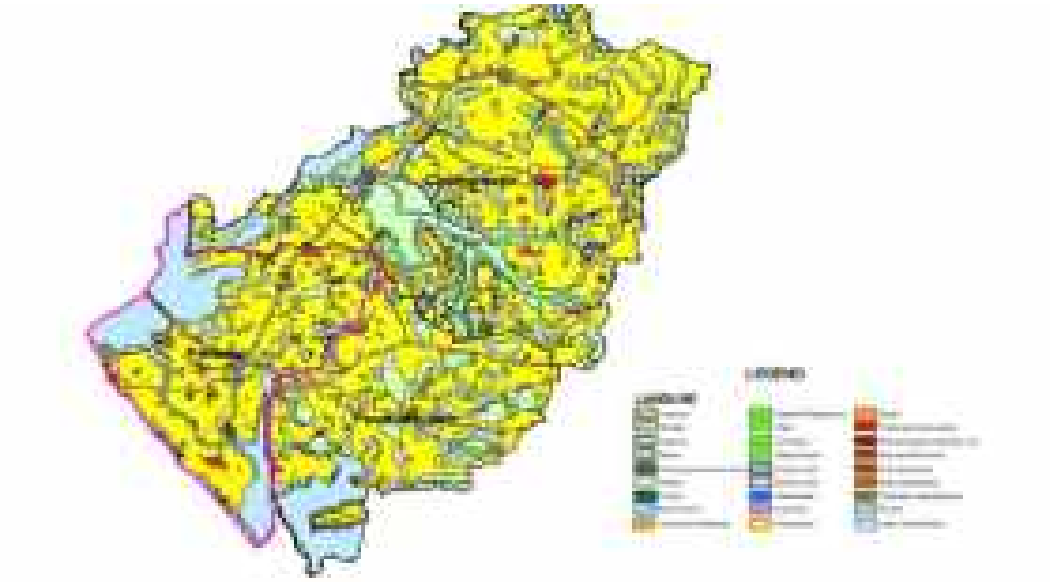


**Figure 3.2 Existing Landuse Map of North Paravur Municipality prepared by Town and country Planning department 2021**

From the above map it can be concluded that the predominant land use of North Paravur Municipality is Residential with 56% of the total geographical area. The area under water body comes second, with 23.8% of the total geographical area. The two back waters of Paravur, the T.S.Canal & Ponds within Municipal area constitute the water body area. The agricultural area in percentage of total geogrpahical area comes about 13.33%, which is in third position after land uses like residential and waterbody.

*Source: Development Plan North Paravur 2021, prepared by Town and country Planning*

## 4.0 Detailed Description of the Dumpsite

Vedimara facility, the main processing unit for solid waste for the municipality is a dumping yard, due to the malfunctioning of the system. A part of the bio-waste brought is been processed through windrow composting or vermicomposting. There are facilities for non-degradable wastes, but waste is found dumped everywhere as forward linkage is not proper.

## 4.1 Physical Feature of the Site

North Paravur dumpsite is located approximately 2.2 km from the centre of the town in western side and encompasses an area of approximately 1.25 acres of land. The dumps site is not very far from human settlement. The coordinates of the dumpsite are 10.151089"N & 76.242185"E. It is located in Ward No. 10 of the municipality. North Paravur municipality holds the ownership of the dumpsite. The dumpsite is surrounded by houses from north-western directions. In South-eastern direction, Majid Noor. North-eastern side of the dumpsite is Panikkarachan temple. West, cottelengo church is present. The Periyar river sub stream flows North-eastern side of the dump site within the distance of 300 m.

The exact date for start of the dumpsite was not available with municipality; however approximately it had started in the year of 1985, the information has been gathered during field visit. Presently, almost 60 % of the area is covered with solid waste. The dumping has been irregular with no proper liner system.



**Figure 4.1 Photographs of North Paravur Dumpsite**

**Table 4.1 Salient Features of North Paravur Dump Site during Site Visit**

| Particulars | Details |
|---|---|
| Name of Dumpsite | North Paravur dumpsite |
| Location of Dumpsite | Ward No. 10 of the municipality |
| Co-ordinates of Dumpsite | Latitude: - 10.151089°N<br>Longitude: - 76.242185°E |
| Distance from the central part of the town | 2.2 km |
| Area of dumpsite | 1.25 Acres |
| Average height of dumpsite | Above the Ground level 2.33 m & 6.75 m below the Ground Level |
| Ownership of dumpsite land | Municipality |
| Distance from nearby features- residential, school, offices, temples, institutions, industry etc.) | There are a Residential and other structures within 25 metres from the site |
| Start date of dumpsite | 2001 |
| Utilities on site | Electricity connection is available |
| Details of manpower and vehicles available in dumpsite | 46 HKS & 6 Vehicles |
| Site demarcated | Site is currently demarcated with boundary wall. |
| Details of weighbridge available at dumpsite | No weighbridge at site |
| Road width | 2.7 |
| Plant adjacent to dumpsite details | Vermicompost, Windrow compost |

## 4.2 Information On Site Management

This section describes the current management of the dumpsite in terms of agency responsibility, profile of workers and numbers, nature of work the labour force in engaged in, Waste pickers and other category of workers at the site.

**Agency responsible for current management of the dumpsite:** Currently, the dumpsite is closed and non-functional. A MCF existing nearby the Municipality, which is at Pallithazham is functioning on a temporary basis . About 46 HKS workers are engaged for collection of Waste. The MCF is being handled by 30 Workers from Clean Kerala company Limited who segregate the dry waste.

**Profile of workers and numbers:** About 46 HKS workers are engaged for collection of Waste. The MCF is being handled by 30 Workers from Clean Kerala company Limited who segregate the dry waste.

**Nature of work the labour force in engaged:** HKS workers are involved for collection and CKCL workers are engaged in Segregation of dry Waste.

**Waste pickers and other category of workers at the Site:** The waste is segregated with help of contract labourers. Recovered materials is collected by the Clean Kerala Company. Non recovered materials will be put in the dumpsite.

### 4.3 Relevance in local or regional SWM plans

The ULB is planning to utilise the reclaimed dumpsite land for the construction of a state of art Material Recovery Facility. The non-biodegradable waste from the ULB shall be brought to this facility and material collection facilities and processed for further use. The project may be funded under the KSWMP project.

### 4.4 Litigation status of the Site

The NGT has established norms and guidelines for addressing legacy waste (O.A No 606/2018), which refers to accumulated waste at dumpsites that have been in operations for an extended period. These norms aim to mitigate the environmental and health hazards associated with such waste.

## 5.0 Scope of Work

Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at North Paravur includes the following steps.

- Conducting detailed field investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical, and Environmental Baseline Analysis by M/s Poluchem Laboratories.
- Assessment & Analysis of detailed investigation report submitted by the Laboratories.
- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.

- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the By-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation optimum land recovery – Biomining, Capping partially Biomining & Capping), Methods/Technologies (Stationary & Mobile-compact), Implementation mode, Forward linkages (Utilization/Management of By-products) and Environmental & Social categorization as per the ESMF developed for projects envisaged under KSWMP.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Delineation of baseline assessment, impact & risk assessment, mitigations measures, Environmental Management & monitoring plan, budget for EMP, EMOP, institutional responsibilities for implementing monitoring and reporting
- Social Safeguards - Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.
- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport,
- Environmental and social monitoring costs, Revenue from the project, Funding for project
- Project Implementation plan –contractual models and timelines.

### 5.1 Objectives:

- Maximum reclamation of the area and by eliminating the chances of dump fires, leachate generation, and foul odor.
- To reduce greenhouse gas emissions, soil pollution, and groundwater contamination.
- To increase nearby real estate/social value and benefit the citizens.

## 6 Detailed Investigation Strategy

### 6.1 Investigation Strategy

To understand the nature and composition of the legacy waste and the existing baseline environmental conditions, samples from waste, surface and groundwater, leachate, soil, air, and noise were collected as per the requirements given in the Project Implementation Manual, considering the state and national guidelines. Samples were collected as mentioned below;

- Bore hole upto a depth of 10 m and collection of 3 (nos) samples from the soil at interval of 1.5 m.

- Waste analysis viz., leachate sample from 1 (no) locations and physical analysis from 2 (nos) locations, and chemical analysis from 1 (no) location.
- Environmental baseline analysis surface water 1 (nos) location and ground water samples from 3 (nos) locations (Well Water Samples -1 up gradient, 2 down gradient) and Air sampling from 2 (nos) locations and noise sampling from 1 (nos) location

## 6.2 Investigation Plan

The detailed investigations carried out for the legacy waste dumpsite is given in the table below:

| S.no | Parameters | Sampling Nos |
|---|---|---|
| 1 | **Geotechnical Investigation** | |
| A | Bore Holes up to 10m depth(1No. /2 Hectare) (as per CPHEEO) | 1 |
| B | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, Strength compressibility (vertically-3 samples per borehole). | 1 |
| 2 | **Waste & Environmental Analysis** | |
| A | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammoniacal nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | 1 |
| B | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | 2 |
| C | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium(N-P-K), Total carbon, C/N ratio, calorific value, Biochemical and Biodegradable factor. | 1 |
| D | Ground water (well water samples-1 up gradient, 2 down gradient)- (shallow and deep wells) Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, E Coli and Total coliform (IS 10500-2012). | 3 |
| E | Surface water (pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, E Coli and Total coliforms (IS 10500-2012). | 1 |
| F | Ambient Air Quality (Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3). | 2 |

| S.no | Parameters | Sampling Nos |
|---|---|---|
| | Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | |
| G | Ambient Noise level [E(P)] for 24 hours. | 1 |

## 6.3 Sampling Methodology

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat/Long) were considered. The following table shows the strategic location details of samples selected for the detailed investigation.

**Table 6.1 Detailed Investigation Plan Executed for Waste Dumpsite at North Paravur**

| S.No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 1 | Air sampling (2 Locations) | Sulphur dioxide SO2, Nitrogen Dioxide NO2, Particulate Matters 2.5, Particulate Matters 10, Ozone, Lead Pb, Carbon Monoxide (Co), Ammonia (NH3), Benzene(C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | Within the Dumpsite<br>Dumpsite boundary | The AAQ locations were chosen based on the Windrose data.Two Ambient Air quality monitoring stations were installed within 100 metre distance from the dumpsite in upwind and downwind direction |
| 2 | Noise (1 Location) | Ambient Noise level [E(P)] for 24 hours | Entrance of the dumpsite | Most vulnerable point in the site in regards of Noise quality is due to entry and exit of the waste loading and unloading vehicles. |
| 3 | Surface water (1 Location) | pH, colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, Heavy metals (such as (Pb, Cd, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness, Ecoli and Total coliforms (IS 10500-2012). | Adjacent thodu in 200 m aerial distance | Adjacent thodu sampling was considered.No alternative surface water sources were identified during sampling. |

| S.No | Description | Parameters Tested | Sampling location | Justification |
|---|---|---|---|---|
| 4 | Ground water (3 Locations) | Ph, colour, EC, Turbidity, SS, TDS, TOC, COD, Heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total coliform (IS 10500-2012). | Well water of nearby nearest house in 200 aerial distance | Nearest ground water source in downstream direction |
| 5 | Bore Hole(1 location) | Permeability test-1No/2 hectares (as per CPHEEO Manual) standard penetration test SPT and collection of UDS-Soil investigation – classification, gradation, Atterberg limit, Bulk density, Dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coeff of permeability, Strength compressibility (vertically-3 samples per borehole). | Centre of the dumpsite | Volume of legacy wastes were found to be higher in the centre part of the dumpsite during investigation. So, the bore hole test was performed in the centre. |
| 6 | Waste Analysis | Leachate Analysis (TCLP USEPA 1311) (schedule II of SWM,2016), Suspended solids, Dissolved solids(inorganic) Ph, Ammoniacal nitrogen (asN), TKN (as N), BOD, COD, Arsenic (as As), Mercury, Lead, cadmium, copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds. | Within the dumpsite | The legacy waste was found to be older and no access to all points. Hence sampling location were chosen also based on the accessibility. |
| | | Physical Analysis of waste (As per CPHEEO Manual) including Density, Bulk Density, Moisture content, size of waste constituents. | | |
| | | Chemical Analysis of waste soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium(N-P-K), Total carbon, C/N ratio, calorific value, Bio-chemical and Biodegradable factor | | |

For the borehole investigation, the samples were collected by rotary drilling a 150mm bore hole using a fast rig attached to a drag bit. The soil drillings are removed by a circulating bentonite slurry which also aids in keeping the side walls stable. An SPT sampler was driven in to collect the representative samples, which is carefully packed in double walled polythene bags, sealed, and sent to laboratory for testing. Standard penetration tests were conducted on soil at every 1.5m depth and the number of blows to achieve 300mm penetration were noted. Fractions recovered from the mining of legacy waste should be tested, especially for the presence of toxic metals and organic contaminants.

The total quantity of waste present in the waste dump is calculated based on the topographic study executed by ULB (towards calculating quantum of waste above ground level) and the results of borehole investigation (towards calculating the quantum of waste below ground level).

## 6.4 Analysis and Interpretation of Exploratory Data

The baseline condition of the waste dumpsite at North Paravur, has been assessed through the geotechnical investigation and Waste & Environmental baseline assessment executed through M/s Matter Material Testing & Research Laboratory (P) Ltd and M/s Polluchem Laboratories (P) Ltd respectively. The results of Topographical survey conducted in the year 2022 also considered for the analysis. The signed reports of all analysis are enclosed as Annexures as detailed below;

Annexure 1 – Topographical survey report

Annexure 2 –Geotechnical Survey report

Annexure 3- Waste Characterization study report

Annexure 4 - Waste & Environmental baseline assessment reports

The initial site visit was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd on 23rd May 2023. 2023 along with the experts of TSC and PIUs. Field Geotechnical investigation to collect the soil samples after drilling through the legacy waste was started on 10th June 2023 and was completed on 11th June 2023. Positioning of Air samplers & Noise monitoring equipment, sampling of surface/groundwater, leachate, and legacy waste were done on 25th May2023 by M/s Polluchem Laboratories (P) Ltd.

### 6.4.1 Topographic Survey Results

Topographic survey was conducted by ULB itself in the year 2023 towards assessing the quantum of the waste present in the dumpsite above the ground level. The Topographical survey report is presented in **Annexure 1**. The inference of the Topographical survey is as follows;

- Topographical Survey Map shows Approximate 1.25acres of land used for waste dumping.
- Maximum height of waste dump above soil is 2.33 m
- Estimated waste volume above GL is 11,860 cum which will constitute 9488 T of waste (density of waste is 0.8 T/cum as per the characterization study results presented in subsequent sections)

### 6.4.2 Geotechnical Exploratory Details

The geotechnical investigation at the dumpsite at North Paravur, Ernakulam district was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was drilled through the waste into the ground using a rotary drilling method. The maximum depth of investigation was 12 m (6.75 in waste after that 5.25 m soil). SPT and collection of undisturbed soil samples were carried out at regular intervals within the ground. Various laboratory tests were carried out on the SPT and undisturbed soil samples. The full geotechnical report is appended as **Annexure** 2. The major inference of the geotechnical investigations are as follows;

- In the borehole investigation it was asserted that the depth of waste column below ground level is 6.75m

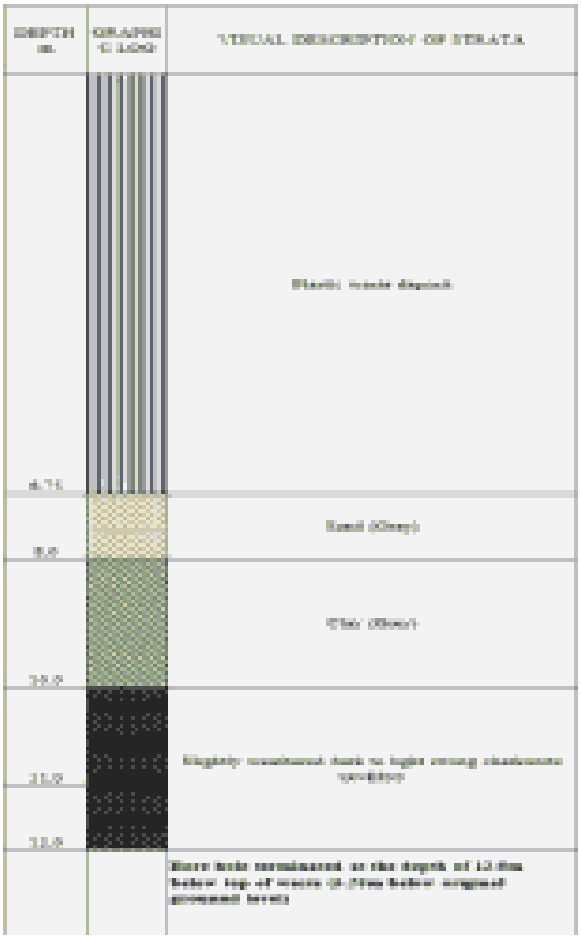


**Figure 6.1 Borehole Strata Obtained for North Paravur Dumpsite**

- The soil exhibited a plasticity index is 15. The base soil has a plasticity index greater than 10 and the clay and silt fractions account to more than 40%, which makes it a good soil for the subbase.
- The clay fraction is 26%.
- The pre-consolidation pressure is b 145 KPa.
- The permeability value is 1.28 E-05.
- The Cation Exchange Capacity (CEC) of the soil is 14.6 meq/100gm

### 6.4.3 Estimated Total Quantity of Waste

The total quantity of waste is estimated based on the contour/topography survey profile of the waste over the ground level and exploratory data of the bore log (Geotechnical investigations). As detailed under section 6.4.1 the estimated quantity of the waste above the ground level is **11,860 Cum**.

Quantity of waste below the ground level is estimated as **11,472.84 Cum**. The quantity of waste below ground level may vary as per actual site conditions.

Thus the total legacy waste present in the North Paravur dumpsite is calculated as below;

**Table 6.2 Total Waste Quantification for North Paravur Dumpsite**

| Sl no | Name of Dumpsite | Quantity of Waste present above the Ground level | Quantity of Waste present below the Ground level | Total quantity of legacy waste to be managed |
|---|---|---|---|---|
| 1 | North Paravur | 11,860 Cum | 11472.84 Cum | 23,332.84 Cum |
| | | 9,488 T | 9178.27 T | 18666.27 T |

### 6.4.4 Legacy Waste Characterization

The characteristics of the legacy waste were assessed by collecting a 15kg sample. The legacy waste samples were collected on 10/06/2023 by M/s Matters lab (P) Ltd. The assessment of waste characteristics. was done based on the results of the analysis. The details of the physical characteristics are provided in the tables below: The detailed legacy waste characterisation reports are enclosed as **Annexure 3**

**Table 6.3 Grain Size Analysis of Legacy Waste (total weight of sample taken 15 kg)**

| Sieve Size (mm) | Percentage Retained |
|---|---|
| 80 | 0 |
| 37.5 | 16 |
| 10 | 41.5 |
| 4 | 21.1 |
| Pan | 21.4 |

**Table 6.4 Characterisation of Waste Material Retained in Each Sieve**

| Test/ Parameters | Waste Material Retained on each sieve in % | | |
|---|---|---|---|
| | 37.5 mm | 10mm | 4mm |
| Plastic Waste | 9.6 | 2.5 | 0 |
| Cloth | 1.4 | 0 | 0 |
| Glass | 0 | 0.2 | 0 |
| Wood | 3 | 18.4 | 0 |
| C&D | 0 | 0 | 0 |
| Bio Fraction | 0 | 0 | 0 |
| Gravel | 86 | 78.6 | 100 |
| Metal | 0 | 0.3 | 0 |

**Table 6.5 By Product Composition**

| Particular | Percentage of Composition (%) |
|---|---|
| RDF | 11.04 |
| Inert | 67.56 |
| Compost Soil Enricher | 21.40 |

**Table 6.6 Physical Characteristics of Waste**

| Sl no | Parameter | Test Method | Unit | Value |
|---|---|---|---|---|
| 1 | Moisture@105°C | ASTM D 2216 | % | 12.4 |
| 2 | Bulk Density | USEPA | kg/m3 | 0.8974 |
| 3 | Density | USEPA | g/cm3 | 904 |

**Table 6.7 Chemical Analysis**

| Sl No | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | .. | 7.98 |
| 02 | Biodegradable Factor | USEPA | % | 2.4 |
| 03 | Total carbon | USEPA 9060A | % | 3.4 |
| 04 | Phosphorus(P) | USEPA | % | 0.031 |
| 05 | Nitrogen(N) | USEPA | % | 0.18 |
| 07 | Potassium(K) | USEPA | % | 0.045 |
| 08 | C/N Ratio | USEPA | .. | 18.8:1 |

*Note : The average Nitrogen, Phosphorus and Potassium (NPK) content in the legacy waste samples picked from the site is 0.18, 0.031, 0.045, respectively by weight. This is far lower than 0.8, 0.4 and 0.8 as specified by the Fertilizer Control Order (FCO) 1985 for city compost and hence cannot be used as compost. The carbon: nitrogen ratio is 18.8:1 which is much lesser than the specified standard. This could be due to the materials being exposed to sun and air over the years or that the carbon content may have leached into the ground through leachate during the rainy season. Another possible contributor to the reduced carbon levels could be multiple fire incidents at the site. Although the material has very less carbon content, the NPK value can be enriched by adding additives like poultry litter. The enriched material can be given to farmers or used for horticulture purposes.*

### 6.4.5. Soil Conditions of the Dumpsite

As it is an unlined dumpsite, there is a probability of finding traces of contaminant from waste and leachate in the underlying soil. Since it is an uncontrolled disposal site, the mixed waste contains different types of pollutants which may eventually have an impact on the soil. Results of soil analysis of the samples taken from the borehole in the Vedimara dumpsite is as shown below:

**Table 6.8: Chemical analysis of soil extracted from borehole at North Paravur dumpsite**

| Sl. No | Parameter | Result | US (NY State-Codes, rules and regulations) Industrial Use |
|---|---|---|---|
| 1 | Cadmium (Cd) mg/Kg | <5.0 | 60 |
| 2 | Chromium (Cr) mg/Kg | 115.8 | 800 (Hexavalent) 6800 (Trivalent) |
| 3 | Copper (Cu) mg/Kg | 55.9 | 10000 |
| 4 | Nickel (Ni) mg/Kg | 48.9 | 10000 |
| 5 | Lead (Pb) mg/Kg | 33.9 | 3900 |
| 6 | Zinc (Zn) mg/Kg | 386.3 | 10000 |
| 7 | Mercury (Hg) mg/Kg | <0.1 | 5.7 |
| 8 | Arsenic (As) mg/Kg | 7.0 | 16 |

While comparing results of the report with the US Industrial Use benchmark, it is observed that the values are within the SLB values. Bioremediation may be carried out to reduce traces of heavy metals in soil and for site clearance. Though the concentration of Cadmium makes the land unsuitable for residential use, industrial land use may be promoted. The location may be used as a site for the SWM facilities like Material Collection and Resource Recovery Facility. However, the solution may be considered after proper soil and groundwater investigation post dump-clearing stage.

### 6.4.6 Leachate Characterization and Quantification

There is no leachate collection/management system in the dumpsite. To address the concern of contamination of the groundwater and soil due to uncontrolled dumping, leachate samples are picked for analysis. The data is presented in **Annexure 4**. The data indicates that the TDS is about 23000mg/l while the suspended solids is about 864mg/l. The chlorides are high at 12535

mg/l, while the COD, BOD are 88000mg/l and 20000mg/l respectively. The heavy metals are found to be low, hence the soil is unlikely to be contaminated by heavy metals from waste.

**Table 6.9 Leachate characteristics at North Paravur Dumpsite**

| Parameters tested | Test method | Results |
|---|---|---|
| Sampling Location | N-9 °59'23.582" E -76°33'51.031 | |
| pH | IS 3025 (P) 11 –1983RA2017 | 4.77 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 16900 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 540 mg/l |
| Chloride as Cl- | IS 3025 (P) 32 – 1988RA2014 | 6267.5 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 76000 mg/l |
| B O D (3 days at 27O C) | IS 3025 (P) 44 – 1993 RA 2014 | 43000 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 3540 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 1406.7 mg/l |
| Phenolic Compound asC6H5OH | IS 3025 (P) 43-1992 RA2014 | 16.84 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 2.56 mg/l |
| Cyanide as CN- | IS 3025(P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 3.54 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 2.6 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

*BDL- Below Detection Level, MDL- Minimum Detection Level*

All the heavy metals are significantly low or below detectable limits. The heavy metals are found to be low, hence the soil is unlikely to be contaminated by heavy metals from waste.

### 6.4.7 Environmental Baseline

The environmental baseline was assessed from the analytical results of air, surface & groundwater, noise and leachate. The samples by M/s Polluchem Laboratories (P) Ltd. The Environmental baseline was analyzed with reference to the lab analysis reports. The details of analysis & inferences are provided in the ESIA Section in **Annexure 5**

### 6.4.8 Risk Assessment

**Surface Water:** Dumpsites can release pollutants into nearby surface water bodies through leachate, which is generated when rainwater or other liquids come into contact with the waste. Leachate can contain various contaminants such as heavy metals, organic compounds, and

pathogens. Proper containment and management of leachate are essential to prevent water pollution.

The analysis of surface water reveals that all the parameters are within the acceptable limit and the dissolved oxygen content is less than prescribed limit, so also the BOD is greater than the allowable limit, indicating that the water contains organic load.

**Table 6.10 Risk Assessment- surface water**

| **Risk Assessment** | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite -BOD Higher than the acceptable limits |
| **Pathway** | Water/Run off |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | High BOD Indicates the water is highly polluted and it is harmful to the ecosystem as fish and other aquatic life may suffocate in oxygen-depleted waters. Also it will contain more Pathogen and make the water unfit for human and animal |

**Ground Water**: Pollutants from dumpsite can infiltrate into underlying groundwater, particularly if the dumpsite is not adequately lined or if waste disposal practices have caused contamination of the soil. Once pollutants enter the groundwater, they can spread over a wide area, affecting drinking water sources. Remediation techniques often focus on preventing or minimizing further groundwater contamination.

The analysis of ground water samples taken at one location reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The pH of the sample analysis is 5.61, which is in a slightly acidic range which can make the water not fit for any industrial purpose as it is more corrosive.

**Table 6.11 Risk Assessment - Ground water**

| **Risk Assessment** | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite - pH is acidic in nature |
| **Pathway** | Water ,soil |
| **Receptor** | Humsn, Animals, Aquatic life and flora fauna |
| **Risk** | Possible risk to human health are;<br>• Diarrhea<br>• Nausea and Vomiting |

| | |
|---|---|
| | • Abdominal Pain<br>• Weakness<br>Possible risk to flora<br>It can decrease the availability of plant nutrients, such as phosphorus and molybdenum, and increases the availability of some elements to toxic levels, particularly aluminium and manganese. |

**Air**: Dumpsites may emit pollutants into the air through processes such as open burning of waste or the release of gases from decomposing organic materials. Airborne pollutants can include particulate matter, volatile organic compounds (VOCs), dioxins, and other hazardous substances. These pollutants can have adverse effects on air quality and human health. Measures to control and mitigate air pollution during dumpsite remediation include covering waste, implementing proper waste management practices viz., dust containment screens, etc. to be ensure

**Table 6.12 Risk Assessment - Air**

| **Risk Assessment** | |
|---|---|
| **Source** | Legacy waste Dumpsite |
| **Pollutant** | Within the limits |
| **Pathway** | Air |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | No Anticipated risk |

**Soil**: Dumpsites can contaminate the surrounding soil with a wide range of pollutants. Hazardous chemicals, heavy metals, and organic compounds can leach from the waste and accumulate in the soil, potentially posing risks to plants, animals, and humans.

**Table 6.13 Risk Assessment - Soil**

| **Risk Assessment** | |
|---|---|
| **source** | Legacy waste Dumpsite |
| **Pollutant** | Heavy metals |
| **Pathway** | soil |
| **Receptor** | Human, Animals, Aquatic life and flora fauna |
| **Risk** | Possible risk to human health: Soil that contains substances such as heavy metals which may be toxic to humans can pass those substances on to humans through crop uptake leading to unsafe foods. |

| | |
|---|---|
| | Possible risks to animals: when farm animals consume the plant grown from contaminated soil it affected the health of animal<br>Possible risk to flora: Soil pollution may after plant metabolism and reduce crop yield, also the trees and plants that absorb the soil contaminants enter into the food chain |

**Bioaccumulation in Biota**: Pollutants from dumpsites can enter the food chain and bioaccumulate in plants and animals. As pollutants move up the food chain, their concentrations can increase, leading to potential health risks for humans and wildlife. Remediation efforts include restoring the land and minimizing the exposure of organisms to contaminated environments.

**Table 6.14 Risk Assessment - Bioaccumulation in Biota**

| **Risk Assessment** | |
|---|---|
| source | Legacy waste Dumpsite |
| Pollutant | Leachate and heavy metals |
| Pathway | Air,water and soil |
| Receptor | Human, Animals, flora and fauna |
| Risk | Possible risks to human health, animal flora and fauna<br>Accumulated of contaminants in plants and animals indirectly through food chain affects human health |

## 7. Evaluation of Remediation Techniques

Reclamation of existing unmanaged municipal waste dumpsites is becoming a key requirement for ULB's in India as unscientific and unplanned methods of waste disposal in non-engineered landfills have led to lot of environmental issues including soil and ground water contamination, uncontrolled landfill gas emissions into the atmosphere and exposure to disease vectors and scavengers. The Hon'ble NGT seized with these problems across the country has ordered that the respective authorities to remedy this at the earliest.

The dumpsites have emerged as pollution hubs, especially those situated in human settlements, as cities have grown over the decades. It has, therefore, become a necessity for the city authorities to remediate the existing dumpsites in an environmentally sound and economically viable manner.

Remediation of waste dumpsite is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

- Environment Enhancement - reduction in greenhouse gas emissions, soil pollution, groundwater contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.
- Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in nearby real state value and rental values.
- Land - Dumpsite land becomes available for utilizing the same for the establishment of other Waste Management Facilities.
- Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled, or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels

For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- A total station survey for assessment of volumetric quantity of legacy waste above the ground level.
- Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- History of the site, Physical features of site, as –is/current situation and compositional analysis of waste.
- Baseline study of heavy metals; subsurface soils and water; rainfall; soil type; surface hydrology; topography; wind direction etc. Shall be studied prior to bioremediation
- Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area.

Alternative analysis for the various dumpsite remediation options are detailed in following section.

## 7.1 Bio-Mining – Reclamation/Recovery of Land

Bio- mining is the scientific technique to extract materials of economic interest from legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) and followed by sustainable management through recycling, co-processing, road construction etc.




| | |
|---|---|
| Salient Features | • Land recovery, increase in value of land and available for public use/habitation with immediate effect.<br>• Ensures long-term sustainability and environmentally sound treatment of legacy waste and present lucrative revenue-generating opportunities.<br>• Bio products/aggregates generated from the process can be used as alternative construction material, fuel and recyclables.<br>• Compliance to SWM Rules and NGT orders.<br>• Improvement in aesthetics and quality of life & health. |
| Applicability | • The ownership is well defined.<br>• Working space is available in the dumpsite.<br>• Linkage for utilization by-products is available |

## 7.2 Capping Without Land Recovery

Capping is a scientific process of profiling legacy waste and covering with barrier layers consisting of soil, high density polyethylene (HDPE) liner, gas collection system surface drainage system, and a vegetative cover to minimize the percolation of rainwater into the legacy waste.

| | |
|---|---|
| Salient Features | • The capped area becomes a green space and can be developed into parks/recreational areas.<br>• Capped area will be equipped with environmental monitoring systems for post-closure maintenance to monitor |

| | |
|---|---|
| | pollution levels in groundwater and surface-water sources and air (especially methane emissions) at least 15 years<br>• Capped area needs to be inspected periodically for settlement due to physical, chemical and biological transformation, leachate generation, erosion and naturally occurring invasion by deep- rooted vegetation.<br>• Recurring expenditure will be incurred for regular maintenance. On July 17, 2019, the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested bio- mining as environmentally safe and the most preferable approaches to dumpsite remediation.<br>• SWM rules do not permit habitation over it for at least 15 years because of the danger posed by toxic gases release by the waste. |
| Applicability | • Simple & robust, least expensive method among various available technologies |

## 7.3 Capping with Partial Land Recovery

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bioremediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can be linked to relevant buyers and the inert material will be capped over lower footprints, with well-designed slopes to prevent further degradation of the environment.

The reclaimed land may be covered with loamy soil that has plants with high transpiration rates. The plants do not permit the ingress of water into the soil thereby reducing the possibility of leachate generation. The plants and soil microbes also behave as oxidation layer. The soil is compacted and maintained with gentle slopes with 1V to 3 H. Contour drains may be provided to divert the water away from the soil thereby preventing ponding of water. The reclaimed land may be covered with solar panels to generate renewable energy during the period of observation following the post closure.

| | |
|---|---|
| Salient Features | • The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.<br>• Ensures short -term sustainability and environmentally sound treatment of legacy waste. |

| | |
|---|---|
| Applicability | • Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area<br>• Legacy waste dumpsite area partial of steep terrain, inaccessible ravines and narrow valleys.<br>• Lack of linkage for disposal of inert<br>• Recovery land for public use is not a priority |

## 7.4 Selection of Remediation Option

Selection of the applicable method/type or technique is based on the factors like., salient aspects & applicability of remediation types viz., Capping without land recovery, Bio-mining – reclamation/recovery of land & capping with partial land recovery and also available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for land recovery and forward linkages/utilization of processed aggregates/by-products.

Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. Moreover, as per Solid Waste Management Rules, 2016 and several National Green Tribunal (NGT) directives have mandated that urban local bodies opt for bio-mining over capping

However, after the bioremediation municipality wants to use the land for setting up of Material Collection Facility and Resource Recovery Facility. Hence backfilling of the site with boulders and inert are planned.

For the execution of dumpsite bio-mining two strategies can be adopted;

- *Insitu biomining*: Here the biomining is carried out within the premises of the dumpsite after clearing the waste and reaching the original ground level or in a land adjoining the dumpsite. The advantage is that only the finished products are moved out of the premises, inerts may be used for gradation and filling up low lying areas within the site, or in a newly developed sanitary landfill. This is quite economical when legacy waste quantities are significant. The possibility of gaseous emissions, noise and odor and formation of leachate exist as the processing takes place at the site. The location would remain affected for the time till all waste are processed.
- *Ex Situ biomining:* In small dumpsites, or where the area is a constraint, the entire waste is excavated and taken away to an alternate location for processing. The work in the dumpsite can be completed quickly and the disturbance due to the excavation can be minimized. The cost of transportation of the whole waste adds to the cost of bio mining. But since the process plant can serve multiple locations, economies of scale may be achieved and may also compensate for the added transport cost.

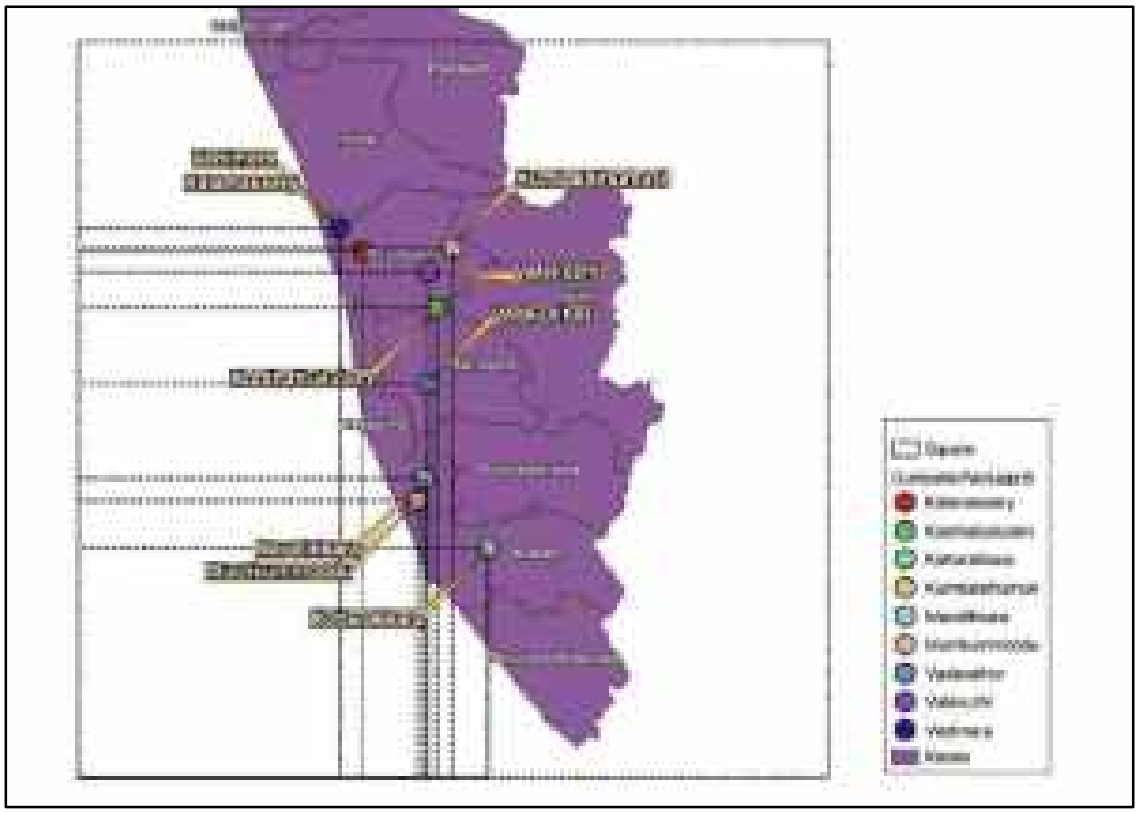


**Figure 7.1 Location of Other Dumpsites nearby**

## 8.0 Technical Description of the Selected Option

### 8.1 Methodology

The legacy waste dumpsite reclamation through bio-mining with recovery of land involves

Phase 1: stabilization

Phase 2: sorting & segregation

Phase 3: disposal & utilization

Phase 4: Back filling of boulders and inerts

### 8.2 Selection of Machineries

The type of machinery, capacity and type of screens to stabilize the legacy waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) will depend on the physical site conditions including quantity & characteristics of legacy waste and utilization of the aggregates/by-products/recovered material.

The type of machinery available for the bio mining are as follows:

- Stationary screening machinery and
- Mobile/compact machinery

### 8.2.1 Stationary Screening Machinery

A Stationary trommel is a specialized piece of equipment used in legacy waste bioremediation processes to separate and classify solid waste materials. It is designed to efficiently screen and sort different components of the waste based on size and other characteristics. Technical description of a Stationary Trommel used in legacy waste bioremediation are as follows:

- Structure: The Stationary trommel consists of a frame made of steel or other durable materials. It is designed to withstand the harsh conditions of waste treatment facilities. The frame supports a cylindrical drum that is inclined at an angle for optimal material flow.
- Drum: The drum is the main component of the Stationary Trommel and is typically made of perforated metal or mesh. It is cylindrical in shape and rotates on its axis using a motorized drive system. The drum's 3- 5 mtr diameter and 10 mtr length can vary depending on the specific requirements of the waste treatment process.
- Motor and Drive System: The Stationary Trommel is equipped with a motor and drive system that powers the rotation of the drum. The motor is typically electrically powered and is connected to the drum through a gearbox or direct drive mechanism. The rotational speed of the drum can be adjusted to optimize the screening process
- Inlet and Outlet: The Stationary Trommel has an inlet where the legacy waste is fed into the drum for processing. The waste material enters the drum at one end, typically assisted by a conveyor or loader. The screened waste material is discharged from the opposite end of the drum through an outlet.
- Screening Mechanism: As the drum rotates, the legacy waste inside it is subjected to a combination of tumbling and rolling actions. The perforated drum allows smaller-sized particles and materials to pass through, while larger items such as bulky waste, debris, and contaminants are retained inside the drum. The drum's perforation size can be customized to achieve the desired separation efficiency.
- Waste Sorting: The Stationary Trommel facilitates the separation of different components within the legacy waste. It effectively segregates organic waste, inert materials, recyclables, and other categories based on their size and physical properties. This sorting process prepares the waste for further treatment or disposal.

### 8.2.2 Mobile/Compact Screening Machinery

The Mobile Trommel is a technical apparatus utilized in legacy waste bioremediation processes. Its primary function is to separate and sort various types of waste materials, such as solid waste and organic matter, for effective bioremediation

***Structure***: The trommel consists of a cylindrical drum, typically made of heavy-duty metal, which is inclined at a slight angle. The drum is supported by a framework and set in motion by a motor or engine, causing it to rotate slowly. The rotation of the drum allows the waste materials to be fed into the trommel at one end, while simultaneously moving the materials along its length. Large screening area (9.5 sq m). Helps in good quality segregation & high productivity

***Screening Mechanism***: The Mobile Trommel incorporates various mechanical features to facilitate waste separation. As the waste enters the drum, it encounters a series of screens or perforations arranged along the length of the drum. These screens have different mesh sizes, which allow for the separation of different-sized particles. The smaller particles, such as sand or fine soil, pass through the screens and fall through openings at the bottom of the trommel, while larger materials, such as plastics or larger debris, are retained and carried along by the rotation of the drum.

***Separation System***: Additionally, the Mobile Trommel may be equipped with paddles or lifters mounted inside the drum. These paddles help to agitate and tumble the waste materials, assisting in the separation process by ensuring proper contact between the waste and the screens. They also help to break up clumps or aggregates, aiding in the release of trapped organic matter. Four different screen inclination angles for operations between 20°-35° are available for selection provides flexibility.

***Treatment Process***: In the context of legacy waste bioremediation, the Mobile Trommel plays a crucial role in preparing the waste for subsequent treatment steps. By separating the waste into different fractions based on particle size, it allows for targeted bioremediation processes. For example, the fine fraction may be subjected to aerobic or anaerobic composting, while the larger fraction can undergo mechanical or physical treatments.

***Transport***: Quick and easy folding of conveyor helps in quick setup time.

***Discharge height***: Wider conveyor and higher discharge heights help in making bigger stockpile and eliminates the frequent loader usages

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by- products as per the requirements of the utilization/forward linkage.

Based on the detailed assessment of the selection parameters listed above, the site conditions, legacy waste characteristics, statutory requirements etc, stationary trammel machine shall be the optimum screening machinery

## 8.3 System Requirements

The following are the infrastructural facilities required for setting up of machineries and equipment in biomining of a dumpsite: These are required irrespective of the option of in-situ or ex-situ processing.

- Fencing and secure entrance gate
- Security and reception office
- Weighing bridge
- Records room
- Laboratory
- Medical room
- Workers' area
- Parking for vehicles (heavy earth equipment, trucks, etc.) with tire washing facility.
- Administrative building
- Fire control unit (detailed methodology for fire management plan)
- Toilet–bath complex, with personnel protection equipment (PPE) storage room)
- Overhead water tank
- Leachate collection and treatment unit
- Environmental monitoring unit
- Segregation and processing area
- Temporary storage area for rejects, domestic hazardous waste and sanitary waste
- Material storage area
- Waste drying and windrow area.
- DG set

The total area required is about 900 sqm in an in situ biomining plant. The process shed needs to be covered building. Temporary construction power at 440V needs to be obtained from KSEB. This can be easily availed as there is an existing electrical infrastructure passing through the site. A 440V, 125KVA needs to be established for the project. Water storage tanks needs to be provided for the duration of the project. The water may be supplied by tankers. Labour will reside in North Paravur and commute daily to the site, hence no labopur sheds are envisaged during this project. The requirements are only indicative, and the contractor is required to propose own design and capacity to complete the works in the stipulated time and standards.

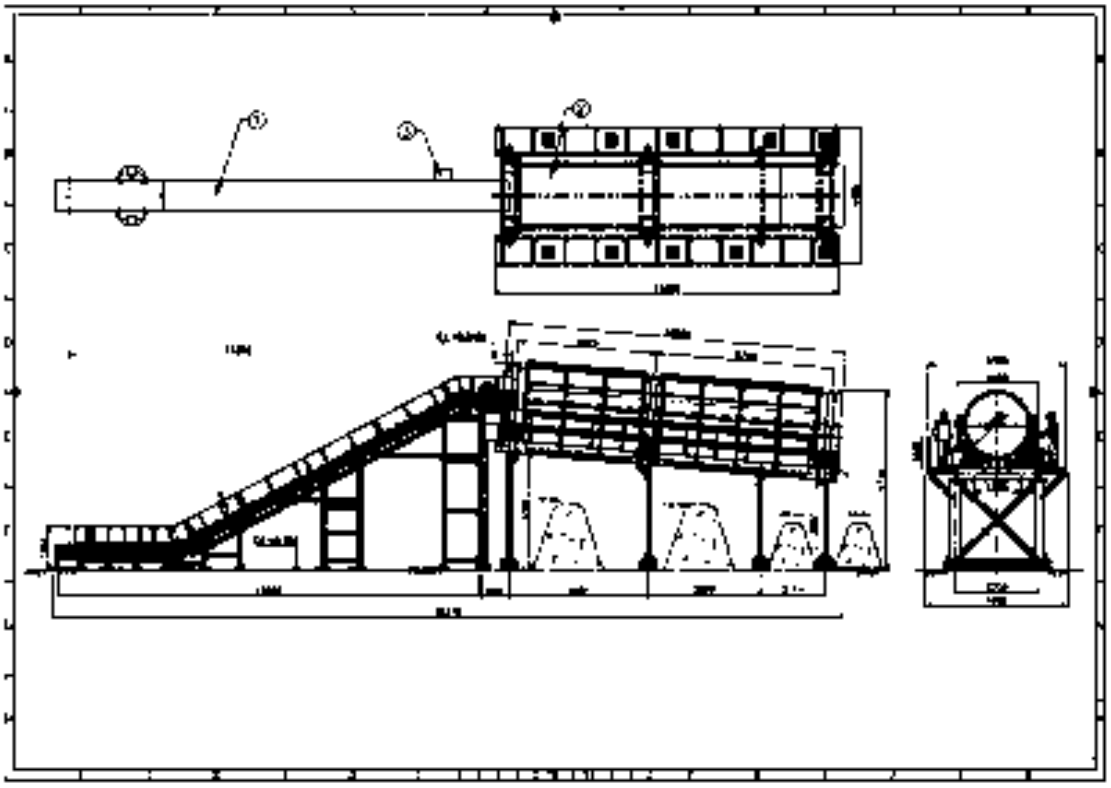


**Figure 8.1 Schematic of the Segregation System**

## 8.4 Site Reclamation Requirement

As detailed under section 6 the North Pravur Dumpsite have waste spread of Approx.1.25 acres of land with a max of waste dump height 2.33 m above the ground level. Estimated volume of waste above the ground level is: 11860 cum which will be around 9488 MT. *(source: Topographical survey result for the North paravur Dumpsite conducted in the year 2022 by ULB)*

In the borehole investigation it was asserted that the depth of the waste column below ground level is 6.75 .m and the quantity of waste below ground level is estimated 11472.84 Cum as detailed under section 6. *(source: Borehole investigation survey conducted by KSWMP through Matter Labs for the North Paravur Dumpsite on June 2023)*

Since the ULB intends to use the land recovered after bioremediation, backfilling of the boulders and inert material obtained after the bio inning is inevitable.

# 9.0 Scope of Disposal Including Location of Disposal for RDF, Bio Soils, C & D Waste, And Others as Per Local Demands

## 9.1 Utilization of By Products

The details of the utilization of aggregates/by–products screened out by processing of the stabilized legacy waste are provided in the table below

**Table 9.1 By Product Composition**

| By-products | Percentage Composition | Quantity (Cum) | Utilization/Linkage/Usage |
|---|---|---|---|
| RDF | 11.04 | 2575.62 | RDF will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel. |
| Inert | 67.56 | 15764.73 | Can be utilized for filling at the site itself |
| Compost Soil Enricher | 21.40 | 4993.49 | Can be used as a soil enricher and given to farmers. The same cannot be sold as fertilizer unless it is enriched with carbon content to meet the standards suggested by FCO for city compost |
| Total | 100 | 23332.84 | |

The **Table 9.1** details the expected recovered items in line with the investigation results present. However, during the execution stage, the bidder is required to analyse each recovered fraction at least every 15 days and report submitted to the concerned authority. It is to be noted that the RFB document should cover necessary clause in this regard.

RDF / SCF consists largely of combustible components which are shredded into a uniform size, in order to produce a homogeneous material which can be used as substitute for fossil fuels in e.g. cement plants, lime plants, coal fired power plants or as reduction agent in steel furnaces. The calorific value of the RDF should be higher than 1500kcal/kg for use in cement plants.

The nearest cement Industry that can accept the RDF from North Paravur City is located near Trichy, TamilNadu at a distance varying between approx 360 kms from the Dumpsite site. The other sites are at Karnataka between 740km to 1074km, while cements plants at Andhra are at 740km to 900kms.

**Table 9.2 Distance to potential RDF / SCF users**

| Name of the cement plant | Location | State | Distance from Kochi (KM) |
|---|---|---|---|
| Dalmia Bharath | Ariyalur | Tamilnadu | 458 |
| Dalmia Bharath | Dalmiapuram | Tamilnadu | 424 |
| ACC | Wadi | Karnataka | 1,075 |
| Chettinad | Karikazhi | Tamilnadu | 315 |
| Chettinad | Kallur | Tamilnadu | 386 |
| Dalmia Bharath | Belagavi | Karnataka | 956 |
| JK | Muddapur | Karnataka | 965 |
| Dalmia Bharath | Kadapa | Karnataka | 739 |
| Bharathi VICAT | Kalburgi | Karnataka | 1,074 |
| JSW | Kurnool | Andhra Pradesh | 901 |

| | | | |
|---|---|---|---|
| Bharathi VICAT | Kadapa | Andhra Pradesh | 739 |
| Ultratech | Tadipatri | Andhra Pradesh | 815 |
| Zuari | Yerraguntla | Andhra Pradesh | 877 |

Based on the chemical analysis the waste material has less than as suggested by the Fertiliser Control Order (FCO). The screened compost materials having size less than 4 mm shall be heaped to form windrows, the leachate from excavation shall be used for enriching the compost qualities to the FCO standards and its amendments from time to time. The materials shall be tested for carbon content and NPK values during execution of works, the materials may be sold to farmers depending on the test outcomes. If the compost materials are not meeting with the standards, the same shall be mixed with good earth sourced from external sources to form uniform mix having a density of minimum 2400 kg/cubic meter and shall be used for refilling within site itself.

Inert is coarse fraction received from the landfill mining of MSW. It is comprising stones, construction debris, ceramics, some decomposed organic matter. This is helpful in backfilling in the site or can be use as a subgrade material for highways, low land filling. It can also be used as cover for landfills.

## 10 Estimated Project Cost

The details of the estimated cost for bio-mining - recovery of land by remediating legacy waste dumpsite is provided in the table below:

**Table 10.1 Details of Estimated Project Cost**

| Sl. No. | Activity | Rate/ m3 | Quantity (m3) | Amount (INR) |
|---|---|---|---|---|
| 1 | **Bio-mining Operations** | | | |
| a | Processing the Waste | [redacted] | [redacted] | [redacted] |
| 2 | **Disposal Cost** | | | |
| a | Disposal of RDF | [redacted] | [redacted] | [redacted] |
| b | Disposal of Compost/ Soil enricher | [redacted] | [redacted] | [redacted] |
| c | Disposal of Inert | [redacted] | [redacted] | [redacted] |
| | Total (1+2) | | | [redacted] |
| | E & S Safeguards from ESIA | | | [redacted] |
| | Contractors Profit and Overheads at 15% | | | [redacted] |
| | Net Cost | | | [redacted] |
| | Average Cost Index for Kerala based on DSR 2018 is ~1.35 at present. Considering the same, the Grand Total | | | [redacted] |
| | Cost per m3 | | | [redacted] |

### 10.1 Revenue from the Project

The anticipated sources of revenue from the processing of the legacy waste dumpsite viz., by sale Bio earth & C&D waste, organic compost, RDF and recyclables. But due to the following reasons mentioned below no revenue from the project is considered

- RDF is utilized as fuel (co – processing) in the cement industries, presently most cement industries are only accepting the RDF at free cost and transportation cost also not borne by the cement industries.
- The uncertainty of quantity and quality of the recyclables from legacy dumpsite due to burnt or crushed or disintegrated, rusted and additional money is required for cleaning of the recyclables for saleable

### 10.2 Funding for Project

The estimated cost of INR [redacted] for the project Dumpsite Remediation. The sources and funding pattern is given below:

**Table 10.2 Sources of funds in Crores**

| Sl no | Item wise funding pattern | | | |
|---|---|---|---|---|
| | Item | External (70%) (INR) | State Govt.(30%) (INR) | Total Cost (INR) |
| 1 | Dumpsite remediation for the North Paravur | [redacted] | [redacted] | [redacted] |

## 11.0 Project Implementation Plan

North Paravur Municipality intends to complete this project as early as possible. However, considering the time required for mobilisation, installation, sieving and handling recoverable etc, a time frame of about 06 months is considered.

### 11.1 Timeline

The broad timeline for the execution of this project is given below.

**Table 11.1 Project Timeline**

| TIMELINE CHART FOR EXECUTION | | | | | | | |
|---|---|---|---|---|---|---|---|
| S. No. | Task Name | M 1 | M 2 | M 3 | M 4 | M 5 | M 6 |
| 1 | Planning & Mobilization | | | | | | |
| 2 | Foundation & Civil Works (Cover Shed installation) for machineries , Hiring & Installation of Machineries, Electrical Works | | | | | | |
| 3 | Excavation of Legacy Waste | | | | | | |
| 4 | Site Development for Windrows & Leachate Collection | | | | | | |
| 5 | Windrow Formation & Spraying of Bio culture | | | | | | |
| 6 | Sieving Operations | | | | | | |
| 7 | Handling Outputs (RDF, Bio-soil, Inert, C&D waste, Recyclables, etc.) | | | | | | |
| 8 | Project Closure Activities:<br>Levelling of Reclaimed Land using Bio-soil<br>Handover the available infrastructure at site to the ULB<br>Closure Report Submission to ULB, | | | | | | |

## 11.2 Contract Model

***Execution Method:***

Design, Own, Operate and disposal/Management of by-products/aggregates with zero residues and maximum land recovery. The work shall be carried out in compliance with SWM Rules 2016 and CPCB Guidelines for the disposal of legacy waste 2019.

***Working Model***

- 100% work to outsourced to selected private contractor
- TSC will assess the quantity of waste and the ULB will hand over the land for setting up the plant to the Contractor.
- Cost of Electricity connection to be provided by ULB for the plant.
- Electricity charges for the usage of the plant to be paid by contractor
- ULB shall facilitate the disposal/Utilization of By-products and contractor is responsibility for disposal of RDF, recyclables and aggregates

## 12 Benefits of the Project

The project benefits of dumpsite remediation at North Paravur are;

- Reclamation of Land: An area of 1.25 acres will be reclaimed which can be used for resetting SWM facilities of ULB
- Environmental Protection: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By cleaning up contaminated sites, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity
- Health Improvement: Remediation projects reduce these risks, leading to improved public health outcomes and a reduction in waterborne and airborne diseases.
- Enhanced Water Quality: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to safe drinking water.
- Aesthetic and Social Benefits: Remediation of legacy waste dumpsite can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents. Uncontrolled waste dumping will be stopped.
- Operational & Life cycle Aspects - Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through a bio-mining process.

## 13. Conclusion

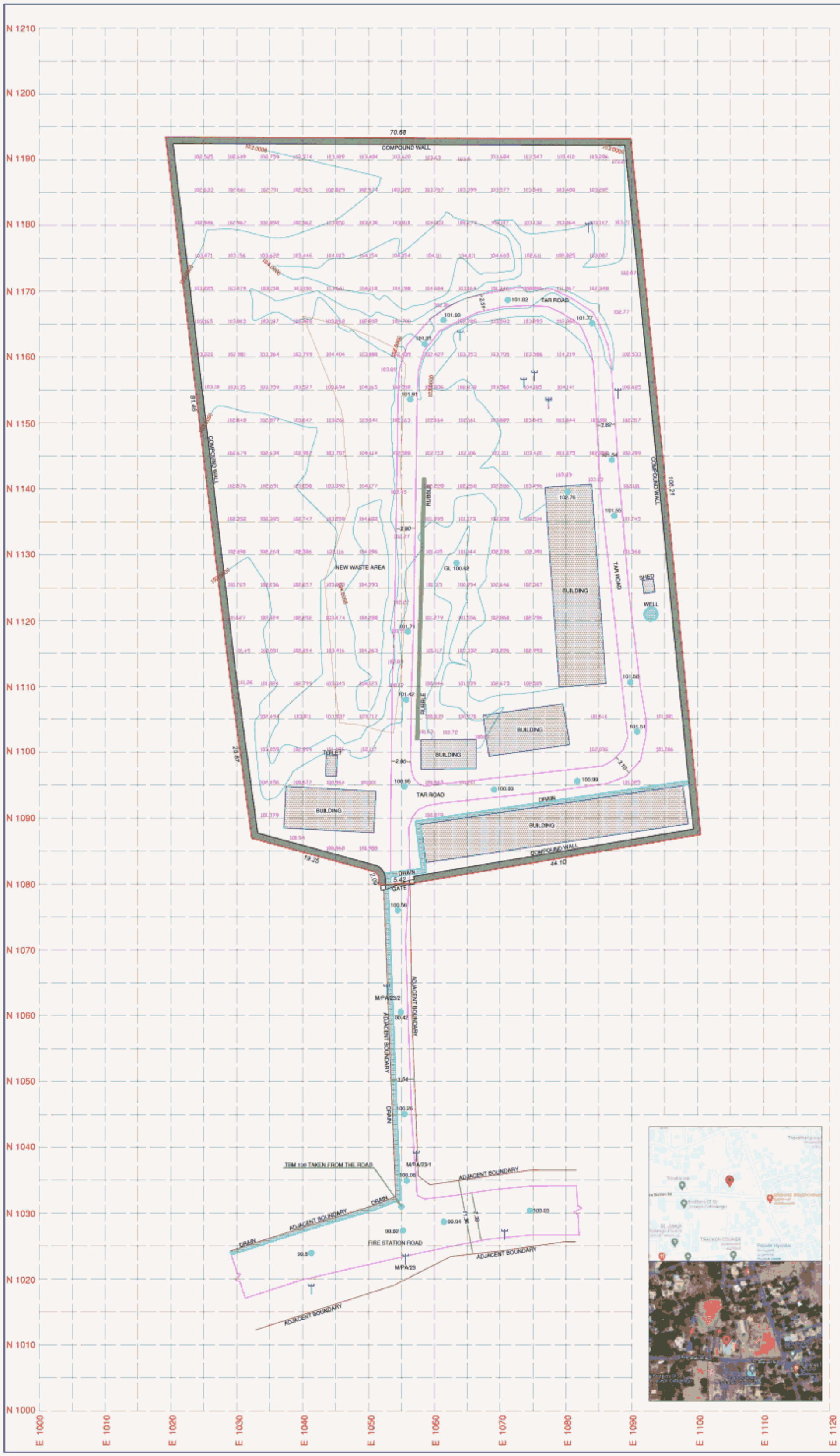
- The activities of the bio-mining will be commenced from December 2023 to Mar 2024. An area of **1.25 acres** will be reclaimed and will be used for setting up other solid waste management facilities in future.
- Optimum of the land will be reclaimed and recovered through the biomining process, and this will by ensuring environmental safeguards.
- For the optimum screening of the **23332.83 m3** of legacy waste, mobile / compact screening machinery shall be used.
- Favourable site conditions for bio-mining:
    - Electrical power infrastructure viz., power lines & electrical transformer is available adjacent to the boundary of the dumpsite.
    - Piped water supply is available at the dumpsite.
- The project activity requires “Site Authorization, Consent to Establish and Consent to Operate” from KSPCB
- The implementation/execution of the project activities shall be conforming to SWM Rules 2016, NGT orders, KSPCB norms, World Bank guidelines and KSWMP ESMF and other regulatory rules & norms Environmental & Social safeguards:

- The project attracts E2 Environmental category based on the project activities and status of the environment baseline.
- Site specific Environmental Assessment and Environmental Management Plan has been developed.
- The project attracts moderate risk social category based on the social mapping & transect walk to understand the settlements/habitations/establishments etc., and consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.

- Total cost of the project is Rs [redacted]

# Annexures

| | |
|---|---|
| Annexure 1 | Topographical Survey Report |
| Annexure 2 | Geotechnical Survey Report |
| Annexure 3 | Waste Characterization Report |
| Annexure 4 | Waste & Environmental baseline assessment reports |
| Annexure 5 | Site Plan |
| Annexure 6 | Operation Plan |
| Annexure 7 | ESIA Report |




SCALE : 1:100
PRINT SCALE :

| | |
|---|---|
| DATE | 12/01/2023 |
| DRAWN | SINSHA |
| CHECKED | PRAKASH |

LEGENDS

ELECTRIC POST

SPOT LEVELS

BOUNDARY
ROAD
BUILDING
WALL
RUBBLE
DRAIN

AREA

CONTOUR INTERVAL - 1 METRE
GRID INTERVAL - 5X5 M

**AREA - 1.89 ACRES**

ALL DIMENSIONS ARE IN METRE

CLIENT

KSWMP
KAKKANAD

ARCHITECTS

SURVEYED BY

AKHILESH
NANDHU
KIRAN
NOEL

TITLE

CONTOUR & TOPO
SURVEY

DRAWING CODE

D.N. : 16638

SITE AT

PARAVOOR

( 10.151668 ° North , 76.242209 ° East )
( N10.151668 , E76.242209 )


SURVEYED BY

Spreads SURVEY

G-171, NR.SHOPPING COMPLEX

PANAMPILLY NAGAR

COCHIN - 682 036

Ph:0484 2323446

Mob: 98954 48367/9895448368

ROOM NO ,49,50 , VYAPARABHAVAN,

BANK ROAD

CALICUT-1 PH:0495-4020804

Mob: 98954 48369

spreadssurvey@gmail.com

# Volume Report

| Sl. No. | Section From | Previous Section | Difference | Width | Cutting Volume | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Area Sq. Meters | Previous Area | Average Sq. Meters | Volume Cubic Meters |
| 1 | 1122305.000 | | 0.000 | 30.000 | 6.954 | 0.000 | 3.477 | 0.000 |
| 2 | 1122310.000 | 1122305.000 | 5.000 | 60.000 | 14.758 | 6.954 | 10.856 | 54.280 |
| 3 | 1122315.000 | 1122310.000 | 5.000 | 60.000 | 21.633 | 14.758 | 18.196 | 90.978 |
| 4 | 1122320.000 | 1122315.000 | 5.000 | 60.000 | 42.514 | 21.633 | 32.074 | 160.368 |
| 5 | 1122325.000 | 1122320.000 | 5.000 | 60.000 | 68.175 | 42.514 | 55.345 | 276.723 |
| 6 | 1122330.000 | 1122325.000 | 5.000 | 60.000 | 91.631 | 68.175 | 79.903 | 399.513 |
| 7 | 1122335.000 | 1122330.000 | 5.000 | 60.000 | 102.202 | 91.631 | 96.917 | 484.583 |
| 8 | 1122340.000 | 1122335.000 | 5.000 | 60.000 | 102.886 | 102.202 | 102.544 | 512.720 |
| 9 | 1122345.000 | 1122340.000 | 5.000 | 60.000 | 103.884 | 102.886 | 103.385 | 516.925 |
| 10 | 1122350.000 | 1122345.000 | 5.000 | 60.000 | 103.479 | 103.884 | 103.682 | 518.408 |
| 11 | 1122355.000 | 1122350.000 | 5.000 | 60.000 | 110.788 | 103.479 | 107.134 | 535.668 |
| 12 | 1122360.000 | 1122355.000 | 5.000 | 60.000 | 132.431 | 110.788 | 121.610 | 608.048 |
| 13 | 1122365.000 | 1122360.000 | 5.000 | 55.000 | 135.867 | 132.431 | 134.149 | 670.745 |
| 14 | 1122370.000 | 1122365.000 | 5.000 | 55.000 | 132.914 | 135.867 | 134.391 | 671.953 |
| 15 | 1122375.000 | 1122370.000 | 5.000 | 55.000 | 155.432 | 132.914 | 144.173 | 720.865 |
| 16 | 1122380.000 | 1122375.000 | 5.000 | 60.000 | 168.778 | 155.432 | 162.105 | 810.525 |
| 17 | 1122385.000 | 1122380.000 | 5.000 | 60.000 | 155.762 | 168.778 | 162.270 | 811.350 |
| 18 | 1122390.000 | 1122385.000 | 5.000 | 60.000 | 173.683 | 155.762 | 164.723 | 823.613 |
| 19 | 1122395.000 | 1122390.000 | 5.000 | 60.000 | 181.700 | 173.683 | 177.692 | 888.458 |
| 20 | 1122400.000 | 1122395.000 | 5.000 | 60.000 | 161.385 | 181.700 | 171.543 | 857.713 |
| 21 | 1122405.000 | 1122400.000 | 5.000 | 60.000 | 148.708 | 161.385 | 155.047 | 775.233 |
| 22 | 1122410.000 | 1122405.000 | 5.000 | 55.000 | 119.960 | 148.708 | 134.334 | 671.670 |
| | | | | Total | | | | 11860.341 |

MatterLab

Report Number: **ML/GT/2885/231/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE B OF KSWMP AT VEDIMARA, NORTH PARAVOOR, ERNAKULAM DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | IPE Global Ltd. |
| Address | : | 2nd Floor, 16/3878-3879, Kavanatt Building, Karuvanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact Person | : | Mr. Ranbir Dey |
| Project No | : | GT-223 |
| Project Name | : | Geotechnical examination of dumpsite under package B of KSWMP at Vedimara, North Paravoor, Ernakulam District. KSWMP |
| Owner | : | Kumbalathumuri, Kothamangalam, Ernakulam District |
| Project Location | : | - |
| Tel / Fax No | : | |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 04-08-2023 | 1st Submission | Dr. Gautham Adapa | |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Dr. Jimmy Thomas | Geotechnical Expert, Consultant, MatterLab | |
| Approved by: | Freddy Soman | General Manager, MatterLab | |

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## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results

# 1 INTRODUCTION

Matter Material Testing and Research Laboratory Pvt. Ltd has been set-up as a result of increased demand locally from various industries for a multidisciplinary testing, materials consultancy & investigation facility in alignment with global standards and technology advancements. MatterLab is an independent professional and technical services provider to all who are concerned with quality and performance of materials & products.

IPE Global Ltd. which provides technical support consultancy services to the Urban local bodies in different municipalities for the Kerala State Waste Management Project (KSWMP) has entrusted the geotechnical investigative works as part of their DPR study for the remediation of dumpsite in Vedimara, North Paravoor, Ernakulam district to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was bored using a rotary drill. The initial site visit was done on 23rd May 2023. During the site visit, it was observed that the dumpsite is situated with people living around the dumpsite. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 10th June 2023 and was completed on 11th June 2023. Standard Penetration test (SPT) was conducted within the borehole as required. Representative and undisturbed soil samples were collected to conduct relevant laboratory tests to acquire the necessary parameters. This report presents results of the geotechnical investigation of the ground encountered after drilling through the waste at the dumpsite.

# 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil samples and performing necessary laboratory tests on the collected samples to obtain the desired parameters of the ground profile.
- Preparation of report with laboratory test results.

# 3 OBSERVATIONS FROM SITE VISIT

Matterlab has deputed a team from our geotechnical department along with Mr. Ajit Kumar Nayan and Mr. Ravi Kumar of IPE Global during the fourth week of May 2023, in order to

collect the information regarding the site prior to mobilizing the equipment for drilling. It was observed that there is habitation situated around the dumpsite at this location. At the point of location of borehole, a 1.0m depth of waste was cleared before drilling.



**Figure 1** : Location of the borehole drilled at the dumpsite.

## 4 GEOTECHNICAL INVESTIGATIONS

### 4.1 Rotary drilling

Rotary drilling technique was adopted for advancing and clearing out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste in the landfill.

### 4.2 Drilling equipment

Mechanical rotary drilling machine was used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The borehole of 150mm diameter was formed using a drag bit (Soil Cutter) in soil. The drag bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by drilling mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

### 4.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as representative samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

**Extraction of Cores:**

The core samples were extracted from the core barrels in a manner to prevent disturbances to the core. All the pieces of cores were sequentially numbered from top to bottom. Arrows indicating the lower end of the piece are marked on each core. Rock classification in terms of weathering and state of fractures and strength is carried out in the following manner. Tabulations given in below explain it briefly.

**Table 1: Rock Classification**

| Terms | Description | Grade |
|---|---|---|
| Fresh | No visible sign of rock material weathering; perhaps slight discoloration on Minor discontinuity surfaces. | I |
| Slightly Weathered | Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discoloured by weathering. | II |
| Moderately Weathered | Less than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as core stones. | III |
| Highly Weathered | More than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as core stones | IV |
| Disintegrated Rock | All rock material is decomposed and / or disintegrated to soil. The original mass structure is still largely intact. | V |
| Residual Soil | All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported. | VI |

-As per IS 4464-1985 (Reaffirmed 2004)

It should be understood that all grades of weathering may not be seen in a given rock mass and that in some cases a particular grade may be present to a very small extent. Distribution of the various weathering grades of rock material in the rock mass may be related to the porosity of the rock material and the presence of open discontinuities of all types in the rock mass.

**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log the commencement and completion date, location of borehole, elevation of top and bottom of boring, ground water table, boundaries of

each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelog is attached as **Appendix-I.**

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant Standard Codes. A summary of laboratory tests carried out is shown below in **Table 2** and the complete results of laboratory testing are presented in **Appendix II**.

**Table 2: Details of various laboratory tests and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 1 | Soil | Grain-Size Analysis | IS: 2720(Part-4)-1985 |
| 2 | | Atterberg's Limit | IS: 2720(Part-5)-1976 |
| 3 | | MDD/OMC(Light Compaction) | IS:2720(Part-7)-1980 |
| 4 | | Direct Shear | IS:2720(part-130-1986 |
| 5 | | Permeability | IS :2720 (Part-17)-1986 |
| 6 | | Bulk Density & Dry Density | BS:1377-(Part-2)-1990 |
| 7 | | Unconfined compressive strength | IS:2720(part-10)-1991(R2015) |
| 8 | | Consolidation | IS:2720(Part-15)-1986 |
| 9 | | Cation Exchange Capacity | USDA No. 16 |
| 10 | Rock | Point Load Test | ISRM suggested Method |
| 11 | | Water Absorption | IS: 1124 - 1974 |
| 12 | | SSD specific gravity | ISRM suggested Method |
| | | Dry specific gravity | |
| 13 | | Rock density | ISRM suggested Method |
| 14 | | Mohrs' Hardness | Using Mohrs' scale |



**Figure 2** : Laboratory tests performed at MatterLab.

## 6 SUMMARY

The geotechnical investigation of the original ground below the waste at the dumpsite at Vedimara, North Paravoor, Ernakulam district was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a single borehole was drilled through the waste into the ground using a rotary drilling method. The maximum depth of investigation was 12.0m (6.75m in waste and 5.25m in the ground). SPT and collection of undisturbed soil samples were carried out at regular intervals within the ground. Various laboratory tests were carried out on the SPT and undisturbed soil samples.

Based on the investigations carried out, it is observed that below the dumped waste, a 1.3m thick sandy layer is present, followed by a 2.0m thick layer of silt with sand which is resting on a highly weathered strong biotite gneiss with an average core recovery of 20% for the depth of cutting of 2.0m. As per the information provided by the client, the waste in the dumpsite needs to be excavated, segregated using a few machinery and the inert material left after the bio-mining needs to be dumped within the site. As informed by the client, during the process of bio-mining the waste would be excavated from one feasible location of the site and transferred to another location of the site. During these operations, any temporary storage waste in the form of heaps should be carried out ensuring the stability of the sloping face of the waste. It is suggested that for slopes with height ≤ 1.5 m the angle of face should not be steeper than 45°. For slopes of height greater than 1.5 m the slope should be limited to 300 to horizontal or flatter. It is not advisable to use slope heights > 5 m without a proper stability analysis. If the inert material is being disposed at the site with no further plans of transporting it or transferring it, it is recommended to compact the material into layers using an 8-10 T roller with compacted lift thickness not exceeding 300 mm.

**The Safe Bearing Capacity (SBC)** is calculated as per IS 6403:1981 (Reaffirmed 2021). For any temporary structures planned at the site, the **recommended allowable bearing pressure** for isolated footings at a minimum depth of 1.0 m below **original ground level** is **50 kPa.** The ground profile consists of a clay layer of 2.0 m thickness underlain by rock. Hence, long term consolidation settlement may be a concern if the original ground is subjected to pressure appreciably greater than it has experienced before. The parameters obtained from the consolidation test of the soil at 2.75 m Appendix II can be used to evaluate the settlements of the ground. For any slope stability calculations involving the natural ground, the parameters presented in the summary sheet of laboratory results can be used.

The above recommendations are made based on the subsoil profile and laboratory test results obtained on the samples collected from the site. If there is any variation in soil profile during execution, fresh recommendation may be obtained from M/s Matter Material Testing & Research Laboratory (P) Ltd. or from a qualified and experienced geotechnical engineer.

# APPENDIX-I

# BORELOGS

Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT** | **: Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor.** | **SHEET NO.** | **: 1 of 1`** | **START DATE** | **: 10/06/2023** |
| **CLIENT** | **: Program Manager IPE Global Ltd .** | **BORE DIAMETER (mm)** | **: 150** | **END DATE** | **: 11/06/2023** |
| **Proposed Structure :** | **Dump site** | **BORING TYPE** | **: Rotary** | **REDUCED LEVEL (m)** | **: -** |
| **LOCATION** | **: Vedimara, North Paravoor, Ernakulam** | **TERMINATION DEPTH (m)** | **: 10.5** | **EASTING (m)** | **: - 76.242066** |
| **BOREHOLE NO.** | **: BH-01** | **WATER LEVEL** | **:** | **NORTHING (m)** | **: - 10.151225** |

| DEPTH m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM N1 | N2 | N3 | SPT N VAL | DEPTH V/S N VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6.75 | | Plastic waste deposit | 6.75 | | | | | | | | |
| 8.0 | | Sand (Grey) | 1.3 | 7.0<br>7.50 | SPT-1<br>UDS-1 | 7 | 9 | 10 | 19 | | <br>Sample slipped |
| 10.0 | | Clay (Grey) | 2.0 | 8.0<br><br>9.0<br>9.50 | UDS-2<br><br>SPT-2<br>UDS-3 | <br><br>2 | <br><br>2 | <br><br>2 | <br><br>4 | | Sample collected<br><br><br>Sample collected |
| 11.0 | | Slightly weathered dark to light strong charkonite GNEISS | 1.0 | 10.0 | SPT-3<br><br>RC-1 | >50 | > | > | >5 | | Rebound, No sample<br>CR 15%<br>RQD NIL |
| 12.0 | | | 1.0 | | RC-2 | | | | | | CR 23%<br>RQD NIL |
| | | **Bore hole terminated at the depth of 12.0m below top of waste (5.25m below original grounnd level)** | | | | | | | | | |

Abbreviations
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
CR- Core Recovery, RQD- Rock Quality Designation

Sd/-
Site Supervisor

# APPENDIX-II

# LABORATORY TEST RESULTS

# SUMMARY OF LABORATORY TEST RESULTS

**Report Number : ML23/R-02008 Report Date:27/06/2023**

**Project : Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor, Ernakulam District**

**Borehole ID : BH-01**

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Where Quality Matters

| N value | MatterLab ref. | Depth (m) | Type of sample (SPT/UDS/RC) | Soil description | IS Classification | Atterberg Limit | | | Grain size distribution | | | | | | | Maximum dry density, gm/cc | Optimum moisture content, % | Bulk Density, gm/cc | Dry Density, gm/cc | Moisture content, % | Cohesion (c), kPa | Internal friction angle, ° | Permeability, cm/s | Unconfined compressive strength, kPa | Consolidation | | | | Rock cores | | | | | | | Chemical |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit,% | Plastic Limit,% | Plastic Index | Coarse Gravel,% | Fine Gravel,% | Coarse Sand,% | Medium Sand,% | Fine Sand,% | Silt,% | Clay,% | | | | | | | | | | | Initial Void ratio | Preconsolidation pressure, kPa | Compression Index, $C_c$ | Recompression Index, $C_r$ | Core recovery (%) | RQD (%) | Point load (MPa) | Water Absorption (%) | Apparent specific gravity, gm/cc | Rock density (kg/m$^3$) | Mohrs Hardness | Cation exchange capacity (meq/100gm) |
| 19 | ML23/W-02008/S1 | 7.0 | SPT | Poorly graded sand with silt | SP-SM | 26 | - | NP | | | 1 | 25 | 67 | 7 | | | | | | | | | | | | | | | | | | | | | | |
| | ML23/W-02008/S2 | 8.0 | UDS | | | | | | | | | | | | | 1.57 | 14 | 1.18 | 1.04 | 14 | | | | 145 | | | | | | | | | | | | |
| 6 | ML23/W-02008/S3 | 9.0 | SPT | Silt of high plasticity with sand | MH | 117 | 57 | 60 | | 11 | 0 | 7 | 16 | 40 | 26 | | | | | | | | | | | | | | | | | | | | 14.6 |
| | ML23/W-02008/S4 | 9.5 | UDS | Sandy clay of intermediate plasticity | CI | 35 | 20 | 15 | | | 1 | 11 | 30 | 25 | 33 | 1.59 | 14 | 1.70 | 1.48 | 15 | 4 | 32 | 1.28 E-05 | | 1.490 | 141 | 0.58 | 0.02 | | | | | | | | |
| | ML23/W-02008/S5 | 10 to 11 | RC | Slightly weathered dark to light strong charkonite gneiss | | | | | | | | | | | | | | | | | | | | | | | | 15 | NIL | 0.1 | 10.3 | 2.55 | 2190 | 2.5 | |
| | ML23/W-02008/S6 | 11 to 12 | RC | | | | | | | | | | | | | | | | | | | | | | | | | 23 | NIL | 0.2 | 9.20 | 2.52 | 2290 | 2.5 | |

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Mini Bypass Road, Thiruvannur Nada (PO) Thiruvannur,
Kozhikode, Kerala, 673029.

# Grain Size Distribution of Soil Test Report

Report No: ML23/R-020008/1
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveriatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

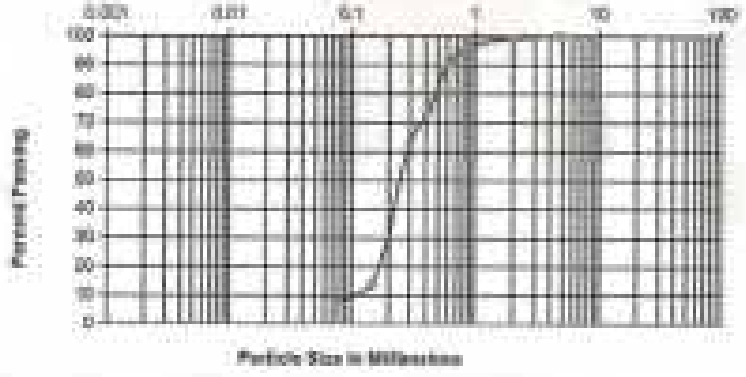
ULR-TC107423000000LE20F

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 7.00m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/S1 | Source*: | BH 01, Depth 7.00m |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vadimara, North Paravoor, Ernakulam | Date Tested : | 20/06/2023 - 22/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 7.00m |
| Tested By: | GK | Client Sample Desc.*: | Soil, BH 01, Depth 7.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution - Wet Sieving

Method: IS: 2720 (Part 4)-1985




| Sieve Size (mm) | % Passing | Project Limit |
|---|---|---|
| 4.750 | 100 | - |
| 2.000 | 99 | - |
| 1.180 | 98 | - |
| 0.850 | 96 | - |
| 0.600 | 90 | - |
| 0.425 | 74 | - |
| 0.300 | 53 | - |
| 0.150 | 14 | - |
| 0.075 | 7 | - |

For and on behalf of MatterLab

Comments:
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Kozhikode, Kerala, 673029

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-02008/2
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 626030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vedimara, North Parawoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vedimara, North Parawoor, Ernakulam |
| Tel / Email: | - |

UL-TC107023000004629

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 7.00m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/01 | Source*: | BH 01, Depth 7.00m |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vedimara, North Parawoor, Ernakulam | Date Tested : | 19/06/2023 - 21/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 7.00m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 7.00m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.4: Cone Penetrometer | Liquid Limit,% | 28 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | Could not be determined | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | Non-plastic | - |

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# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-02008/2
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IFE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara, North Parawoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil, BH 01, Depth 9.00m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/S2 | Source*: | BH 01, Depth 9.00m |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | 8 Approx |
| Sample Location*: | Vadimara, North Paravoor, Ernakulam | Date Tested : | 19/06/2023 - 21/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 9.00m |
| Tested By: | VY | Client Sample Desc*.: | Soil, BH 01, Depth 9.00m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3: Mechanical Method | Liquid Limit,% | 117 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 57 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 60 | - |

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Kozhikode, Kerala, 673029.

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML22/R-0208/R
Issue No: 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IRE Global |
| Address: | Kavanat Building, Kaniyanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

UL9-7C1074 2 3 0 0 0 0 A E 3 0 F

## Sample Details

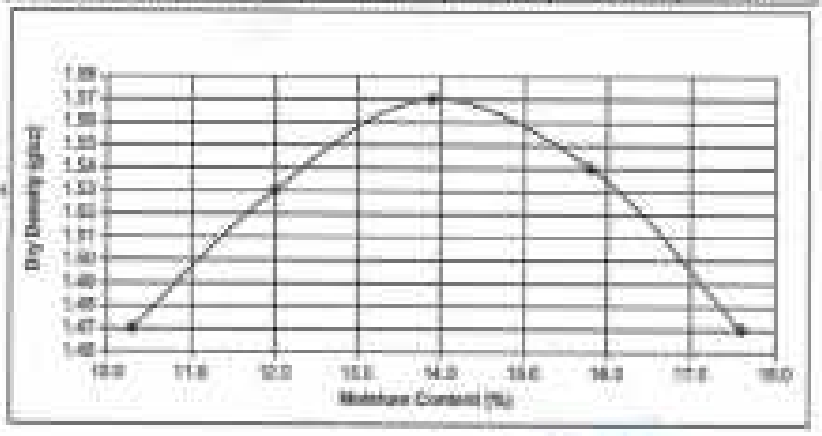
| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-2), BH 01, Depth 8.00m |
| Work Order ID: | ML23/W-02208 | Sample Submitted By.*: | Geotechnical Division |
| Sample ID: | ML23/W-02208/53 | Source*: | BH 01, Depth 8.00m |
| Date Sampled: | 10/06/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 8 Approx |
| Sample Location*: | Vadimara, North Paravoor, Ernakulam | Date Tested : | 21/06/2023 - 22/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 8.00m |
| Tested By: | DK/GK | Client Sample Desc.: | Soil (UDS-2), BH 01, Depth 8.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Mould volume: $V_m$ (cm³) | | | 1000 | | | | |
|---|---|---|---|---|---|---|---|
| Test No. | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould: $W_m$ (g) | | | 4065 | | | | |
| Mass of mould + compacted sample: W (g) | | | 5660 | 5770 | 5840 | 5839 | 5760 |
| Mass of sample | | | 1617 | 1707 | 1796 | 1774 | 1727 |
| Wet density | $(W-W_m)/V_m$ | $\rho_b$ (Mg/m³) | 1.62 | 1.71 | 1.79 | 1.78 | 1.73 |
| Mass of wet sample | | W (g) | 425.0 | 442.2 | 425.1 | 429.8 | 433.8 |
| Mass of dry sample | | W (g) | 385.3 | 394.8 | 379.2 | 379.8 | 368.9 |
| Moisture content | $[(W_2-W_1)/W_1]x100$ | m (%) | 10.3 | 12.0 | 12.9 | 13.8 | 17.6 |
| Dry density | $\rho_b/(1+m/100)$ | $\rho_d$ (Mg/m³) | 1.47 | 1.53 | 1.57 | 1.64 | 1.47 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc | 1.57 |
| Optimum moisture content, % | 14 |
| Material retained on 22mm,% | 0 |
| Sample used | Single |
| Size of mould | 1000cm³ |
| Weight of rammer | 2.6 kg |




For and on behalf of MatterLab:

Comments:

*Information provided by client

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Kozhikode, Kerala, 673028.

TC-10748

# Water Content-Dry Density Relationship Using Light Compaction Test Report

Report No: ML/23/W-02008/R
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628032 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

ULR-TC710423000866453F

## Sample Details

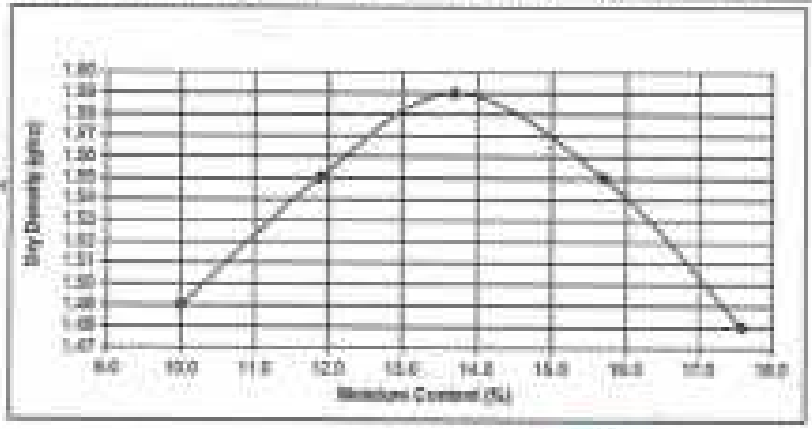
| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 9.50m |
| Work Order ID: | ML/23/W-02008 | Sample Submitted By.*: | Geotechnical Division |
| Sample ID: | ML/23/W-02008/Sa | Source*: | BH 01, Depth 9.50m |
| Date Sampled: | 10/06/2023 | Sampled By*: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vadimara, North Paravoor, Ernakulam | Date Tested : | 21/06/2023 - 22/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 9.50m |
| Tested By: | DK/GK | Client Sample Desc.: | Soil (UDS-3), BH 01, Depth 9.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mould volume | | $V_m$ (cm³) | 998 | | | | |
| Test No: | | | 1 | 2 | 3 | 4 | 5 |
| Mass of mould | | $W_m$ (g) | 4163 | | | | |
| Mass of mould + compacted sample | | W (g) | 5755 | 5790 | 5869 | 5849 | 5759 |
| Mass of sample | | | 1652 | 1727 | 1806 | 1736 | 1756 |
| Wet density | $(W-W_m)/V_m$ | $\rho_w$ (Mg/m³) | 1.84 | 1.73 | 1.81 | 1.74 | 1.74 |
| Mass of wet sample | | W (g) | 417.6 | 440.3 | 466.9 | 428.7 | 440.9 |
| Mass of dry sample | | W (g) | 379.6 | 393.9 | 410.8 | 388.8 | 374.9 |
| Moisture content | $(W_1-W_2)/W_2 \times 100$ | m (%) | 10.0 | 11.8 | 13.7 | 10.7 | 17.6 |
| Dry density | $\rho_w/(1+m/100)$ | $\rho_d$ (Mg/m³) | 1.49 | 1.55 | 1.59 | 1.65 | 1.48 |

Method: IS 2720 : Part 7 : 1980

| | |
|---|---|
| Maximum dry density, g/cc: | 1.59 |
| Optimum moisture content, % | 14 |
| Material retained on 20mm,% | 0 |
| Sample used | Single |
| Size of mould | 1000cm³ |
| Weight of rammer | 2.6 kg |




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Comments:
*Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673028

# Hydrometer Analysis Test Report

Report No: ML/23/0 [illegible]
Issue No: 1
Report Date: 27/06/2023

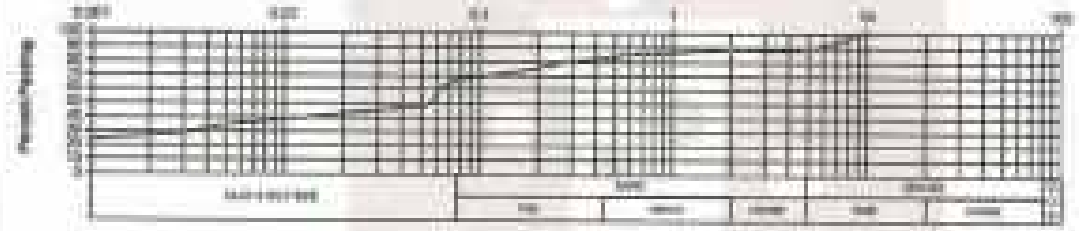
| | | | |
|---|---|---|---|
| Client: | PE Global | Consultant: | - |
| Address: | Kavalakatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 682030 | Owner: | KSWSP |
| Contact: | Mr. Ronaldo Dey | Contractor: | - |
| Project No: | - | Project Location: | Vadhirara, North Paravoor, Ernakulam |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadhirara, North Paravoor | Test Result: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 19/06/2023 | Client Sample Ref.*): | Soil, BH 01, Depth 9.00m |
| Work Order ID: | ML23/W-02068 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02068/03 | Source*): | BH 01, Depth 9.00m |
| Date Sampled: | 19/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2131 - 1981 | Sample Size(kg): | 5 Approx |
| Sample Location*): | Vadhirara, North Paravoor, Ernakulam | Date Tested: | 21/06/2023 - 26/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil, BH 01, Depth 9.00m |
| Tested By: | BH | Client Sample Desc.*): | Soil, BH 01, Depth 9.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution

Method: IS: 2720 (Part 4)-1985, Cl.6.4




| Sieve Size (mm) | % Passing |
|---|---|
| 9.500 | 100 |
| 4.750 | 99 |
| 2.000 | 90 |
| 0.850 | 86 |
| 0.600 | 82 |
| 0.425 | 80 |
| 0.300 | 80 |
| 0.150 | 72 |
| 0.075 | 66 |
| 0.053 | 48 |
| 0.037 | 46 |
| 0.026 | 44 |
| 0.019 | 42 |
| 0.014 | 40 |
| 0.010 | 38 |
| 0.007 | 36 |
| 0.005 | 34 |
| 0.004 | 32 |
| 0.003 | 29 |
| 0.001 | 24 |

| | |
|---|---|
| Gravel,% | 11 |
| Sand,% | 23 |
| Silt,% | 42 |
| Clay,% | 24 |

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Comments:
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# UNCONFINED COMPRESSIVE STRENGTH(UCS) OF SOIL TEST REPORT

Report No: ML23/R-02008/2
Issue No : 1
Report Date: 21/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanad Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 526036 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/09/2023 | Client Sample Ref.*: | Soil (UDS-2), BH 01, Depth 6.00m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/03 | Source: | BH 01, Depth 6.00m |
| Date Sampled: | 10/09/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2132 - 1986 | Sample Size(kg): | 6 Approx |
| Sample Location: | Vadimara, North Paravoor, Ernakulam | Date Tested : | 21/09/2023 - 22/09/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 6.00m |
| Tested By: | DIOJJ | Client Sample Desc.: | Soil (UDS-2), BH 01, Depth 6.00m |

**Test Results** — Method: IS: 2720 (Part 10) -1991 (R2019)




| | |
|---|---|
| Unconfined Compressive Strength(kPa) | 142 |
| Specimen Height (mm) | 76 |
| Specimen Diameter | 38 |
| Specimen Density(g/cc) | 1.18 |
| Moisture Content(%) | 14 |
| Type of specimen | Undisturbed |
| Specimen Condition | - |

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**Comments**

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# BULK DENSITY OF SOIL TEST REPORT

Report No: ML23/R-02009/01
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Vadimara, North Paravoor |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Vadimara, North Paravoor, Ernakulam |
| **Tel./ Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 13/06/2023 | **Client Sample Ref.*:** | Soil (UDS-3), BH 01, Depth 9.50m |
| **Work Order ID:** | ML23/W-02009 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02009/04 | **Source*:** | BH 01, Depth 9.00m |
| **Date Sampled:** | 10/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2132 - 1986 | **Sample Size(kg):** | 3 Approx |
| **Sample Location:** | Vadimara, North Paravoor, Ernakulam | **Date Tested :** | 20/06/2023 |
| **Sample Cont. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil (UDS-3), BH 01, Depth 9.50m |
| **Tested By:** | GK | **Client Sample Desc.*:** | Soil (UDS-3), BH 01, Depth 9.50m |
| **Test Location:** | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 1.70 | - |

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# POINT LOAD INDEX OF ROCK TEST REPORT

Report No: ML23/R-020085
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vedimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client sample Ref.:* | BH 01, Depth 10m - 11m |
| Work Order ID: | ML23/W-02008 | Source*: | BH 01, Depth 10m - 11m |
| Sample ID: | ML23/W-02008/S6 | Sampled By*: | Geotechnical Division |
| Sampling Location: | Vedimara, North Paravoor, Ernakulam | Sampling Method: | IS: 2131 - 1981 |
| Sample Cert. No: | - | Date Tested : | 24/06/2023 - 25/06/2023 |
| Tested By: | GK | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Sample Description: | Rock Core sample |

| Test Results | | | Test Method: ISRM Suggested Method | |
|---|---|---|---|---|
| Specimen No | | | 1 | 2 |
| Sampling Date | | | 10/06/2023 | |
| Moisture Condition @ Test | | | As Received | |
| Moisture Content | (%) | | 3.41 | 3.19 |
| Test type | | | Irregular | |
| Direction of Loading to Plane of Weakness | | | Perpendicular | |
| Specimen Diameter | (mm) | | 50.6 | 50.5 |
| Specimen Thickness | (mm) | | 37.3 | 30.8 |
| Failure Load | (kN) | | 0.330 | 0.239 |
| Equivalent Core Dia | (mm) | | 2404 | 1979 |
| Point Load Index, $I_s$ | (MPa) | | 0.14 | 0.12 |
| Corrected Point Load Index, $I_{s(50)}$ | (MPa) | | 0.14 | 0.11 |
| Mean Point Load Index, $I_{s(50)}$ | (MPa) | | 0.1 | |

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**Comments**

*Information provided by client

Test conducted on available bore hole samples.

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# POINT LOAD INDEX OF ROCK TEST REPORT

Report No: ML23/R-02008/B
Issue No: 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarott Building, Kanayannor Village, Kakkanad, Ernakulam, Kerala - 626030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vellimana, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vellimana, North Paravoor, Ernakulam |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client sample Ref.:* | BH 01; Depth 11m - 12m |
| Work Order ID: | ML23/W-02008 | Source*: | BH 01, Depth 11m - 12m |
| Sample ID: | ML23/W-02008/58 | Sampled By*: | Geotechnical Division |
| Sampling Location: | Vellimana, North Paravoor, Ernakulam | Sampling Method: | IS: 2131 - 1981 |
| Sample Cert. No: | - | Date Tested : | 24/05/2023 - 25/05/2023 |
| Tested By: | GK/JJ | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Sample Description: | Rock Core sample |

| Test Results: | | | | Test Method: ISRM Suggested Method |
|---|---|---|---|---|
| Specimen No | | 1 | 2 | 3 |
| Sampling Date | | 19/05/2023 | | |
| Moisture Condition @ Test | | As received | | |
| Moisture Content | (%) | 3.48 | 3.34 | 3.84 |
| Test type | | Axial | | |
| Direction of Loading to Plane of Weakness | | Perpendicular | | |
| Specimen Diameter | (mm) | 51.0 | 54.8 | 53.1 |
| Specimen Thickness | (mm) | 40.0 | 35.3 | 36.4 |
| Failure Load | (kN) | 0.980 | 0.820 | 0.219 |
| Equivalent Core Dia | (mm) | 2031 | 1792 | 2269 |
| Point Load Index, $I_s$ | (MPa) | 0.22 | 0.30 | 0.09 |
| Corrected Point Load Index, $I_{s(50)}$ | (MPa) | 0.22 | 0.32 | 0.09 |
| Mean Point Load Index, $I_{s(50)}$ | (MPa) | 0.2 | | |

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Head Civil Laboratory

For and on behalf of MatterLab

| Comments |
|---|
| *Information provided by client |
| Test conducted on available bore hole sample. |

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# Permeability of Soil Test Report

Report No: ML23/R-02008/01
Issue No: 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vedimara, North Parawoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vedimara, North Parawoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 9.50m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/04 | Source*: | BH 01, Depth 9.50m |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vedimara, North Parawoor, Ernakulam | Date Tested : | 21/06/2023 - 22/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 9.50m |
| Tested By: | DK/GK | Client Sample Desc.*: | Soil (UDS-3), BH 01, Depth 9.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS 2720 (Part 17) - 1986 Falling Head Method | Permeability at 27°C, cm/s | 1.39 E-05 | - |

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**Comments**

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## SHEAR STRENGTH TEST REPORT

Report No: ML23/IT-02008/12
Issue No: 1
Report Date: 27/06/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavanatt Building, Kaniyannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Vedimara, North Paravoor, Ernakulam |
| **Tel / Email:** | - |

### Sample Details

| | | | |
|---|---|---|---|
| **Received Date:** | 13/06/2023 | **Client Sample Ref.*:** | Soil (UDS-3), BH 01, Depth 0.50m |
| **Work Order ID:** | ML23/W-02008 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/WI-02008/54 | **Source:*** | BH 01, Depth 0.50m |
| **Date Sampled:** | 10/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method:** | IS: 2132 - 1986 | **Sample Size(kg):** | 1 Approx. |
| **Sample Location:*** | Vedimara, North Paravoor, Ernakulam | **Date Tested:** | 22/06/2023 - 23/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Test Location:** | MatterLab - Kozhikode | **Lab Sample Desc.:** | Soil (UDS-3), BH 01, Depth 0.50m |
| **Tested By:** | MV | **Client Sample Desc.:** | Soil (UDS-3), BH 01, Depth 0.50m |

### Test Results

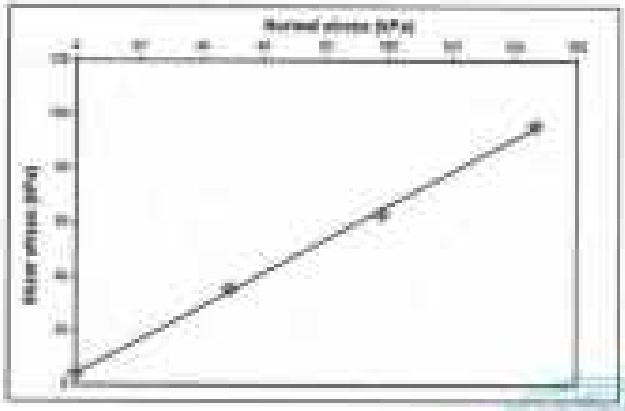
Method: IS 2720 (Part 13)-1986

| | |
|---|---|
| Area of specimen ($cm^2$) | 36 |
| Height of specimen (mm) | 20 |
| Rate of strain (mm/min) | 1.25 |
| Test Condition | Unconsolidated Drained |
| Bulk Density ($Mg/m^3$) | 1.70 |
| Moisture content (%) | 16 |
| Dry Density ($Mg/m^3$) | 1.46 |

| Load Increment | Applied Normal Stress (kPa) | Maximum Shear Stress (kPa) | Displacement at Max. Stress (mm) |
|---|---|---|---|
| 1 | 49 | 85.4 | 2.0 |
| 2 | 98 | 63.2 | 1.8 |
| 3 | 147 | 95.9 | 3.6 |

Cohesion Intercept (C'), kPa: 4

Angle of Internal Friction (ϕ'): 32°




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### Comments

*Information provided by client

Material tested was passing 4.75 mm test sieve, recompacted at maximum achievable density and moisture content

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Page 1 of 1
End of test.

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# Water Absorption - Test Report

Report No: ML23/R-02008/13
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavanati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Vedimara, North Paravoor, Ernakulam |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 13/06/2023 | **Client Sample Ref*:** | Laterite Core, BH 01, Depth 10m - 11m |
| **Work Order ID:** | ML23/W-02008 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02008/05 | **Source*:** | BH 01, Depth 10m - 11m |
| **Date Sampled:** | 10/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method:** | IS: 2131 - 1981 | **Sample Size/kg:** | - |
| **Sample Location*:** | Vedimara, North Paravoor, Ernakulam | **Date Tested :** | 25/06/2023 - 27/06/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Laterite Core, BH 01, Depth 10m - 11m |
| **Tested By:** | GK | **Client Sample Desc.*:** | Laterite Core, BH 01, Depth 10m - 11m |
| **Test Location:** | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Water Absorption,% | 10.3 | - |

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Asst.Chief Laboratory

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**Comments**

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Thiruvennur, Kozhikode, Kerala, 673029

## Water Absorption - Test Report

Report No: ML23/R-02008/54
Issue No : 1
Report Date:27/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Vedimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vedimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

### Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/09/2023 | Client Sample Ref*): | Laterite Core, BH 01, Depth 11m - 12m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/59 | Source*): | BH 01, Depth 10m - 11m |
| Date Sampled: | 10/09/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*): | Vedimara, North Paravoor, Ernakulam | Date Tested : | 26/09/2023 - 27/09/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 11m - 12m |
| Tested By: | GK | Client Sample Desc.*): | Laterite Core, BH 01, Depth 11m - 12m |
| Test Location: | MatterLab - Kozhikode | | |

### Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Water Absorption,% | 9.2 | - |

SREELESH TV
Senior Civil Engineer

For and on behalf of MatterLab

### Comments

*Information provided by client

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# Specific Gravity - Test Report

Report No: ML23/W-02008/15
Issue No : 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Karayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref*: | Laterite Core, BH 01, Depth 10m - 11m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/55 | Source*: | BH 01, Depth 10m - 11m |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Vadimara, North Paravoor, Ernakulam | Date Tested : | 25/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 10m - 11m |
| Tested By: | GK | Client Sample Desc.*: | Laterite Core, BH 01, Depth 10m - 11m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS: 1124 - 1974 | Apparent Specific Gravity g/cc | 2.55 | - |

For and on behalf of MatterLab

## Comments

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Thiruvannur, Kozhikode, Kerala, 673029

# Specific Gravity - Test Report

Report No: ML23/R-02008/16
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vedimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 19/06/2023 | Client Sample Ref*: | Laterite Core, BH 01, Depth 11m - 12m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/S6 | Source*: | BH 01, Depth 11m - 12m |
| Date Sampled: | 19/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Vedimara, North Paravoor, Ernakulam | Date Tested : | 20/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 11m - 12m |
| Tested By: | GK | Client Sample Desc.*: | Laterite Core, BH 01, Depth 11m - 12m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS: 1124 - 1974 | Apparent Specific Gravity @ 20 | 2.52 | - |

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**Comments**

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Thiruvannur, Kozhikode, Kerala, 673029

# Density - Test Report

Report No: ML23/R-02008/17
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vedimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 19/06/2023 | Client Sample Ref*: | Laterite Core, BH 01, Depth 10m - 11m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/59 | Source*: | BH 01, Depth 10m - 11m |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size/Kgs: | - |
| Sample Location*: | Vedimara, North Paravoor, Ernakulam | Date Tested : | 20/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 10m - 11m |
| Tested By: | GK | Client Sample Desc.*: | Laterite Core, BH 01, Depth 10m - 11m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Rock Density kg/m³ | 2190 | - |

PRAVEEN T V
Head-Civil Laboratory

For and on behalf of MatterLab

## Comments

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# Density - Test Report

Report No: ML23/R-02008/18
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadmara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadmara, North Paravoor, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref*: | Laterite Core, BH 01, Depth 11m - 12m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/18 | Source*: | BH 01, Depth 11m - 12m |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Vadmara, North Paravoor, Ernakulam | Date Tested : | 23/06/2023 - 27/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 11m - 12m |
| Tested By: | GK | Client Sample Desc.*: | Laterite Core, BH 01, Depth 11m - 12m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Rock Density /kgm³ | 2350 | - |

SREELESH T.V
Lab Manager

For and on behalf of MatterLab

**Comments**

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# SCRATCH HARDNESS OF SURFACE ACCORDING TO MOHS'SCALE OF ROCK TEST REPORT

Report No: ML23W-03008/SS
Issue No: 1
Report Date: 27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanah Building, Karayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vedimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*: | Laterite Core, BH 01, Depth 10m - 11m |
| Work Order ID: | ML23W-03008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-03008/SS | Source*: | BH 01, Depth 10m - 11m |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Vedimara, North Paravoor, Ernakulam | Date Tested : | 25/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 10m - 11m |
| Tested By: | GK | Client Sample Desc.*: | Laterite Core, BH 01, Depth 10m - 11m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| Using Mohs' Scale | Mohs' Hardness | 2.5 | - |

SREELESH T V
Chief Chemist Laboratory

For and on behalf of Matter Lab

**Comments**

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Thiruvannur, Kozhikode, Kerala, 673029

# SCRATCH HARDNESS OF SURFACE ACCORDING TO MOHS'SCALE OF ROCK TEST REPORT

Report No: ML23/W-02008/02
Issue No : 1
Report Date:27/06/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vedimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 13/06/2023 | Client Sample Ref.*): | Laterite Core, BH 01, Depth 11m - 12m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/08 | Source*: | BH 01, Depth 11m - 12m |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | Vedimara, North Paravoor, Ernakulam | Date Tested : | 25/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 11m - 12m |
| Tested By: | GK | Client Sample Desc.*): | Laterite Core, BH 01, Depth 11m - 12m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| Using Mohs' Scale | Mohs' Hardness | 2.5 | - |

FREELISH TS
Head-Civil Laboratory

For and on behalf of Matter Lab

**Comments**

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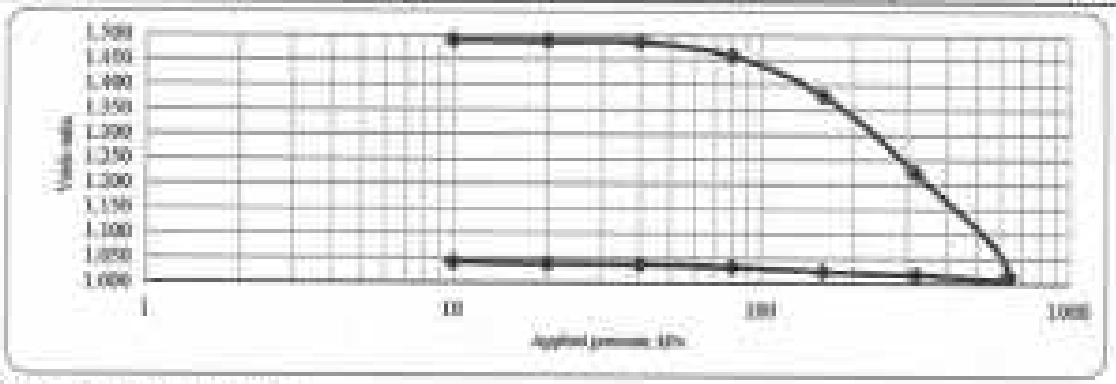
# SOIL CONSOLIDATION (OEDOMETER) TEST REPORT

| | | | |
|---|---|---|---|
| Date Received | 13/06/2023 | Report No. | ML23/R-020306/21 |
| Date Reported | 24/07/2023 | Client Ref. | Soil (UDS-3), BH 01, Depth 6.50m |

| | | | |
|---|---|---|---|
| Client | IPE Global | | |
| Adress | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 | | |
| Contact | Mr. Rakshit Dey | | |
| Project Number | - | | |
| Project Name | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor | | |
| Consultant | - | | |
| Owner | KSWMP | | |
| Source* | BH 01, Depth 6.50m | Client Sample Ref*. | Soil (UDS-3), BH 01, Depth 6.50m |
| Sampled by | Geotechnical Division | Date Tested | 04/07/2023 - 13/07/2023 |
| Test Method | IS : 2720 ( Part 15 ) - 1986 | Test Location | MatterLab - Kozhikode |

| | | | |
|---|---|---|---|
| MatterLab Sample No. | ML23/M-020306/S4 | Initial diameter (mm) | 50 |
| Initial height of specimen (mm) | 20.00 | Sample Location | Vedimara, North Paravoor, Ernakulam |
| Initial voids ratio | 1.400 | Dry Density (Mg/m$^3$) | 1.044 |
| Moisture content (%) | 34.2 | | |

| Applied Stress (kPa) | Voids ratio | Coefficient of consolidation, $C_v$ (mm$^2$/minute) | Coefficient of volume compressibility, $m_v$ (m$^2$/MN) |
|---|---|---|---|
| 10 | 1.469 | 1388.12 | 0.050 |
| 20 | 1.466 | 1284.77 | 0.050 |
| 40 | 1.460 | 809.87 | 0.025 |
| 80 | 1.458 | 276.28 | 0.288 |
| 160 | 1.378 | 5.98 | 0.405 |
| 320 | 1.333 | 3.38 | 0.409 |
| 640 | 1.313 | 3.10 | 0.204 |




Preconsolidation Pressure: 141 kPa
Compression Index, $C_c$: 0.58
Recompression Index, $C_r$: 0.02

Note: Compression vs Square root of time curves are also attached herewith (Refer Sheet 2 of 3 & 3 of 3)
*Information provided by client

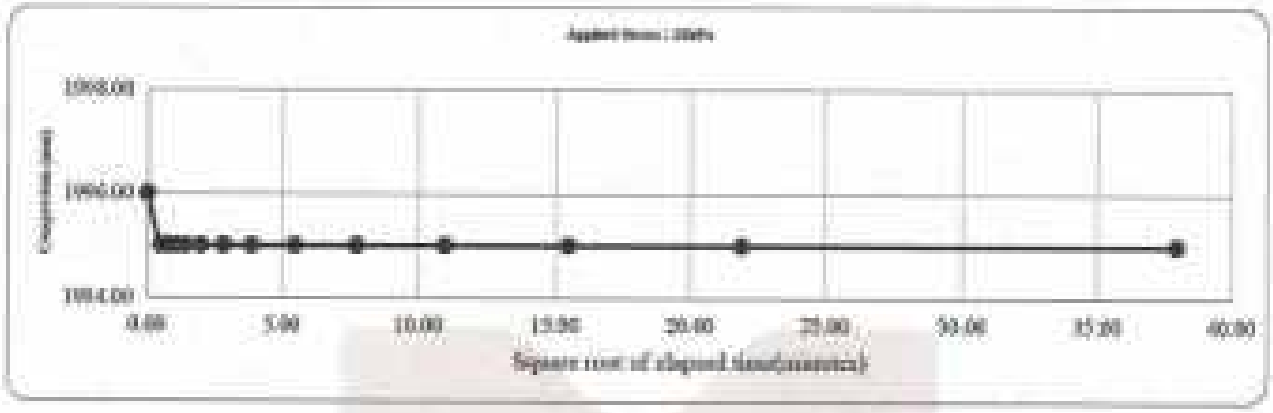


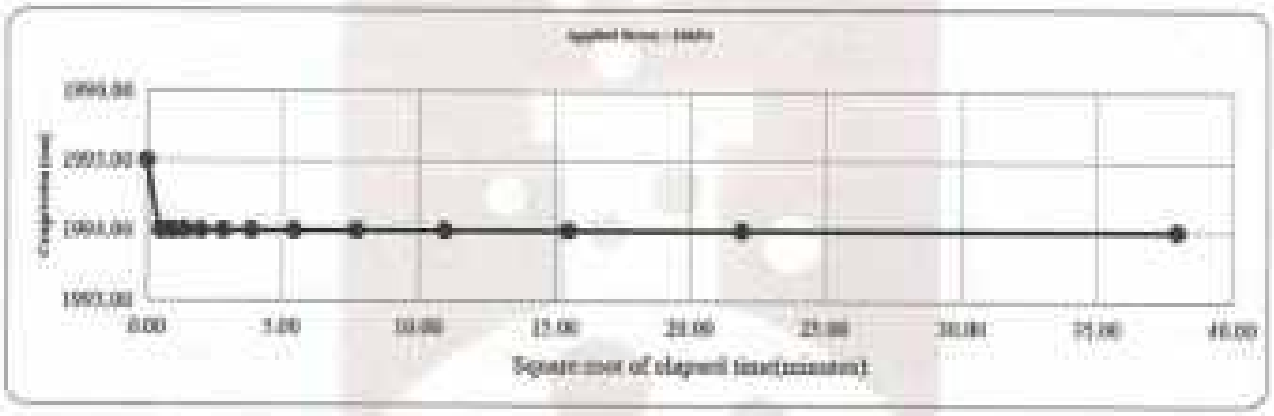
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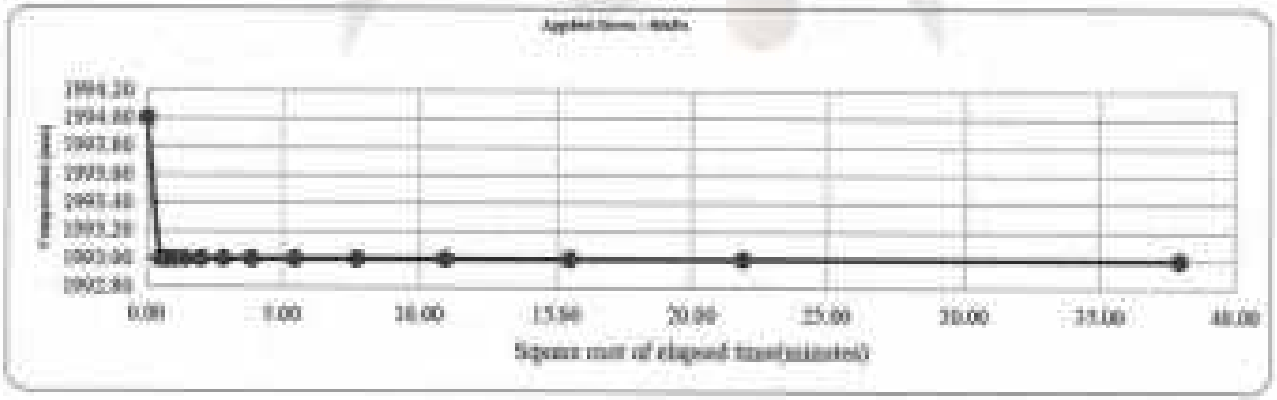
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Compression Vs square root of time curves



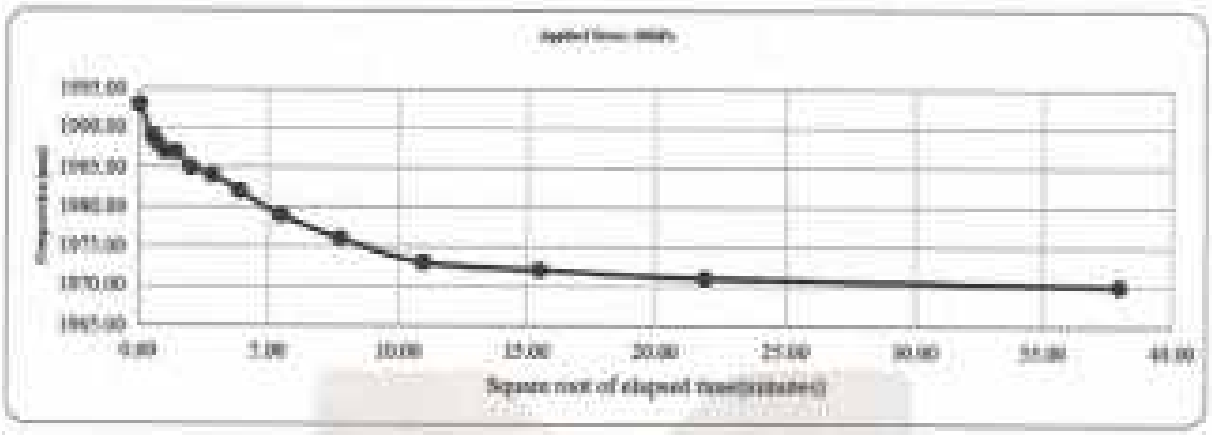



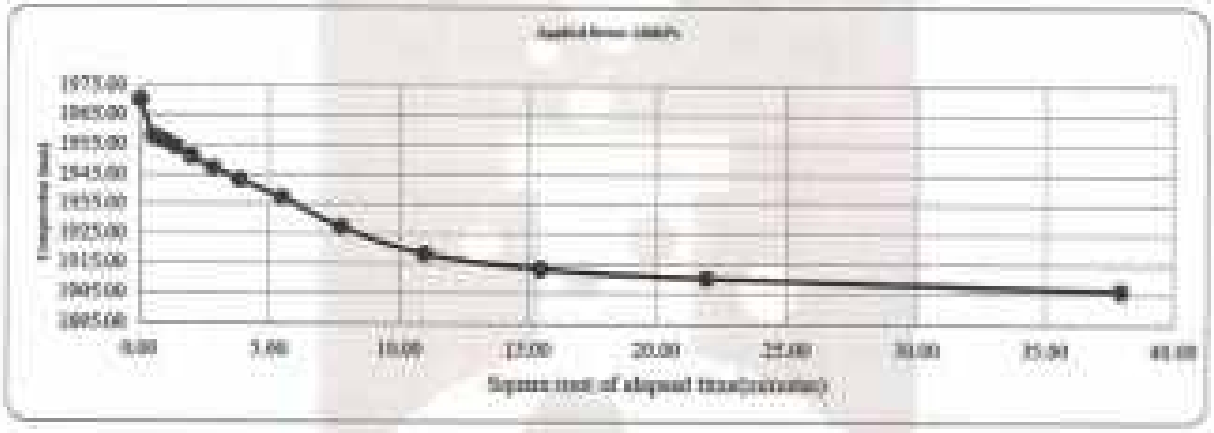


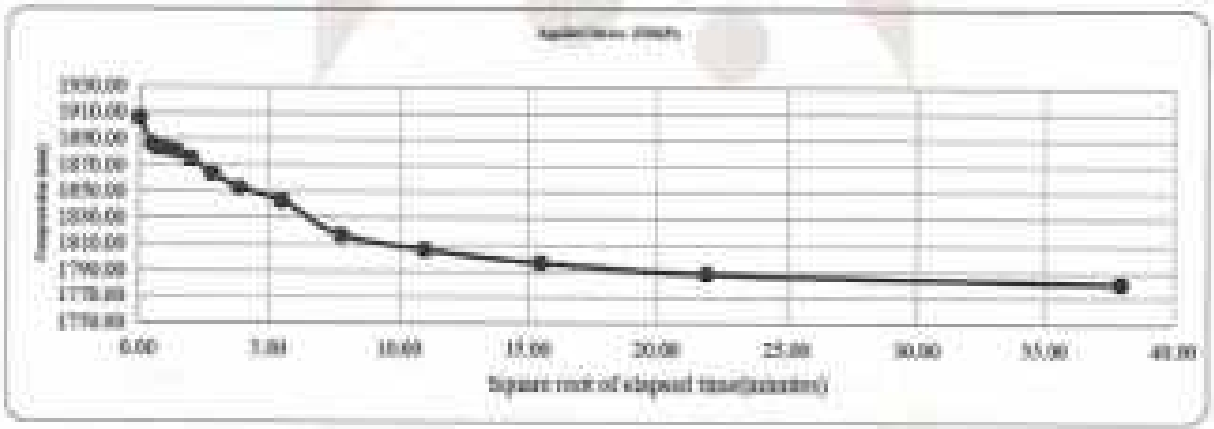

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**Compression Vs square root of time curves**

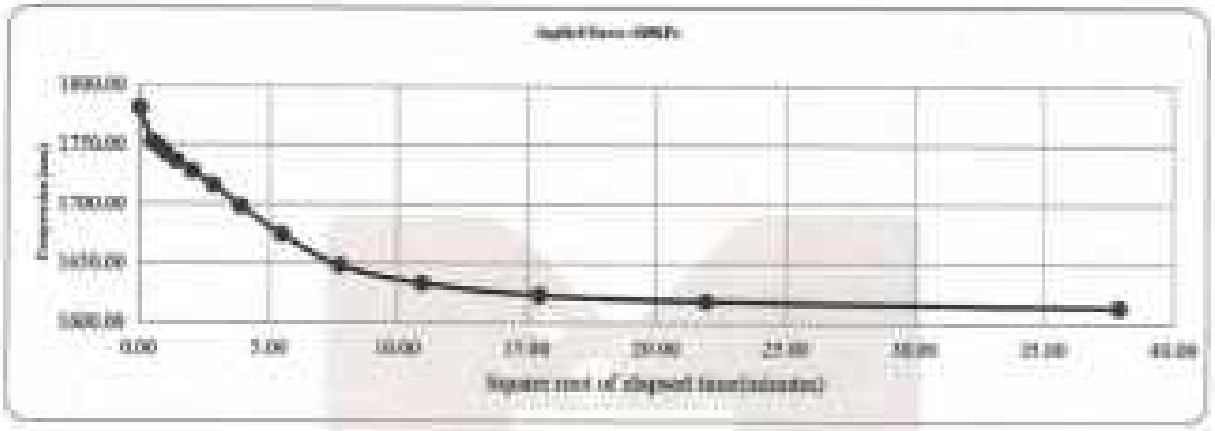


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Compression Vs square root of time curves




SREELESH T.V
Head-Civil Laboratory

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Sheet 4 of 4
End of test

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Kozhikode, Kerala, 673029.

TC-16740

# Water Content of Soil Test Report

Report No: ML/2023-02008/02
Issue No : 1
Report Date: 03/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanjapancor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vedimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-2), BH 01, Depth 8.00m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/03 | Source*: | BH 01, Depth 8.00m |
| Date Sampled: | 19/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 – 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vedimara, North Paravoor, Ernakulam | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 8.00m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-2), BH 01, Depth 8.00m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 14 | - |

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Head-Civil Laboratory

For and on behalf of Matter Lab

Comments
*Information provided by client

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Kozhikode, Kerala, 673029

# Water Content of Soil Test Report

Report No: ML23/R-02008/23
Issue No: 1
Report Date: 03/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628330 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vedimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-3), BH 01, Depth 9.50m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/S-02008/S4 | Source*: | BH 01, Depth 9.50m |
| Date Sampled: | 19/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vedimara, North Paravoor, Ernakulam | Date Tested : | 29/07/2023 - 30/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth 9.50m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-3), BH 01, Depth 9.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 2)-1973 | Water Content (w),% | 15 | - |

SREELESH T.V
Head-Civil Laboratory

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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Mini Bypass Road, Thiruvannur Nada (PO) Thiruvannur,
Kozhikode, Kerala, 673329.

# Liquid Limit, Plastic Limit & Plasticity Index Test Report

Report No: ML23/R-02008/24
Issue No: 1
Report Date:03/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavaratti Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vedimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 25/07/2023 | Client Sample Ref.*: | Soil (UDS-3); BH 01, Depth 9.50m |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/S4 | Source*: | BH 01, Depth 9.50m |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location*: | Vedimara, North Paravoor, Ernakulam | Date Tested : | 25/07/2023 - 28/07/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3); BH 01, Depth 9.50m |
| Tested By: | MV | Client Sample Desc*.: | Soil (UDS-3); BH 01, Depth 9.50m |
| Condition of Soil: | Natural | Period of Soaking: | 24 Hrs |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS:2720(Part 5)-1985-Cl.3: Mechanical Method | Liquid Limit,% | 35 | - |
| IS:2720(Part 5)-1985-Cl.7 | Plastic Limit,% | 20 | - |
| IS:2720(Part 5)-1985-Cl.8 | Plasticity Index | 15 | - |

SREELESH T.V
Civil Laboratory

For and on behalf of MatterLab

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Thiruvannur, Kozhikode, Kerala, 673028

# Hydrometer Analysis Test Report

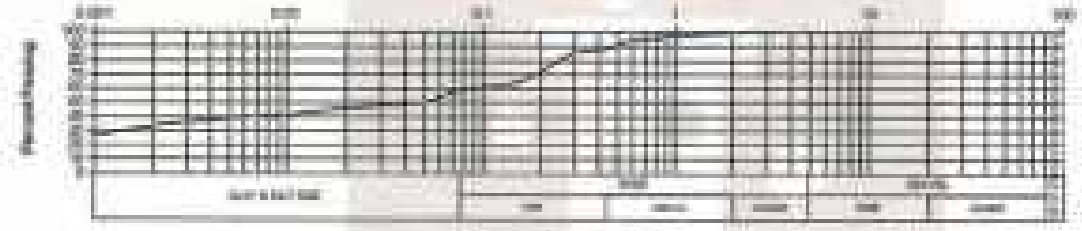
| | | | |
|---|---|---|---|
| Client: | PE Global | Consultant: | - |
| Address: | Kinderest Building, Kaniyancoor Village, Kakkanad, Ernakulam, Kerala - 628000 | Owner: | KSINMP |
| Contact: | Mr. Ranabir Dey | Contractor: | - |
| Project No: | - | Project Location: | Vadimara, North Paravoor, Ernakulam |
| Project Name: | Geotechnical Investigation at Courgaide in Vadimara, North Paravoor | Ref / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 28/07/2023 | Client Sample Ref.*): | Soil (UDS-3), BH 01, Depth-9.80m |
| Work Order ID: | ML23/W-02000 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02000/S4 | Source*): | BH 01, Depth-9.80m |
| Date Sampled: | 19/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2132 - 1986 | Sample Size(kg): | 0.4approx |
| Sample Location*: | Vadimara, North Paravoor, Ernakulam | Date Tested: | 28/07/2023 - 29/07/2023 |
| Sample Cont. No: | - | Test Method Variations: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-3), BH 01, Depth-9.80m |
| Tested By: | RH | Client Sample Desc.*): | Soil (UDS-3), BH 01, Depth-9.80m |
| Test Location: | MatterLab - Kozhikode | | |

## Particle Size Distribution

Method: IS: 2720 (Part 4)-1985, Cl 9.3




| Sieve Size (mm) | % Passing |
|---|---|
| 4.750 | 100 |
| 2.000 | 99 |
| 0.850 | 96 |
| 0.600 | 94 |
| 0.425 | 88 |
| 0.300 | 83 |
| 0.150 | 64 |
| 0.075 | 58 |
| 0.051 | 50 |
| 0.036 | 48 |
| 0.026 | 47 |
| 0.019 | 45 |
| 0.013 | 43 |
| 0.010 | 41 |
| 0.007 | 40 |
| 0.005 | 38 |
| 0.003 | 36 |
| 0.002 | 33 |
| 0.001 | 30 |

| | |
|---|---|
| Gravel,% | Nil |
| Sand,% | 42 |
| Silt,% | 25 |
| Clay,% | 33 |

SEELESH T.V
Chief Executive

For and on behalf of MatterLab

Comments:
*Information provided by client

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Thiruvennur, Kozhikode, Kerala, 673035

# TEST REPORT

Report No: ML23/R-02000/00
Issue No: 1
Report Date: 03/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kaveraki Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 26/07/2023 | Client Sample Ref.*: | Soil (UDS-2), BH 01, Depth 6.00m |
| Work Order ID: | ML23/W-02000 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02000/03 | Source*: | BH 01, Depth 6.00m |
| Date Sampled: | 19/06/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2132 - 1986 | Sample Size(kg): | 5 Approx |
| Sample Location: | Vadimara, North Paravoor, Ernakulam | Date Tested : | 26/07/2023 - 30/07/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Soil (UDS-2), BH 01, Depth 6.00m |
| Tested By: | DK | Client Sample Desc.*: | Soil (UDS-2), BH 01, Depth 6.00m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2):1990 | Bulk Density of Soil, g/ml | 1.18 | - |
| | Dry Density of Soil, g/cc | 1.04 | - |

SREELESH T.V
Head-Civil Laboratory

For and on behalf of MatterLab

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# TEST REPORT

Report No: ML23/R-02008/01
Issue No : 1
Report Date: 03/08/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Vedimara, North Paravoor, Ernakulam |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 25/07/2023 | **Client Sample Ref.*:** | Soil (UDS-3), BH 01, Depth 9.00m |
| **Work Order ID:** | ML23/WI-02008 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/WI-02008/04 | **Source*:** | BH 01, Depth 9.50m |
| **Date Sampled:** | 10/06/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | IS: 2132 - 1986 | **Sample Size(kg):** | 5 Approx |
| **Sample Location:** | Vedimara, North Paravoor, Ernakulam | **Date Tested :** | 29/07/2023 - 30/07/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | Soil (UDS-3), BH 01, Depth 9.50m |
| **Tested By:** | DK | **Client Sample Desc.*:** | Soil (UDS-3), BH 01, Depth 9.50m |
| **Test Location:** | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| BS: 1377( Part 2): 1990 | Bulk Density of Soil, g/ml | 1.70 | - |
| | Dry Density of Soil, g/cc | 1.48 | - |

SREELEESH T.V
Head - Soil Laboratory

For and on behalf of MatterLab

**Comments**

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## Chemical Test Report of Soil

Report No: ML23/R-02573/1
Issue No : 1
Report Date:27/07/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavarati Building,Kanayancor Village,Kakkanad,Ernakulam,Kerala - 629030 |
| Contact: | Mr.Ranabir Dev |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara ,North Paravoor |
| Owner: | KSWMP |
| Project Location: | Vadimara,North Paravoor,Ernakulam |
| Tel No: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 12/07/2023 | Client Sample ID:* | Soil and Rock |
| Work Order ID: | ML23/W-02573 | Source:* | Borehole - 1 (Depth 2m from orginal soil) |
| Sample ID: | ML23/W-02573/01 | Sample Submitted By: | Geotechnical Division |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Sample Location: | Vadimara,North Paravoor | Date Tested: | 13/07/23 - 20/07/23 |
| Tested By: | MLA | Test Method Variation: | None |

**CHEMICAL ANALYSIS**

| Test/Parameter | Test Method | Unit | Result |
|---|---|---|---|
| Cation Exchange Capacity | USDA No.18 | (meq/100gm) | 14.8 |

ANWAR. P
Lab Manager-Chemistry

For and on behalf of Matter Lab

**Comments**

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Thiruvannur, Kozhikode, Kerala, 673028

# Chemical Test Report of Soil

Report No: ML23/R-02573/2
Issue No: 1
Report Date: 06/10/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building,Karayanoor Village,Kakkanad,Ernakulam,Kerala - 682030 |
| Contact: | Mr Ranabir Dey |
| Project Name: | Geotechnical Investigation at Dumpsite in Vedimara,North Paravoor |
| Owner: | KSWMP |
| Project Location: | Vedimara,North Paravoor,Ernakulam |
| Tel No: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 12/07/2023 | Client Sample ID:* | Soil and Rock |
| Work Order ID: | ML23/W-02573 | Source:* | Borehole - 1 (2 meter from original ground level) |
| Sample ID: | ML23/W-02573/S1 | | |
| Date Sampled: | 10/06/2023 | Sampled By: | Geotechnical Division |
| Tested By: | MatterLab,Kozhikode | Date Tested: | 13/08/23 - 20/08/23 |
| Sample Location: | Vedimara,North Paravoor | Test Method Variation: | None |

## CHEMICAL ANALYSIS - Test Method:IS 3234 2021 & CPHEEO Manual

| Test/Parameters | Units | Results |
|---|---|---|
| pH Value | - | 8.39 |
| Electrical Conductivity | mS/cm | 0.221 |
| Nitrogen (N) | % | 0.23 |
| Phosphorus (P) | % | 0.02 |
| Potassium (K) | % | 0.20 |
| Carbon | % | 2.94 |
| Carbon / Nitrogen Ratio | % | 12.78 |
| Biodegradable Factor | % | < 0.1 |

## HEAVY METALS - Test Method: EPA 3050 (ICP OES)

| | | |
|---|---|---|
| Arsenic (As) | mg/Kg | 7.0 |
| Cadmium (Cd) | mg/Kg | < 5.0 |
| Chromium (Cr) | mg/Kg | 115.8 |
| Copper (Cu) | mg/Kg | 58.9 |
| Lead (Pb) | mg/Kg | 51.9 |
| Nickel (Ni) | mg/Kg | 48.9 |
| Zinc (Zn) | mg/Kg | 388.3 |
| Mercury (Hg) | mg/Kg | < 0.1 |

ANWAR. P
Lab Manager-Chemistry

For and on behalf of Matter Lab

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## Size Distribution of Solid Waste - Test Report

Report No: ML23/R-02008/28
Issue No : 1
Report Date: 19/08/2023

| | |
|---|---|
| **Client:** | IPE Global |
| **Address:** | Kavarati Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| **Contact:** | Mr. Ranabir Dey |
| **Project No:** | - |
| **Project Name:** | Geotechnical Investigation at Dumpsite in Vedimara, North Paravoor |
| **Consultant:** | - |
| **Owner:** | KSWMP |
| **Contractor:** | - |
| **Project Location:** | Vedimara, North Paravoor, Ernakulam |
| **Tel / Email:** | - |

**Sample Details**

| | | | |
|---|---|---|---|
| **Received Date:** | 09/08/2023 | **Client Sample Ref.*:** | MSW |
| **Work Order ID:** | ML23/W-02008 | **Sample Submitted By:** | Geotechnical Division |
| **Sample ID:** | ML23/W-02008/07 | **Source*:** | - |
| **Date Sampled:** | 09/08/2023 | **Sampled By:** | Geotechnical Division |
| **Sampling Method*:** | - | **Sample Size(kg):** | 15 Approx |
| **Sample Location*:** | Vedimara, North Paravoor, Ernakulam | **Date Tested :** | 09/08/2023 |
| **Sample Cert. No:** | - | **Test Method Variation:** | None |
| **Lot No / Lot Size:** | - | **Lab Sample Desc.:** | MSW |
| **Tested By:** | GK | **Client Sample Desc.*:** | MSW |
| **Test Location:** | MatterLab - Kozhikode | | |

**Particle Size Distribution** — Method: IS: 2720 (Part 4)-1985

| Sieve Size (mm) | % Retained |
|---|---|
| 80.0 | Nil |
| 37.5 | 16.0 |
| 10.0 | 41.5 |
| 4.0 | 21.1 |
| Passing | 21.4 |

SREESLESH T.V
Laboratory

For and on behalf of MatterLab

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# Field Density (Core-Cutter Method) of Solid Waste - Test Report

Report No: ML23/R-02008/SW
Issue No : 1
Report Date:19/08/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanat Building, Kanayancor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

**Test Results**

| | | | |
|---|---|---|---|
| Date Recieved: | 09/08/2023 | Client Ref:* | - |
| Work Order ID: | ML23/W-02008 | Layer | - |
| Sample ID: | ML23/W-02008/SB (1-2) | Depth of test (mm): | - |
| Sample Description: | MSW | Date Tested | 09/08/2023 - 10/08/2023 |
| Source* | - | Tested By | GK |
| Location* | Vadimara, North Paravoor, Ernakulam | Method Variation | None |
| Test Methods : | IS 2720 : Part 29 : 1975-(DRY DENSITY OF SOILS IN PLACE BY THE CORE-CUTTER METHOD)<br>IS 2720 : Part 2 : 1973 -(DETERMINATION OF WATER CONTENT) | | |

| Test No. | 1 | 2 |
|---|---|---|
| Sample ID | SB-1 | SB-2 |
| Test Location | Vadimara, North Paravoor, Ernakulam | |
| Weight of wet Material (g) | 927 | 927 |
| Volume of core-cutter ($cm^3$) | 992 | 1008 |
| In-situ Bulk Density ($g/cm^3$) | 0.76 | 0.65 |
| In-situ Water Content (%) | 23 | 24 |
| In-situ Dry Density ($g/cm^3$) | 0.76 | 0.65 |

SREELESH T.V
Head-GWI Laboratory

For and on behalf of MatterLab

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Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

## Moisture Content of Solid Waste - Test Report

Report No: ML23/R-03008/00
Issue No: 1
Report Date: 19/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimala, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimala, North Paravoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-03008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-03008/S7 | Source*: | - |
| Date Sampled: | 09/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 15 Approx |
| Sample Location*: | Vadimala, North Paravoor, Ernakulam | Date Tested : | 09/08/2023 - 10/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | DK | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Moisture Content, % | 18 | - |

SREELESH TV
Head - Soil Laboratory

For and on behalf of Matter Lab

**Comments**

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# Solid Waste - Test Report

Report No: ML23W-02008/01
Issue No : 1
Report Date: 14/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanapanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ramesh Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara, North Parawoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimara, North Parawoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 08/09/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-02008/01 | Source*: | - |
| Date Sampled: | 08/09/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Quantity: | 15 Approx |
| Sample Location*: | Vadimara, North Parawoor, Ernakulam | Date Tested : | 14/09/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GR | Client Sample Desc.*: | MSW |
| Test Location: | Matterlab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Waste Materials retained on | | |
|---|---|---|---|---|
| | | 37.5 mm | 10 mm | 4 mm |
| CPHEEO (2000) | Percentage of Plastic Waste, % | 9.6 | 2.5 | Nil |
| | Percentage of Cloth Waste, % | 1.4 | Nil | Nil |
| | Percentage of Glass Waste, % | Nil | 0.2 | Nil |
| | Percentage of Wood Waste, % | 3.0 | 16.4 | Nil |
| | Percentage of Construction Debris, % | Nil | Nil | Nil |
| | Percentage of Bio Fraction, % | Nil | Nil | Nil |
| | Percentage of Gravel, % | 86.0 | 78.8 | 100 |
| | Rubber, % | Nil | 0.3 | Nil |
| | Metal, % | Nil | Nil | Nil |

SREELESH T V
Technical Assistant

For and on behalf of Matter Lab

**Comments**
*Information provided by client

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Where Quality Matters

Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

# Solid Waste - Test Report

Report No: ML23/R-02016/02
Issue No : 1
Report Date:04/09/2023

| | |
|---|---|
| Client: | IPE Global |
| Address: | Kavanatt Building, Kanapanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/S7 | Source*: | - |
| Date Sampled: | 09/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 15 Approx |
| Sample Location*: | Vadimara, North Paravoor, Ernakulam | Date Tested: | 14/08/2023 - 19/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | GK | Client Sample Desc.*: | MSW |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| CPHEEO (2000) | Silt & Clay, % | 12 | - |

For and on behalf of Matter Lab.

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Mini Bypass Road, Thiruvennur Nada (PO)
Thiruvennur, Kozhikode, Kerala, 673029

# Solid Waste Size Analysis - Test Report

Report No: ML23/R-02008/23
Issue No : 1
Report Date: 14/08/2023

| | |
|---|---|
| Client: | IRE Global |
| Address: | Kaveriat Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 626030 |
| Contact: | Mr. Ranabir Dey |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Vadimara, North Paravoor |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Vadimara, North Paravoor, Ernakulam |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*: | MSW |
| Work Order ID: | ML23/W-02008 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-02008/S7 | Source*: | - |
| Date Sampled: | 09/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | - | Sample Size(kg): | 15 Approx |
| Sample Location*: | Vadimara, North Paravoor, Ernakulam | Date Tested : | 14/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | MSW |
| Tested By: | MV | Client Sample Desc.*: | MSW |
| Test Location: | Matterlab - Kozhikode | | |

**Test Results** — Test Method:CPHEEO - 2000

| Type of Waste Material | 37.5 mm | | 10 mm | |
|---|---|---|---|---|
| | Minimum Size of a Single Waste Material, m | Maximum Size of a Single Waste Material, m | Minimum Size of a Single Waste Material, m | Maximum Size of a Single Waste Material, m |
| Plastic Waste | 0.2115 | 0.3283 | 0.0208 | 0.0374 |
| Cloth Waste | 0.2068 | 0.2728 | - | - |
| Glass Waste | - | - | 0.0178** | |
| Wood Waste | 0.2008 | 0.3018 | 0.0143 | 0.0408 |
| Rubber | - | - | 0.0224** | |

For and on behalf of Matter Lab

**Comments**
*Information provided by client
** Only one piece of glass waste & rubber included in the waste composite

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Phone : 0484-2544030, 8281982322, 9747400085, www.poluchem.com, poluchem@gmail.com

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**TEST REPORT** 

| **Client Name & Address** | **Certificate No:** | **PL/RT/5066/2023** |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 15/06/2023 |
| | Date of monitoring | 29/05/2023 |
| | Date of sample received: | 29/05/2023 |
| | Date of analysis | 30/05/2023 |
| | Sample Description | Waste Analysis -North Paravoor-Vedimara |
| | Sample Location | Gps Reading : : N- 10°09'1.884"<br>E -76°14'31.56" |

| **CHEMICAL PARAMETERS** | | | | |
|---|---|---|---|---|
| **SL NO** | **Parameters tested** | **Test Method** | **Unit** | **Result** |
| 01 | pH@25°C | USEPA | .. | 7.98 |
| 02 | Biodegradable Factor | USEPA | % | 2.4 |
| 03 | Total carbon | USEPA 9060A | % | 3.4 |
| 04 | Phosphorus(P) | USEPA | % | 0.031 |
| 05 | Nitrogen(N) | USEPA | % | 0.18 |
| 07 | Potassium(K) | USEPA | % | 0.045 |
| 08 | C/N Ratio | USEPA | .. | 18.8:1 |
| 09 | Calorific Value | ASTM D 5865 | K.cal/kg | 181 |

Contd.....

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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5066/2023 |
|---|---|---|
| M/s. IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 15/06/2023 |
| | Date of monitoring | 29/05/2023 |
| | Date of sample received: | 29/05/2023 |
| | Date of analysis | 30/05/2023 |
| | Sample Description | Waste Analysis - North Paravoor-Vedimara |
| | Sample Location | Gps Reading : : N- 10 °09'1.884"<br>E -76°14'31.56" |

**TOXICITY ANALYSIS- HEAVY METALS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 10 | Iron (Fe) | USEPA 3050 | % | 1.87 |
| 11 | Arsenic(As) | USEPA 3050 | mg/kg | <0.1 |
| 12 | Selenium(Se) | USEPA 3050 | mg/kg | <0.1 |
| 13 | Nickel(Ni) | USEPA 3050 | mg/kg | <0.1 |
| 14 | Zinc (Zn) | USEPA 3050 | mg/kg | 144 |
| 15 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 |
| 16 | Copper (Cu) | USEPA 3050 | mg/kg | 42.1 |
| 17 | Chromium(Cr) | USEPA 3050 | mg/kg | 10.08 |
| 18 | Lead(Pb) | USEPA 3050 | mg/kg | <0.1 |
| 19 | Mercury(Hg) | USEPA 3050 | mg/kg | <0.1 |
| 20 | Manganese(Mn) | USEPA 3050 | mg/kg | 35.13 |

* End of the Report*

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QUALITY MANAGER

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5068/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 15/06/2023 |
| | Date of monitoring | 29/05/2023 |
| | Date of sample received: | 29/05/2023 |
| | Date of analysis | 30/05/2023 |
| | Sample Description | Waste Analysis - North Paravoor-Vedimara |
| | Sample Location | Gps Reading : : N- 10 °09'1.884"<br>E -76°14'31.56" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 31.4 |
| 02 | Bulk Density | | | USEPA | $kg/m^3$ | 810 |
| 03 | Density | | | USEPA | $g/cm^3$ | 0.8054 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 210 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 4.75 | 4 + | | | 40.3 |
| | | 2.36 | 8 | | | 16.8 |
| | | 1.18 | 16 | | | 32.4 |
| | | 0.6 | 30 | | | 10.5 |

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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5069/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 15/06/2023 |
| | Date of monitoring | 29/05/2023 |
| | Date of sample received: | 29/05/2023 |
| | Date of analysis | 30/05/2023 |
| | Sample Description | Waste Analysis - North Paravoor- Vedimara |
| | Sample Location | GPS Reading : N- 10 °09'4.329"<br>E -76°14'32.597" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 38.4 |
| 02 | Bulk Density | | | USEPA | $kg/m^3$ | 756 |
| 03 | Density | | | USEPA | $g/cm^3$ | 0.7309 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 181 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 4.75 | 4 + | | | 54.97 |
| | | 2.36 | 8 | | | 12.64 |
| | | 1.18 | 16 | | | 27.26 |
| | | 0.6 | 30 | | | 5.04 |

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SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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TC-6984

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/SD/5062/2023(ULR NO:TC658923000000005062F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue: | 15/06/2023 |
| | Date of monitoring | 29/05/2023 |
| | Monitoring Location | North Paravoor—Vedimara<br>GPS Reading : N- 10 °09'01.982"<br>E -76°14'31.593" |
| | Sample Description | Ambient Sound Level |

| HOURLY INTERVAL | | RESULT | HOURLY INTERVAL | RESULT |
|---|---|---|---|---|
| 29.05.2023 | 11.00 Hrs | 59.8 dB (A) | 04.00 Hrs | 59.8 dB (A) |
| 12.00 Hrs | | 56.9 dB (A) | 05.00 Hrs | 60.2 dB (A) |
| 13.00 Hrs | | 61.2 dB (A) | 06.00 Hrs | 58.6 dB (A) |
| 14.00 Hrs | | 62.6 dB (A) | 07.00 Hrs | 61.3 dB (A) |
| 15.00 Hrs | | 61.5 dB (A) | 08.00 Hrs | 58.7 dB (A) |
| 16.00 Hrs | | 60.9 dB (A) | 09.00 Hrs | 59.8 dB (A) |
| 17.00 Hrs | | 58.8 dB (A) | 10.00 Hrs | 60.3 dB (A) |
| 18.00 Hrs | | 56.6 dB (A) | | |
| 19.00 Hrs | | 54.9 dB (A) | | |
| 20.00 Hrs | | 53.1 dB (A) | | |
| 21.00 Hrs | | 52.4 dB (A) | | |
| 22.00 Hrs | | 56.3 dB (A) | | |
| 23.00 Hrs | | 51.3 dB (A) | | |
| 30.05.2023 | 00.00 Hrs | 50.3 dB (A) | | |
| 01.00 Hrs | | 55.6 dB (A) | | |
| 02.00 Hrs | | 53.6 dB (A) | LeqDay | 59.6 dB (A) |
| 03.00 Hrs | | 56.3 dB (A) | LeqNight | 55.3 dB (A) |

Limits: Industrial Area Day Time-75dB(A),Night Time- 70dB(A),Commercial area Day Time -65 dB(A),Night Time55dB(A),
Residential area Day Time -55 dB(A),Night Time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am

*End of the Report *

For Poluchem Laboratories (P) Ltd.

Authorized Signatory

SREEJA RAJEEV
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

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TC-6589

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## TEST REPORT



**Ref.No: PL/RT/GW/1094/2023**
(ULR NO:TC658923000000001094F)

**Date of Issue: 15/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-2
Sample Location : North Paravoor- Vedimara
Gps Reading : N- 10 °09'0.373"
E -76°14'30.905"

Sample code : F/1094/2023
Date of Sample Collected : 29/05/2023
Date of receipt of sample : 29/05/2023
Date of analysis started : 30/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.64 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | BDL(MDL-0.1 NTU) | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 280 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 182 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 64 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 64 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 28.50 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 10.35 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | BDL(MDL-0.05 mg/l) | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 3.93 mg/l | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | BDL(MDL-0.1 mg/l) | 1.0 mg/l |

Conti…

SREEJA RA[illegible]
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 1094/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 110 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/5064/2023** **Date of Issue: 15/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-2
Sample Location : North Paravoor- Vedimara
Gps Reading : N- 10 °09'0.373"
E -76°14'30.905"

Sample code : F/5064/2023
Date of Sample Collected : 29/05/2023
Date of receipt of sample : 29/05/2023
Date of analysis started : 30/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 16 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | --- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

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Continuation of Test Certificate No: 5064/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

*End of the report*

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TC-6389

# POLUCHEM LABORATORIES PVT LTD

CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

Phone: 0484-2544030, 8281982322, 9747400085, www.poluchem.com, poluchem@gmail.com

ACCREDITED BY NABL - GOVT. OF INDIA AND KSPCB AS "A" GRADE LABORATORY

## TEST REPORT



**Ref.No: PL/RT/GW/1095/2023** **Date of Issue: 15/06/2023**

(ULR NO:TC658923000000001095F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : North Paravoor- Vedimara
Gps Reading : N- 10 °09'1.193"
E -76°14'30.689"
Sample code : F/1095/2023
Date of Sample Collected : 29/05/2023
Date of receipt of sample : 29/05/2023
Date of analysis started : 30/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 7.12 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 0.8 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 640 µS/cm | --- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 416 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1mg/l) | --- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 240 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 173.3 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 57.0 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 26.53 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.17 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.48 mg/l | 1.0 mg/l |

Conti…

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 1095/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 90 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

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## TEST REPORT



**Ref.No: PL/RT/GW/5065/2023** **Date of Issue: 15/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : North Paravoor- Vedimara
Gps Reading : N- 10 °09'1.193"
E -76°14'30.689

Sample code : F/5065/2023
Date of Sample Collected : 29/05/2023
Date of receipt of sample : 29/05/2023
Date of analysis started : 30/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 14 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | ---- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Conti..

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Continuation of Test Certificate No: 5065/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAVEENDRAN
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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## TEST REPORT



**Ref.No: PL/RT/SW/1096/2023** **Date of Issue: 15/06/2023**

(ULR NO:TC658923000000001096F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- North Paravoor- Vedimara
Sample Location : Gps Reading : N- 10°09'0.85"
E -76°14'14.671"

Sample code : F/1096/2023
Date of Sample Collected : 29/05/2023
Date of receipt of sample : 29/05/2023
Date of analysis started : 30/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 –1983RA2017 | 6.44 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 –1983RA2017 | 6 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 1.3 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 11300 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 7345 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 2 mg/l | --- | -- |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 1100 mg/l | 200 mg/l | -- |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 50 mg/l | -- | -- |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 3182.7 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 190.82 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 –1989RA2014 | 3.4 mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.28 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 1.15 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.95 mg/l | 1.5 mg/l | 1.5 mg/l |

Conti...

SREEJA RAJEESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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Continuation of Test Certificate No: 1096/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 350 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Present | --- | --- |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

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## TEST REPORT



**Ref.No: PL/RT/SW/5074/2023** **Date of Issue: 15/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water- North Paravoor- Vedimara
Sample Location : Gps Reading : N- 10 °09'0.85"
E -76°14'14.671"

Sample code : F/5074/2023
Date of Sample Collected : 29/05/2023
Date of receipt of sample : 29/05/2023
Date of analysis started : 30/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | -- | -- |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | --- |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | --- |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27° C ) | IS 3025 (P) 44 -1993RA2014 | 6.5 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 60 mg/l | --- | -- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | -- | -- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | 4.6 mg/l | --- | -- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory

SREEJA.K.S
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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TC-4599

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/125/2023 (ULR NO:TC658923000000125F) |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 15/06/2023 |
| | Date of monitoring | 29/05/2023 |
| | Date of sample received | 30/05/2023 |
| | Date of analysis Started | 30/05/2023 |
| | Sample description | Ambient air-North Paravoor-Vedimara |
| | Sample Code | G/F/125/2023 |
| | Sample Location | GPS Reading : N- 10 °09'01.787" E -76°14'31.921" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 141µg/m$^3$ | 100 µg/m$^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 43.6µg/m$^3$ | 60 µg/m$^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 6.6 µg/m$^3$ | 80 µg/m$^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 9.7 µg/m$^3$ | 80 µg/m$^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | 0.8 mg/m$^3$ | 4 mg/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

The results are related only to the sample submitted for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory

For and on behalf of
POLUCHEM LABORATORIES (P) LTD

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

# POLUCHEM LABORATORIES PVT LTD

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

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Phone : 0484-2544030, 8281982322, 9747400085,www.poluchem.com, poluchem@gmail.com

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/5059/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package B, KSWMP ) | Date of issue | 15/06/2023 |
| | Date of monitoring | 29/05/2023 |
| | Date of sample received | 30/05/2023 |
| | Date of analysis Started | 30/05/2023 |
| | Sample description | Ambient air - North Paravoor-Vedimara |
| | Sample Code | G/F/5059/2023 |
| | Sample Location | GPS Reading : N- 10 °09'01.787" E -76°14'31.921" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 µg/m$^3$ | 400 µg/m$^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m$^3$ | 1 µg/m$^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 6 ng/m$^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m$^3$ | 20 ng/m$^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m$^3$ | 180 µg/m$^3$ |
| Benzene ($C_6H_6$ ) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m$^3$ | 5 µg/m$^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m$^3$ | 1 ng/m$^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

The results are related only to the sample submitted for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory

For and on behalf of
POLUCHEM LABORATORIES (P) LTD

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER

# POLUCHEM LABORATORIES PVT LTD

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## TEST REPORT



**Ref.No: PL/RT/5067/2023** **Date of Issue: 15/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package B, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Leachate -North Paravoor- Vedimara
Sample Location : Gps Reading : N-10 °09 2'.465"
E -76°14'32.76"

Sample code : F/5067/2023
Date of Sample Collected : 29/05/2023
Date of receipt of sample : 29/05/2023
Date of analysis started : 29/05/2023
Date of completion of analysis : 15/06/2023

| Parameters tested | Test method | Results |
|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 4.77 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 16900 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 540 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 6267.5 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 76000 mg/l |
| B O D (3 days at $27^0$ C) | IS 3025 (P) 44 – 1993RA 2014 | 43000 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 3540 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 1406.7 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 16.84 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 2.56 mg/l |
| Cyanide as $CN^-$ | IS 3025(P)27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | 3.54 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | 2.6 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

BDL- Below Detection Level, MDL- Minimum Detection Level

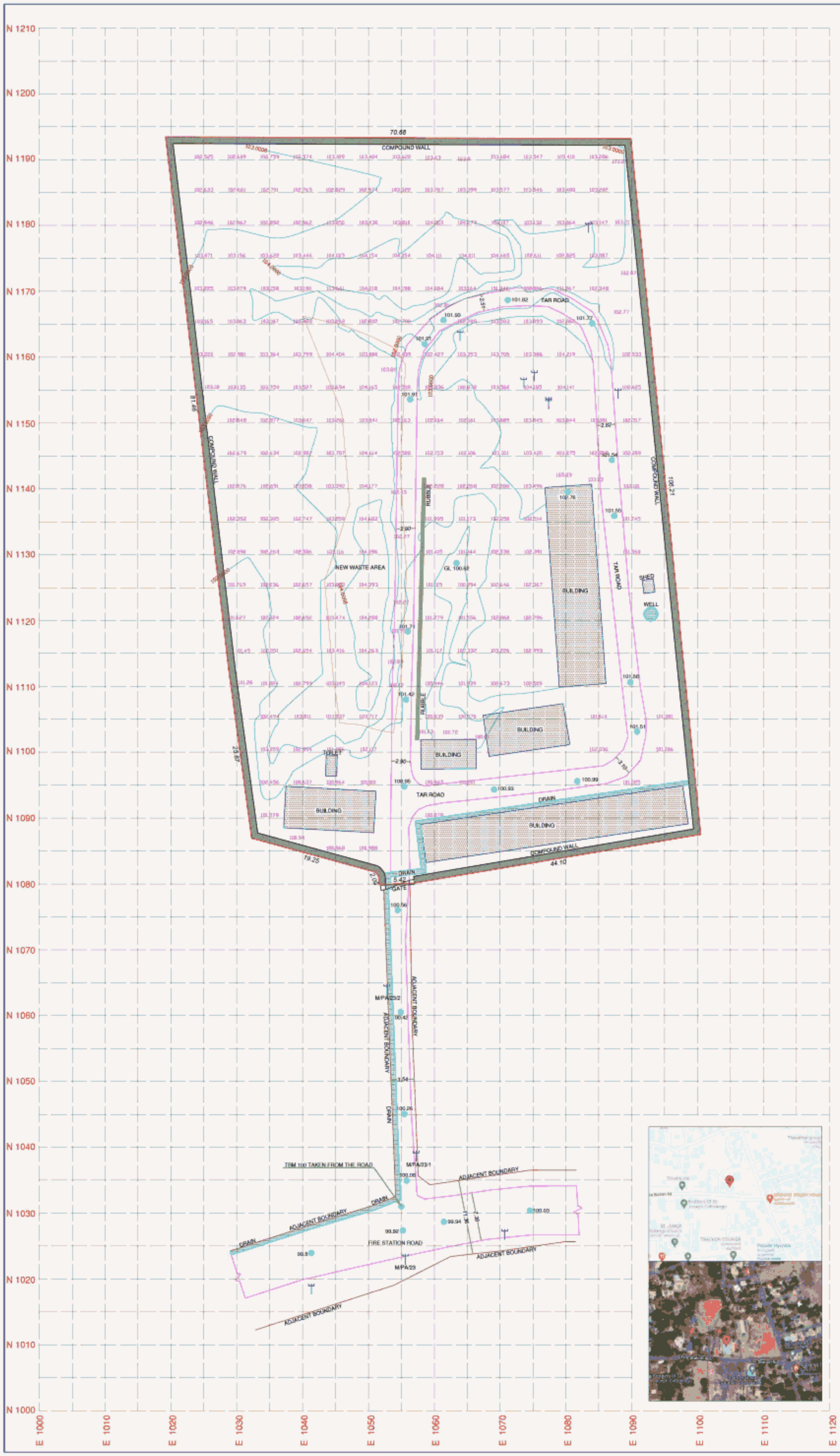
For Poluchem Laboratories (P) Ltd

Authorized Signatory

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

*End of the report*

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SCALE : 1:100
PRINT SCALE :

| | |
|---|---|
| DATE | 12/01/2023 |
| DRAWN | SINSHA |
| CHECKED | PRAKASH |

LEGENDS

ELECTRIC POST

SPOT LEVELS

BOUNDARY
ROAD
BUILDING
WALL
RUBBLE
DRAIN

AREA

CONTOUR INTERVAL - 1 METRE
GRID INTERVAL - 5X5 M

**AREA - 1.89 ACRES**

ALL DIMENSIONS ARE IN METRE

CLIENT

KSWMP
KAKKANAD

ARCHITECTS

SURVEYED BY

AKHILESH
NANDHU
KIRAN
NOEL

TITLE

CONTOUR & TOPO
SURVEY

DRAWING CODE

D.N. : 16638

SITE AT

PARAVOOR

( 10.151668 ° North , 76.242209 ° East )
( N10.151668 , E76.242209 )


SURVEYED BY

Spreads SURVEY

G-171, NR.SHOPPING COMPLEX

PANAMPILLY NAGAR

COCHIN - 682 036

Ph:0484 2323446

Mob: 98954 48367/9895448368

ROOM NO ,49,50 , VYAPARABHAVAN,

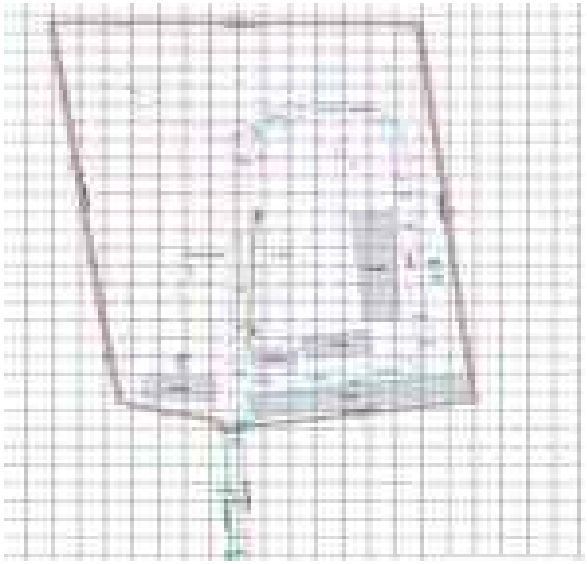
BANK ROAD

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spreadssurvey@gmail.com

- **Survey Map and Contour Map**



- **Proposed Operational Plan**



Land shall be reclaimed i.e. all the legacy waste will be removed till it reaches the surface of the earth/soil. The Machinery & Vehicles of the implementation agency shall be vacated within 14 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB after filling the inert/ soil enricher at the site with proper compaction and appropriate profiling for an aesthetic appearance. The material must be stabilized and is expected to be within the allowable limits for landfill, however the profiling will be done with appropriate drainage system. The contractor is required to provide the design for the profiling ensuring stability, compaction, drainage etc in the technical bid. It will be the responsibility of the contractor to ensure proper slope stability, compaction, and surface run-off drainage. The inert and soil enricher recovered will be subjected to biweekly sampling to check the parameters mentioned in schedule II of SWM Rules 2016 before using the material at site.

# Part B
# SOCIAL IMPACT ASSESSMENT



**VEDIMARA DUMPSITE,**

**NORTH PARAVOOR,**

**District- Ernakulam,**

**ULB- North Paravoor**

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## 1. Introduction

The Vedimara Dumpsite is situated at the ward No.10 of North Paravur Municipality in the Ernakulam District. The Dumping has started here in the year of 1997 onwards. This screening report provides an update about the Vedimara dump site, based on the findings from the social screening and transect walk. The report addresses the current situation at the dumpsite, potential social impacts due to the implementation of the project, recent fire incidents, remediation efforts, the quantity of legacy waste, the dumpsite's location within the solid waste management facility, and the complaints received from nearby communities.

## 2. North Paravoor Municipality- Brief Profile

North Paravoor is a town in the midlands directly to the east of Kochi in Ernakulam district, Kerala. North Paravoor, formerly known as Paravur or Parur, is a municipality and suburb in Ernakulam district in the Indian state of Kerala. It is a northern suburb of the city of Kochi and is situated around 20 km from the city centre. The coastal highway NH-66 Panvel-Kanyakumari passes through this town. The National Waterway-3 Kollam-Kottapuram passes through the west end of the taluk. Total population of the ULB is 31,503 (as per Census 2011). North Paravoor Municipality is located at latitude 10.15°N and longitude 76.23°E and is located on the western part of the district.

## 3. Vedimara Dumpsite

North Paravur dumpsite is located at a distance of 2 km from the centre of North Paravur town in western side and encompasses an area of approximately 1.25 acres of land. The dumpsite is not very far from human settlement. The coordinates of the dumpsite are, 76.242212 E & 10.150518 N. It is located in ward no. 10 of the municipality. North Paravur municipality holds the ownership of the dumpsite. The dumpsite is surrounded by highway from north-western directions. Dumping was started in this site in 1985 and stopped in the month of April 2023. As of now 50 % of the area is covered with solid waste. Presently, the quantity of waste dumped at this site is about 11,860 cum m as per the records available with the ULB.

*Table 3.0.1 Project Information*

| PROJECT INFORMATION | |
|---|---|
| **Location of the sub-project** | Dumpsite Remediation-Vedimara, North Paravoor |
| **GPS coordinate of the Site** | 10. 150518, 76. 242212 |
| **Name of the sub-project** | North Paravoor Solid Waste Dumpsite Reclamation by Bio mining |
| **Name of ULB** | Paravoor |
| **District** | Ernakulam |

| | |
|---|---|
| **Taluk** | Paravoor |
| **Total population in the ULB** | 31503 |
| **Proposed dumpsite area (in acres)** | 1.25 |
| **Land Use and Other Details** | Land Use: Solid Waste Management<br>Ward Name: Vedimara |

## 4. Socio economic baseline of Host community

It is observed that, there are 40 households, a church with a rehabilitation centre for differently abled people with 35 inmates, one fire station **etc.** are situated within the radius of 200 meters from the dumpsite. Among them, a single house and a mechanical workshop were found very close, **i.e.,** within 20m distance from the dumpsite.

## 5. Vulnerability mapping of the Host community

| Sl No. | Particulars | Nos. |
|---|---|---|
| 1 | Number of senior citizens, aged above 60 | 50 |
| 2 | Number of single women | 17 |
| 3 | Physically challenged persons | 35 |
| 4 | Persons with chronic diseases | 15 |
| 5 | Persons having respiratory issues | 20 |
| 6 | Children below 5 years of age | 19 |

*Source of data: Secondary data from Ward level health officer*

## 6. Data Collection Tools

### 6.1 Social Screening

The social screening was conducted using the social and tribal screening checklist in accordance with the requirements of the ESMF. It has been observed that the only anticipated risk is associated with labour, with no other adverse social impacts on dwellings, land, labour, livelihood, or community resources of the host and other vulnerable communities. The assessment of the social screening indicates that the remediation of the dumpsite can have a positive impact on the living conditions of the host community.

Municipality is running an MCF, Vermi compost unit and windrow compost unit in the same compound. Total 46 HKS and 6 sanitation workers are working on shift basis in these units. So, it is essential to adopt proper measures to do the remediation work without interrupting the functioning of these units. No other specific social risks are identified for initiating the remediation process except the occupational hazards to the workers engaged in the remediation process functioning in the site.

6.2 Transect walk

Transect walk is conducted to understand the social dynamics, demographic profile, livelihood patterns, social dynamics of the community and to understand the needs, concerns, and aspirations of the community. The transect walk at North Paravoor dumpsite was carried out on 6-06-2023, which is crucial for developing effective dumpsite remediation strategies that align with their priorities

A transect walk was conducted in and around the dumpsite on 06/06/2023. The aim of the transect walk was to assess the site and gather information about its location, potential social risks, existing infrastructure, and the impact on surrounding communities. The group exercise that entails walking between two points to intentionally cross or transect a community. The group explores environmental and social resources, conditions and systems by observing, asking, listening, looking and producing a transect diagram. Information collected can be used to reveal land use practices, hazards and vulnerabilities to inform disaster mitigation and water management

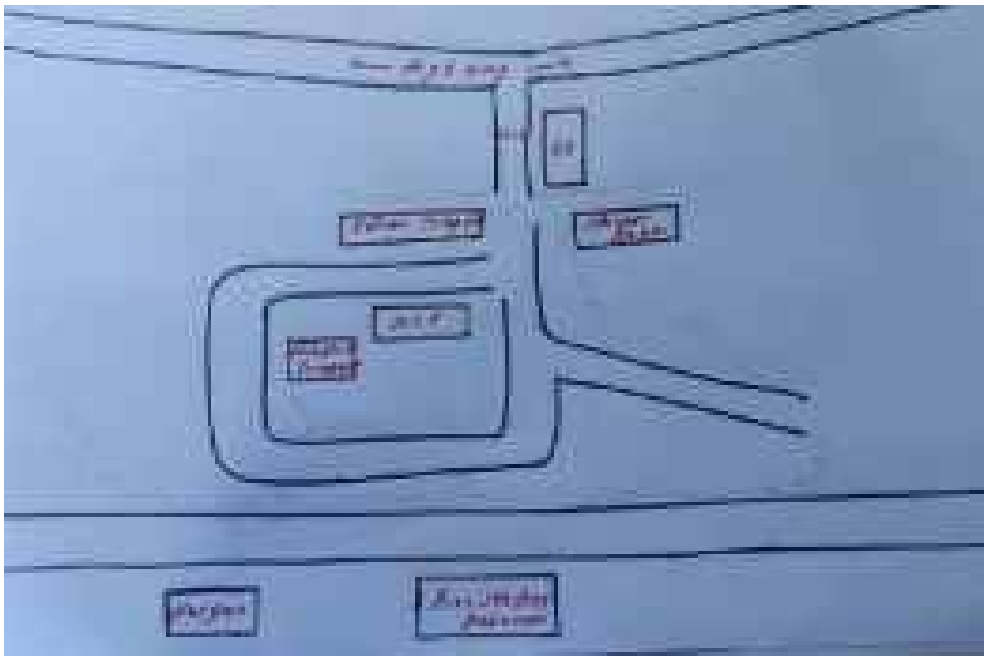


*Figure 6.1 Transect walk Map*

### 6.3 Focused Group Discussion

A Preliminary discussion was conducted on 30.05.2023 in the municipal hall with the families and representatives from the nearby institutions to identify their concerns about the remediation process. The dumpsite remediation process, benefits of the remediation were discussed during the meeting and addressed all the doubts and concerns of the host community during the stakeholder meeting.

### 6.4 Site Specific Observations from Transect walk and social screening

The major observations from the social screening and transect walk are given below:

- It is observed that, elderly aged above 60 years is running the windrow compost unit at the dumpsite. She is working on a full-time basis and this is the major source of income.
- It is observed that, there are 40 households, a church with a rehabilitation centre for differently abled people with 35 inmates, one fire station etc. are situated within the radius of 200 meters from the dumpsite. Among them, a single house and a mechanical workshop were found very close, i.e., within 20m distance from the dumpsite
- The Haritha Karma Sena (HKS) workers and sanitation workers, engaged in the waste management process in the MCF are not using protective gears.
- A rehabilitation centre with 35 differently abled people is functioning within the 200 meters radius from the dumpsite.
- There are no rag pickers staying within the 200-meter radius from the site.
- It is informed that, there was a fire hazard happened in the year 2019, and a major flood occurred in 2018.
- There is no requirement for government, forest, or private land acquisition for the dumpsite remediation project.
- The existing road to the dumpsite is only 3 meters wide, which is insufficient for accessing large transportation vehicles required for the remediation project.
- It is observed that, the host community is facing so many environmental and social issues due to the dumpsite.
- Proper firefighting mechanism is not installed in the dumpsite.

## 7. Stakeholder Analysis

Social safeguard aspects during dump site remediation are mainly focusing on meaningful stakeholder engagement, understanding stakeholder's risk perception and restoring them to a safe and environmentally sustainable state. The remediation process requires collaboration of the following stakeholders.

*Table 7.0.1 Stake Holder Details*

| SL No | Stakeholders | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| 1 | ULB Council | Provide ground support |
| 2 | ULB Officials | Support and Monitoring of the process |
| 3 | DPMU | Monitoring and Evaluation |
| 4 | TSC/PMC | Technical support and consultation |
| 5 | Contractor | Execution of the Remediation process |
| 6 | Service providers/HKS | 46 HKS workers and 5 sanitation workers helps in the proper collection and waste segregation to prevent further dumping after remediation. |
| 7 | Public coming to the nearby workshop | Support and cooperation for the remediation process |
| 8 | Labours of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |
| 9 | Rag Pickers | Participation of informal sector to strengthen the collection process for preventing further dumping. |
| 10 | Waste Generator in Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |
| 11 | Owner and workers in the Workshop located within 20m of the site | Cooperating with the remediation process. |
| 12 | Public coming to the nearby workshop | Support and cooperation for the remediation process |

| | | |
|---|---|---|
| 13 | Staffs of the Fire Station located within the 20m of the site. | Provide emergency service at site if any emergency situations like fire or accidents at site. |
| 14 | Scrap dealers | Informal participation in NBD waste management to prevent further dumping after remediation |
| 15 | End recyclers | Process the inert and legacy waste safely after remediation |

## 8. Positive social impacts after remediation

Dumpsite remediation will create 1.25 acres of vacant land which can be effectively useful for other purposes of ULB especially for the waste management. Apart from the land, many dumps show significant contribution of recyclables to the revenue generated. And the removal of waste dump sites can create new opportunities for economic development in the area. The cleaned-up land can potentially be used for new construction, commercial development, or recreational activities. Other major positive social impacts are shown below.

### 8.1 Enhanced quality of life

The remediation can restore the aesthetics of the area, reducing visual blights, foul odour and improving air and water quality. According to the opinion of people residing in ward 6, the project can contribute to an improved sense of well-being. Also, it results to a clean and hygienic work environment for the workers engaged in MCF.

### 8.2 Livelihood and employment of vulnerable community

It is identified that no rag pickers are currently engaged in collecting waste from the dumpsite or making a living from it. Therefore, the proposed dumpsite rehabilitation project will have no impact on housing or livelihood of any rag pickers.

### 8.3 Economic opportunities.

After remediating the site, the Municipality is planning to enhance the capacity of the MCF to process more non-biodegradable waste and to set up a centralized waste management unit to process the biodegradable waste. These projects will create more job opportunities to the people who are looking for employment in waste management sector.

### 8.4 Access to service.

It is observed that the project will not affect access to any facilities, services, or natural resources as there is enough space/land available in the exiting site.

## 9. Expected social impacts during the remediation

- As a result of remediation process, health and safety issues may occurs to the SWM workers currently working inside dumpsite.
- GBV/SEA incidents might be occurred to the SWM workers and host community members as a result of labour influx as part of remediation.
- Chances of Spreading of Communicable diseases.
- There is a high chance of fire incidents, as there is no firefighting mechanisms installed in functioning MCF.

## 10. Feedback from Screening and Transect walk

- Effective FGD'S should be conducted among the host communities with the elected representatives, community leaders and ULB authorities for conveying the benefits of dumpsite remediation.
- Proper firefighting mechanisms to be established inside the dumpsite.
- A project-level grievance redressal mechanism will be established to address GBV related issues during the work execution.
- The existing road to the dumpsite is only 3 meters wide, which is insufficient for accessing large transportation vehicles required for the remediation project. However, there is an alternative road on the north side of the dumpsite, which is 7 meters wide. It is recommended to reopen this road before commencing bio mining operations to facilitate the transportation of construction materials.
- A detailed IEC plan needs to be prepared.
- Proper sign boards and emergency numbers should be exhibited.

## 11. Scoping of Social Impact Assessment and required Action plans

All the social risks were identified through the social screening and Transect walk conducted at site. Since there are families and institutions in the proximity of the dumpsite, below shown action plans have been formulated to be followed at site.

- **Labour Management Plan**:

Approximately 15 laborers would be engaged in a day during the bio mining process on a regular basis for a period of 6 months. The contractor must get all the mandatory registrations and licenses and to comply with all relevant labour laws. Labour management plan has been prepared and attached as Annexure.

- **Labour Influx Management Plan**

Since the site is near to the habitation, the influx of labour may affect the host community. So, an action plan has been prepared and the same is attached as Annexure.

- **Preventive GBV Action plan**

Preventive GBV plan shall be formulated and followed at site by the contractor as there are female workers engaged in work in the MCF and Windrow composting unit. An action plan has been prepared and the same is attached as Annexure.

- **Citizen Engagement Plan**

Being a thickly populated area, and considering the concerns of the host community, a detailed Community engagement plan has been prepared and the same is attached as Annexure.

As per the detailed assessment of potential social risk during the remediation process, the identification from social screening with screening checklist, transect walk and focus group discussion indicates that there will not be any impacts on the livelihood of the community and service providers including rag pickers and land acquisition is not required as sufficient land is available.

## 12. Conclusion.

The Social Screening and Transect Walk of the North Paravoor Dumpsite helped to analyse and identify the potential social impacts of the dumpsite remediation process on the host community. It also provided insight on the social dynamics, demographic profile, livelihood patterns, social dynamics of the community and to understand the needs, concerns, and aspirations of the community. Removing the current legacy waste at the dump site via bio-mining will be extremely useful to the residents of the area. This can also eliminate the threat of summer fires and protect water supplies from contamination caused by excess leachate during the wet season. This will undoubtedly improve the quality of life for local communities while avoiding health problems caused by pollution. The proposed mitigation measures in this report will reduce the social risks identified through social screening and transect walk.

# ANNEXURE-1

## Citizen Engagement Plan

### 1. Stakeholder identification

As part of social safeguard initiatives for the Bioremediation of Vedimara dumpsite at North Paravoor, the social experts of TSC, DPMC and DPMU conducted interactive meetings with local community and functionaries of North Paravoor Municipality and PIU team. A detailed list of primary and secondary stakeholders is prepared on the basis of these exercises.

#### 1.1 Waste Generator

Since the dump site has been officially closed for the last 3 years, the waste generators in North Paravoor Municipality do not have any stake in the programme at present. But 40 families staying close to the Dump site and the employees of the nearby institutions such as Shelter home, Church and shops are the primary stakeholders.

#### 1.2 Service Providers

For the successful completion of the bioremediation project, service of many people, agencies and departments are to be ensured by proper advocacy and networking initiatives. Following is the list of service providers identified through stakeholder analyses and their expected role/responsibility in the project.

*Table1.1 Roles of Stakeholder*

| SL No | Stakeholder | Roles of the stakeholders w.r.t remediation process |
|---|---|---|
| 1 | Municipal Council | Providing ground support and Monitoring |
| | Officials/staff members of the Municipality | Administrative supports and support for the monitoring of the process |
| 1 | Govt institutions like PCB, KSEB, KWA, and health department | To deliver necessary approvals and provide services for the remediation purpose |
| 3 | KSWMP | Monitoring and Evaluation |
| 4 | TSC/PMC | Technical support and supervision |
| 5 | Contractor | Execution of the Remediation process |
| 6 | Service providers/HKS of the Municipality | Proper collection, segregation, and transportation of waste to appropriate processing units to prevent the formation of such dumping yards in the future |
| 7 | Labors of contractor/Agency at site | Execution of work by strictly following Labour Management plan and Preventive GBV Action plan |

| | | |
|---|---|---|
| 8 | Waste Generator in the Municipality | Compliance with the rules and policies of the ULB related to waste management to avoid the formation of such dumping yards in future |
| 9 | End recyclers | Process the inert and legacy waste safely after remediation |
| 10 | Media | Create an enabling environment for the successful completion of the project through positive reporting by the media. |
| 11 | Police | Ensure law and order in the area, if required |
| 12 | Fire and safety | Extend assistance in case of an emergency. |

## 2. Need of Plan

Citizen engagement as part of the proposed bioremediation of Vedimara dumpsite aims to facilitate two-way communication between the project and its stakeholders in order to make better informed decisions that are of value to the residents of the Municipality. Such an engagement will certainly pave the way for better implementation of the project, and it will ensure public participation in trouble shooting at all the stages of the implementation of the project.

## 3. Objective of Plan

The citizen engagement plan for the proposed dump site remediation is prepared with following objectives.

- To create a conducive environment for the smooth implementation of the proposed bioremediation of the dumpsite by promoting constructive dialogues between the project and its stakeholders.
- To ensure stakeholder participation in the planning, implementation, and monitoring of the project.
- To suggest appropriate activities with a monitoring plan and an expected budget for engaging the stakeholders with the motive of enhancing their ownership in the project through increased participation.

## 4. Stakeholder concerns

### 4.1 Waste Generators

The existing dump on the site is now the concern of the host community for the prevailing environmental and social problems facing them. The remediation work may create some discomfort to the 40 families residing near to the site and the persons associated with the nearby organizations/institutions. This can be managed through proper orientation and proper awareness generation.

### 4.2 Service Providers

Major concerns of the service providers which has to be addressed by the citizen's engagement plan can be summarized as follows.

- The policy makers and decision leaders of the Municipality are not aware about the urgency and importance of remediating the dumpsite. Hence there is an apathy observed among the councilors and officials to the project. Their improved involvement through proper sensitization is essential to the effective implementation.

- SWM related Service providers, HKS working in the MCF, RRF and windrow composting unit at the site need to be properly oriented about the project and health and safety measures to be adopted during the remediation period.
- The entire SWM related Service providers/HKS of the Municipality should be trained and motivated for proper timely collection, segregation, and transportation of waste to appropriate processing units to prevent the formation of such dumping yards in the future.

## 5. Public disclosure Activities proposed

### 5.1 Community Awareness

- Orientation meeting and focused group discussions with host community
- Organize exposure visit to any of the site where the remediation process completed successfully. Members from the primary stakeholders and ULB council may be participated in the exposure visit.
- Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency.

### 5.2 Awareness to Service Providers

- Sensitization on the bio-remediation activity is to be conducted for the Municipal Council and officials prior to the commencement of the actual bio-remediation process.
- Meeting with Contractor to understand their plan of operations/ labors involvement/timeline etc.
- Orientation to the Service providers/HKS members working in the MCF, RRF and Windrow unit.
- Sensitize the local and district level police officials on the proposed bioremediation in the dumpsite and anticipated issues and action required.
- Orientation meeting to the labors about the LMP and GBV action plan to be followed at the site.

## 6. Citizen Engagement Plan Matrix

| S. No | Engagement Challenge | Purpose on Community/Citizen | Proposed activities | Implementing Responsibility |
|---|---|---|---|---|
| 1 | Awareness on Project activities | | | |
| 2 | To facilitate timely support from the ULB and avoid delays in decision making. | To establish transparency and building confidence in the project commitments to ULB elected members and officials. | Sensitization on the bio-remediation activity is to be conducted for the Municipal Council and officials prior to the commencement of the actual bio-remediation process. | Contractor/PIU |
| 3 | To create awareness among 40 families of host community) and members of nearby organizations about the proposed bioremediation activities and safeguard measures to be adopted | To establish transparency and build confidence in the project commitments to the host community. | Sensitization meeting to host community | Contractor/PIU |
| 4 | To facilitate and establish problem solving mechanism at dumpsite site level | To facilitate host community participation in the Bioremediation activity and establish a mechanism to solve the issues raised at the site level at the earliest and avoid any delay and interruptions. | Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency. | Contractor/PIU |
| 5 | Understand the actual operational plans (Time of operations, Machineries involved, no of workers and labour details, action to be | To inform actual plan of operations to the host community and prevent any social and environmental issues and plan mitigation measures | Meeting with Contractor to understand their plan of operations/No labors involvement/timeline etc. | Contractor/PIU |

| | | | | |
|---|---|---|---|---|
| | taken for dust, odor and sound pollution, Vehicle movements etc. for mitigation measures to be planned. | | | |
| 6 | Confidence building measures in the host community to create community participation and generate positive attitudes for bio mining activities. | To avoid delays and completion of remediation activity as planned | Organize exposure visit for the host community and ULB council members | Contractor/PIU |
| 7 | To facilitate proper collection, segregation and transportation of waste to appropriate processing units to prevent the formation of such dumping yards in the future | To safeguard the environment, promote a healthy society, and implement measures for climate-resilient activities. | Orientation to the Service providers/HKS Municipality | Contractor/PIU |
| 8 | To secure support from the line department and prevent delays in decision-making. | To avoid delays and completion of remediation activity as planned | Issue based one to one meeting with Govt institutions like PCB, KSEB, KWA, Health Department | Contractor/PIU |
| 9 | To garner public support and ensure the smooth implementation of bioremediation activities | To raise awareness about the positive impact within the community and dispel any doubts regarding the remediation process. | Orientation to the Media persons on the proposed remediation in the dumpsite. | Contractor/PIU |
| 10 | To ensure peaceful and smooth bio remediation activity and prevent | To prevent unrest and social issues | Sensitize the local and district level police officials on the proposed bio remediation and | Contractor/PIU |

| | | | | |
|---|---|---|---|---|
| | any law and enforcement issue | | anticipated issues and action required | |
| 11 | Making aware of labors of the contractor about the Labour management Plan and GBV action plan to be followed at the site | To prevent violations in the action plans | Interactive session with Labors | Contractor/PIU |

7. Budget

| S. No | Activity | Specification | Quantity | Cost |
|---|---|---|---|---|
| 1 | Sensitization on the bio-remediation activity is to be conducted for the Municipal Council and officials prior to the commencement of the actual bio-remediation process | Half day Programme for the Councilors and Health Staff | 1 | [redacted] |
| 2 | Sensitization meeting to host community (40 families, Authority of shelter home running by the Church and shop keepers | Half day Program at site | 2 | [redacted] |
| 3 | Formation of GRM committee at local level to take up any issue raised at site level and help to resolve an emergency. | Committee formation | 1 | [redacted] |
| 4 | Meeting with Contractor to understand their plan of operations/No labors involvement/timeline etc. | One to one interaction | As required | [redacted] |
| 5 | Organize exposure to the members representing the host community families, employees of nearby institutions and council members | Exposure visits to Alappuzha Sajivothapuram site | 15 participants-1programme | [redacted] |
| 6 | Orientation to the Service providers/HKS of Municipality | Half day programme | 2 | [redacted] |
| 7 | Issue based one to one meeting with Govt institutions like PCB, KSEB, KWA, Health Department | One to one | As required | [redacted] |
| 8 | Orientation to the Media persons on the proposed remediation work | Half day programme | 1 | [redacted] |

| | | | | |
|---|---|---|---|---|
| 9 | Sensitize the local and district level police officials on the proposed bio remediation and anticipated issues and action required | One to one interaction | As required | [redacted] |
| 10 | Orientation to Labors deputed by the contractor about the LMP and GBV Action plans | Half day program | 1 | [redacted] |
| | **Total** [redacted] | | | |

## Annexure-2

# Preventive GBV Action Plan

## 1. Sub project information

Bio Remediation of existing dumpsite in ward 10 of North Paravoor Municipality

### 1.1 Details of labors

The project is under pre planning stage. ULB has to finalize contactor/Agency for Remediation. So, the exact number of Labors are not available. But approximately we can expect maximum of 12 labours

| | |
|---|---|
| Total number of labors | : 12(Approx.) |
| Category of labors (Age/sex/gender) | : Not available |
| Data of migrant labors, if any | : Not available |

## 2. GBV Issues likely to be identified at site

1. Issues against female workers at site
2. Lack of safe and Gender friendly toilets at work sites
3. Disparity in work and wages based on gender
4. Threat of GBV or Sexual Exploitation Abuse (SEA) incidents to female members of the host community

## 3. Activities under GBV Action plan

### 1. Formation of Internal Complaints Committee

The committee should be Presided by a senior woman and more than half of the total Committee members should be women. There should be an external member who has experience in dealing with issues related to women. Preferably a Social Worker /Advocate/NGO Representative.

**2. Placing of ICC informatory boards at Work site**

| Insert Logos of KSWMP,WB,AIIB | | | |
|---|---|---|---|
| **Project Name (KERALA SOLID WASTE MANAGEMENT PROJECT)** | | | |
| **Sub Project Name:** | | | |
| **Internal Complaints Committee** | | | |
| Sl.No | Name | Designation | Contact Number |
| | | | |
| | | | |
| **EMERGENCY CONTACT NUMBER** | | | |

**3. Gender Sensitization trainings for Labors**

The Project expect around 12 labours will be employed in a day and women participation in the labor force is limited, even the project is taking precaution to protect and prevent any GBV incidence at the site. Taking into consideration all these aspects, the project plan to conduct a half day sensitization program in the following subjects, viz. the type of GBV, the action to be taken by the victim, the laws and the support organizations which extend support to the victim of GVB and the role of ICC and their contact details etc.

**4. Sensitization for female host community members**

The citizen engagement plan has proposed an activity of host community meeting in which the importance and expected social risk of GBV will be discussed and the mitigation measures inbuilt in the project will be elaborated to the host community members especially to the women.

**5. Allocation of Gender friendly and safe toilet facilities for women**

Project has taken special care to arrange a separate toilet, wash and rest facility for female workers to protect their privacy and safety, and the same has to be arranged by the contractor.

**6. Keeping of wage register at site to restrict wage disparity based on gender**

The project actively opposes gender-based wage disparity at any site funded under the KSWMP-supported SWM project. To ensure gender parity in various aspects such as wages, division of labour, and facilities, an appropriate monitoring mechanism, such as a wage register, should be maintained for the scrutiny of the project implementers.

## 7. Details of GBV Service Providers identified

The government of Kerala has constituted a help desk under Kudumbashree to support or to prevent and extend support to the GBV victims, and their details are given below.

Kudumbashree Snehitha Gender Help Desk
Contact Number – 0484-2428745
Toll free number - 180042555678

**Preventive GBV Implementation plan**

| Sl No | Activity | Timeline | Primary Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 1 | Formation of Internal complaint committee | Pre-Construction Phase. | TSC/Contractor | DPMU |
| 2 | Placing of ICC informatory Board at worksite | Pre-Construction Phase. | Contractor | DPMU |
| 3 | Gender sensitization Training to labors | During Construction | Contractor/TSC | DPMU |
| 4 | Group Discussion with female host community members | Pre-Construction Phase. | TSC/ULB | DPMU |
| 5 | Ensuring Gender friendly and safe toilet facilities | Construction stage | Contractor | DPMU |
| 6 | Keeping Wage Register at site | Construction stage | Contractor | DPMU |

**Budget**

| Sl No | Particulars | Cost |
|---|---|---|
| 1 | Placing of ICC informatory board at site | [redacted] |
| 2 | Gender sensitization trainings to labor | [redacted] |
| 3 | FGD among Female host community members | [redacted] |
| | **Total Cost** | [redacted] |

**Monitoring plan**

| Activity | Monitoring Indicators | Means of Monitoring | Reporting Period | Responsibility |
|---|---|---|---|---|
| Formation of Internal complaint committee | Minutes of Meeting/Bye Law of Committee/Reports | Verification of Minutes of Meeting and Reports | 15 days after commencement of work | DPMU |
| Placing of ICC informatory boards at worksite | Photos of Boards placed | Physical verification | 15 days after the commencement of work | DPMU |
| Gender sensitization Training to labors | Attendance and Photographs | Verification of Documents | 5 days after the commencement of work | DPMU |
| FGD among female host community members | Attendance and Photographs | Verification of Documents | 5 days after the commencement of work | DPMU |
| Ensuring Gender friendly and safe toilet facilities | Gender friendly signage's, Condition of latches, Floor Condition, Status of Flush | Physical verification | Before Commencement of work | DPMU/TSC |
| Keeping Wage Register at site | Photographs | Verification of Register | 5 days after the commencement of work | DPMU/TSC |

## Annexure-3

# Labour Management Plan

## 1. INTRODUCTION

### 1.1 PROJECT TITLE:

Project for the remediation of dumpsite at Vedimara, owned by North Paravur Municipality

### 1.3 PROJECT AREA

The Vedimara Dumpsite of North Paravur Municipality is situated in ward 10 of the municipality, covering an area of 1.5 acres.

## 2. SCOPE AND STRUCTURE OF THE LABOUR MANAGEMENT PLAN

The scope of the LMP shall be as outlined in the World Bank's ESMF. The engagement will be planned as an integral part of the project's social assessment and project design and implementation. This document has 10 chapters. This chapter viz., chapter 1 served as introduction. Scope and structure of LMP is provided in chapter 2. An overview of labour use in the project is presented in chapter 3. Key potential labour risks are listed in chapter 4. Legislative framework governing labour employment in India/Kerala is discussed in chapter 5. Implementation Arrangements, policies and procedures follow in the subsequent chapter. Grievance redressal mechanism, contractor management are presented in the last chapters.

## 3. OVERVIEW OF LABOUR USE ON THE PROJECT

3.1 Details of Labors

The proposed remediation process requires following category and number labors

| Sl. No | Equipment | Category of labors | Required No.of labors |
|---|---|---|---|
| 1 | One trommel | Labors for waste segregated purpose | 5 |
| 2 | One excavator | Operator | 1 |
| 3 | One JCB | Operator | 1 |
| 4 | Two small tippers | drivers | 2 |

| | | | |
|---|---|---|---|
| | | Helpers | 2 |
| 5 | | Supervisor | 1 |
| **Total Labours** | | | 12 |

## 4. ASSESSMENT OF KEY POTENTIAL LABOUR RISKS

### 4.1 Project Activities:

The bioremediation of the dumpsite includes the following activities;

- Mobilization of plant and machinery for bio-mining
- waste excavation and forming of windrow
- Spraying with inoculum and waste stabilization
- Waste segregation and refinement
- sorting materials into recyclable, RDF, compost and inert
- Transport to the authorized recyclers and end users

### 4.2 Key Labour Risks

It is assessed that key labour risks would be associated with health and safety risks related to the construction activities such as exposure to physical hazards during construction activities such as: use of heavy equipment, exposure to noise and dust, falling objects, exposure to hazardous materials and exposure to electrical hazards from the use of tools and machinery, lack of proper sanitation facilities, availability of separate toilet for women workers. As the construction activities will involve hazardous work, persons under the age of 18 will not be employed by the Project. Many workers will be exposed to occupational health and safety hazards, primarily including but not limited to:

- Injuries/accidents/ fatalities leading to even death, while at work.
- Inadequate accommodation facilities at work force camps, including inadequate sanitation and health facilities.
- Non-payment of wages by Employer.
- Non-payment of benefits (compensation, bonus, maternity benefits etc.) by Employer
- Discrimination in Employment (e.g., abrupt termination from employment, working conditions, wages or benefits etc.)
- Engagement of child labour.
- Sexual harassment at work sites.
- Forced labour or trafficking.
- Security of women workforce.
- Inadequate facilities for pregnant women and lactating mothers.

- Inadequate facilities for the children of the workforce at workforce camp sites
- Possibility of Gender based violence as the work is mostly carried out within the premises of the existing facilities like MCFs/ RRFs etc where female SWM workers are engaged.
- Absence or inadequate or in accessible emergency response system for rescue of labour/workforce.
- Health risks of labour relating to HIV/AIDS and other sexually transmitted diseases.
- Unclear terms and conditions of employment.
- Discrimination and denial of equal opportunity in hiring and promotions/incentives/training opportunities.
- Denial for workers' rights to form workers organizations, etc.
- Absence of a grievance redressal mechanism for labour to seek redressal of their grievances/issues.

## 5. BRIEF OVERVIEW OF LABOUR LEGISLATION: TERMS AND CONDITIONS

| Sl No | Applicable Acts | Details |
|---|---|---|
| 1. | Employees Compensation Act 1923: | The Act provides for compensation in case of injury, disease or death arising out of and during employment |
| 2. | Contract Labour (Regulation & Abolition) Act 1970 | The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. |
| 3. | Minimum Wages Act 1948: | The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. |
| 4. | Payment of Wages Act 1936: | It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the workers. |
| 5. | Equal Remuneration Act 1976: | The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training, and promotions etc. |
| 6. | Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: | The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc. |
| 7. | Child Labour (Prohibition & Regulation) Act 1986: | The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in the Building and Construction Industry. |
| 8. | Employees State Insurance Act 1948: | The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all |

| | | |
|---|---|---|
| | | employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the Central Government. The Act also provides for benefits to dependents of insured persons in case of death because of an employment injury. |
| 9. | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: | This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee |
| 10. | Industrial Disputes Act 1947: | the Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing the establishment. |
| 11. | Trade Unions Act 1926: | The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. |

## 6. RESPONSIBILITY MAPPING

The ULB (Urban Local Body) will award the proposed work to the contractor through competitive bids. The contractor will be responsible for hiring labourers for both civil and skilled work. In the recruitment process, the contractor is obligated to provide opportunities to members of the host community who possess the necessary skills and willingness to engage in the activities available at the dumpsite for remediation.

The contractor is required to adhere to existing labour laws in the state of Kerala while employing labors, ensuring compliance with all applicable welfare measures mandated by the relevant labour legislation and rules. Additionally, the contractor is responsible for implementing measures to protect and assist vulnerable groups of workers, including individuals with disabilities, migrant workers, and women workers. These protective measures should be explicitly outlined in the work agreement.

Furthermore, the contractor must prioritize occupational health and safety measures for the labors. The ULB will actively monitor the contractor's compliance with legal and welfare requirements. The ULB will also organize training sessions for the workers and establish a forum at the ULB level to address any grievances raised by the workers.

It is a prerequisite for the contractor to possess a valid Labor License, and all laborers working on the site must be registered with the appropriate authorities. This comprehensive approach ensures the well-being and fair treatment of workers throughout the remediation project.

## 5. CODE OF CONDUCT

A code of conduct needs to be incorporated with the contract under the project. The contractor should conduct continuous awareness generation and training activities to ensure that the workers abide by the code of conduct. While preparing the code of conduct, following aspects should be ensured.

- Compliance with applicable laws, rules, and regulations of the jurisdiction
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment (PPE), preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment)
- The use of illegal substances
- Non-Discrimination (for example based on family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction)
- Interactions with community members (for example to convey an attitude of respect and non-discrimination)
- Sexual harassment (for example to prohibit use of language or behavior, towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate)
- Violence or exploitation (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favors or other forms of humiliating, degrading or exploitative behavior)
- Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behavior with children, limiting interactions with children, and ensuring their safety in project areas)
- Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by their employer and not open areas)
- Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favors, are not provided to any person with whom there is a financial, family, or personal connection)
- Respecting reasonable work instructions (including regarding environmental and social norms)
- Protection and proper use of property (for example, to prohibit theft, carelessness, or waste)
- Duty to report violations of this Code
- No retaliation against workers who report violations of the Code, if that report is made in good faith.

## 8. SYSTEMATIZING THE CODE OF CONDUCT

Awareness raising: The Contractor is required to conduct ongoing awareness-raising and training activities to ensure that workers consistently adhere to the Code of Conduct. Additionally, the Contractor must take measures to ensure that local communities are well-informed about the Code

of Conduct, enabling them to report any concerns or instances of non-compliance. This proactive approach aims to foster a shared understanding of ethical standards and accountability within both the workforce and the surrounding communities.

## 9. TRANSPARENCY IN CONTRACT SPECIFIC TERMS AND CONDITIONS

All contracts must contain

- Wages: Specific wages and payment modality, timeline
- Working Hours: hours of work, maximum number of hours that can be worked on the project, overtime, compensation
- Leaves: rest per week, annual leave, maternity leave, sick leave
- Benefits: medical treatments in case of accidents or otherwise
- Notice of termination of employment and details of severance payments in a timely manner
- Collective agreements that apply to the project, other specific terms, and conditions
- Details of the grievance redressal mechanism.

**LABOUR MANAGEMENT PLAN MATRIX**

| Activities | Target | Timeline | Means of verification | Responsibility |
|---|---|---|---|---|
| To complete the registration by the Principal Employer, the ULB, as per the provisions of the Contract Labour (Regulation & Abolition) Act 1970 (CL Act), Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979 (ISML Act) and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 (BOCW Act) and procure certificate to that effect. | 3 Registration Certificates to be procured by the ULB under CL Act, ISML Act and BOCW Act respectively. | Before Awarding works | Registration Certificate issued by District Labour Officer under CL Act, ISML Act and BOCW Act | PIU |
| To Procure license under CL Act, ISML Act and registration under BOCW Act by the contractor | 2 Licenses and One registration under CL Act, ISML Act and BOCW Act respectively. | Before commencing the work at site | License and registration certificate issued by the competent Authority. | Contractor |
| To procure Workmen Compensation insurance policy proportionate to the number of labour force deployed. (By the Contractor) | One insurance policy. | Before commencing work at site | Copy of insurance policy | Contractor |
| To display a copy of the certificate of registration at the conspicuous place at the premises where the building and other construction work is being carried on. | One notice board | As soon as the work is started. | Photographs of the notice board where the license is displayed. | Contractor |

| | | | | |
|---|---|---|---|---|
| To establish a labour information signboard at camp site by including following details like, date of payment of wages, working hours, holidays, wages rates for different categories of labours and name and contact details of local labour inspector and his/ her office and emergency contact numbers. | One notice board | Do | do | |
| To conduct pre- employment medical examination (as per the provisions of BOCW Act)- to ensure medical fitness of the employee. | All workers must be examined | No of workers employed by the contractor | Pre-Medical Examination certificate issues as per Rule 223(C) of BOCW Act (Form No. IX) by the Registered Medical Practitioner. | Contractor |
| To conduct Periodical Medical Check-ups (once in every six months) | All workers must be examined. | No of workers employed by the contractor | Medical Examination certificate issued by a registered medical practitioner. | Contractor |
| To provide safe drinking water- the contractor must provide safe drinking water at worksite as well as camp site* (Guideline is provided along with this document) | As per requirement | During the entire contact period | Photographs of supply of potable water, Bill of water purchase. | Contractor |
| To arrange first Aid facility at work site as well as camp site (Specifications and items to be maintained in the box is mentioned in this document) | As per requirement | During the entire contract period | First Aid Register, Bill of purchase, photographs of First Aid kit | Contractor |

| | | | | |
|---|---|---|---|---|
| To arrange separate First Aid room at work site | Allot one specified room | To be made available during the construction period | Photographs of the facility | Contractor |
| To provide first Aid training to selected labourers or staff members through an authorized agency. | One training with authorized agency | Within one month of commencement of the work | Training records & Photographs | Contractor |
| To establish linkage with local hospitals/ health care institutions for emergency medical assistance | Tie up with at least one hospital | Within one month of the commencement of the work | Letters issued by the hospital or correspondence and agreement with the hospital. | Contractor |
| To establish rest room at work site or camp site | | Before the commencement of the work | Photographs of the rest room | Contractor |
| To establish Canteen facility for labours if the contractor engages more than 250 labours | | Before the commencement of the work | Photographs of the facility, canteen register etc | Contractor |
| To maintain essential registers and records like Form A (Registration of employees), Attendance Register, Wages Register, and other registers like incidents registers including Accident register, Harassment complaints, recovery register, Maternity leave, Termination etc | | As and when the work starts | Copy of registers. | Contractor |
| Constitute GRC for labours (maximum members to be six. Number of members from employer and employee to be equal. | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |

| | | | | |
|---|---|---|---|---|
| Female members should be minimum 50%. ) | | | | |
| Constitution of ICC (minimum members to be four. The presiding member should be a senior female employee) | | As and when work starts | Copy of register and minutes of meeting. Complaint box etc | Contractor |
| To publish the abstract of labour laws within the premises of the labour camp.<br>1. The Payment of Wages Act<br>2. The Employee compensation Act<br>3. The Building and Other Construction Workers (RECS) Act<br>4. The Contract Labour (A&R) Act<br>5. The Child and Adolescent Labour (P&R) Act<br>6. The Maternity Benefit Act | Abstract of Six acts | As and when the camp is established | Photos of the notices published. | Contractor |
| To establish code of conduct and provide induction trainings | | As and when new employees are joined | Training reports and other documents | Contractor |
| Conduct HIV/AIDS awareness programs | As per requirement | Once in six months | Reports, photographs etc | Contractor |
| All the Drivers should possess effective and valid Driving License | Drivers should be selected after verification of DL | As and when drivers are appointed | Photocopy of licence ids to be collected | PIU |

| | | | | |
|---|---|---|---|---|
| All the vehicles involved in the project shall be insured to cover the third-party risk | Vehicle must be allowed to be plied in the project only after procurement of third-party insurance to the vehicle | As and when vehicles are plied in the project | Photocopy of insurance is to be collected | PIU |

Budget for LMP

| S.No | Item | Cost |
|---|---|---|
| 1 | Labour compliance as per LMP | [redacted] |

## ANNEXURE – 4

## LABOUR INFLUX MANAGEMENT PLAN

| RISK | MITIGARTION MEASURES | IMPLEMENTATION RESPONSIBILITY | MONITORING INDICATORS | MONITORING RESPONSIBILITY |
|---|---|---|---|---|
| Social and Community wellbeing | 1. Joint Meeting with the community by ULB officials and Elected members | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Economic and Livelihood Issues | Skilled /Unskilled jobs for the Community members in the sub-project | Contractor/PIU | • Risk identification report<br>• Proposed action/mitigation plan<br>• Action taken report/progress report | TSC/DPMU |
| Accommodation /labour camp | 1. Ensure basic amenities are provided to the labors (Toilets, Water, Kitchen facilities etc.)<br><br>Daily briefing to the labors | Contractor | • Risk identification report<br>• Proposed action/mitigation plan<br>• List of facilities in labour camp<br>• Details of labors | TSC/DPMU |

| | | | | |
|---|---|---|---|---|
| Communicable Diseases | Access to Medical Check-up<br>Aaresness to the labors | Contractor | • SOP for prevention of communicable disease and health wellbeing on worksite and labour camp<br><br>Report on medical check-up | TSC/DPMU |
| Crimes | 1. Intimation to the Local police about the camp | Contractor | Work site complaint register<br><br>Number of cases reported, and action taken | TSC/DPMU |
| Child Labour | 1. Ensure Adhar card of all labors at the site<br><br>2. | Contractor & TSC | • Number of child labour issues reported<br><br>Data of labors | ULB/DPMU |
| Gender-based violence, including sexual harassment child abuse and exploitation | 1.Gender sensitization briefing to the labors | Contractor/TSC | • Number of cases reported<br>• Action taken report<br>• Number of cases resolved<br><br>Time taken for resolving complaints | ULB/DPMU |
| Labour licenses | To be ensured by the contractor | Contractor/PIU | Number of labors having license | DPMU |

**Summary of SMP budget**

| S.No | SMP Activity | Cost |
|---|---|---|
| 1 | Labour Management Plan | [redacted] |
| 2 | Labour Influx Management Plan | [redacted] |
| 3 | Preventive GBV action plan | [redacted] |
| 4 | Citizen Engagement Plan | [redacted] |
| **Total** | | [redacted] |

# ENVIRONMENTAL IMPACT ASSESSMENT AND SOCIAL IMPACT ASSESSMENT REPORT FOR DUMPSITE BIOMINING AND BIOREMEDIATION, PUTHIYAPPA, VADAKARA MUNICIPALITY



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## Summary

### Introduction

The Vadakara municipality is an Urban Local Body (ULB) of the Kozhikode district of Kerala, covering an area of 21.34 square kilometers (sqkm)and divided into 47 administrative wards. This municipality generates 35.60 tons per day (TPD) of solid waste. However, Vadakara ULB do not possess adequate solid waste treatment and disposal facilities as mandated by the Solid Waste Management (SWM) Rules,2016. Consequently, unsegregated waste was disposed of in an unscientific manner; essentially dumped at the ULBs trenching ground (where feceas / night soil used to be dumped from pit latrines) at Puthiyappa in ward 20. Over the years of past 50 years, Puthiyappa dumpsite saw various types of wastes dumped there. In order to promote a healthy and sustainable environment, it is imperative to undertake the remediation of the existing dumpsite.

### Subproject Description

The Biomining and Bioremediation at the Vadakara ULB dumpsite is proposed as part of the Kerala Solid Waste Management Project (KSWMP) with support from the World Bank and the Asian Infrastructure Investment Bank. The dumpsite situated in Ward 20, Puthiyappa, covers a total area of 1.52 acres and contains a legacy waste quantity of 29,140 tons. The waste at the site is approximately 50 years old, with dumping activities started in 1962 and stopped in 2018. Initially, the dumpsite served as a trenching ground for the disposal of sewage from pit latrines. The total volume of waste accumulated is approximately 38,367 cubic meters, and the dumpsite spans across an area of 1.25 acres.

i. **Status of Subproject Development at the time of EIA**

   Currently, the dumping has stopped at site and solid waste of the ULB is treated and disposed at multiple decentralized facilities across the city. A section of the dumpsite, comprising 712.09 cubic meters of waste, was capped in 2020. While the capping method remains unclear, the contractor will initiate discussions and assessments of the capped area, taking into account leachate and gas considerations. This will aid in formulating a strategy for biomining, with the implementation of all required fire and health and safety

precautions when disturbing the capped area. The entry to the dumpsite is facilitated by a 4-meter-wide approach road which needs an improvisation inorder to mobilize the heavy machineries, located in Meppayil–Vadakkara stretch. Inside the gated compound of the site, is a concrete tiled road for easy access within the site. Within the premises, there is a partially constructed non-operational MCF (Material Collection Facility) having an area of 180 square meters, having an steel roof and concrete floor and brick walls.

**ii.Technical_Aspects**

Following a comprehensive evaluation, the method or technique of Bio-mining with a goal of achieving 100% land reclamation and recovery is found to be the most suitable remediation approach, ensuring long-term sustainability and environmentally responsible treatment of legacy waste, leading to the complete remediation of the dumpsite. Based on the Feasibility and site conditions, Mobile trommel machinery would be the most suitable option for the small site at Puthiyappa, Vadakara. The optimal time frame for conducting the Biomining Process would be from December to April Months, a period characterized by lower rainfall levels as per climate data.

**Application of Regulatory and Guidance Framework**

In accordance with the SWM Rules of 2016, the selection of an appropriate method or technique for remediating a dumpsite should be determined through a feasibility study that consider technical, financial and environmental aspects complying with regulatory requirements (CPCB, KSPCB andNGT). The formulation of the subproject adhered to the State/National and World Bank ESMF / safeguards policies, both in its planning phase and will continue to do so during the implementation and monitoring stages. This commitment to compliance will be upheld by the ULB during the Project period.

**Baseline Environmental Scenario**

A detailed environmental baseline study was conducted for analyzing quality of air, groundwater, surface water, noise levels, and leachate characteristics. The preliminary Environmental Screening [Annexure -1] and the detailed assessment showed that this sub project falls under “E2” category. (Please note that suggestive environmental categorization of dumpsite biomining / bioremediation as per EMF for KSWMP is E1. However, considering

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the very small extent of the dumpsite, absence of any sensitive environmental feature in or around the site, short biomining period, and the overall positive impacts of the proposed development post mitigation measures; this is categorized as E2. At this stage, locations for disposal of biomined wastes is unknown, the sunproject would be recategorized if the locations are near any sensitive areas. In case the biomining is clubbed with other multiple sites also, the overall categorization would be reconsidered)

An analysis has been conducted at the site to review and comprehend the physiography, climate, soil, cultural heritage, ecology, and biodiversity of the dumpsite. This assessment aims to identify potential impacts on the environment, human health, and biodiversity. Additionally, a traffic assessment has been performed to analyze traffic patterns and movements during the project's implementation phase.

**Terrestrial Ecology:**

The nearest Forest/Protected Area, known as Janakikkadu, is located approximately 22 kilometers away from the site. Various indigenous flora and fauna species commonly inhabit the vicinity of the site, which generally include *Funambulus tristriatus* (Jungle palm squirrel), *Eutropis carinata (*Brahminy Skink), *Pycnonotus cafer (*Red-vented Bulbul), *Acridotheres tristis (*common myna*), Ictinaetus malaiensis (*Black Eagle), *Ailanthus sp. (*Tree), *Areca catechu (Tree), Cyathula prostrate (Herb)* and *Aporosa cardiosperma (Shrub).* The species listed were not classified as Critically Endangered by International Union for Conservation of Nature (IUCN).

**Air Quality:**

Air monitoring was conducted continuously for a 24-hour duration and the results obtained were meticulously analyzed against the National Ambient Air Quality Standards (NAAQS) of 2009. It is noteworthy that all measured pollutants' concentrations were found to be well within the permissible limits. Furthermore, no presence of hazardous or toxic gases was detected during the monitoring process.

**Water Quality:**

The water quality monitoring was carried out at 3 locations for Ground water & 1 Location for Surface Water.

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Groundwater samples were collected from three distinct locations, each within a radius of 200 meters from dumpsite. The analysis of these samples revealed that all parameters examined fall within acceptable limits, with the exception of pH levels.

Surface water assessment indicates that the Kuttiyadi River is located approximately 5 kilometers from the site. Additionally, there is a nearby drain that transports surface runoff, wastewater from the surrounding area, as well as leachate and drainage from the site. A surface water sample was collected from a specific location known as Akkamadathodu, which is at an aerial distance of 303 meters from the site. The Akkamadathode culminates at the Kuttiyadi River. The samples were collected downstream of the Akkamadothode. The natural drainage does not consistently carry water; it only flows when there is rainfall. Upon analysis, it was found that all examined parameters were within acceptable limits, with the exception of Biological Oxygen Demand (BoD).

**Noise Level:**

Sample for noise level monitoring were collected within the dumpsite to assess the current ambient noise levels. The results indicate that the noise levels observed are comfortably within the permissible limits. However, it shall be noted that there is no activity currently on site. And noise levels are expected to increase with biomining activity.

**Assessment of Risks/Impacts and Proposed Mitigation measures and Monitoring**

The anticipated impacts of the interventions proposed have been analyzed in detail and mitigation measures proposed. The Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) documents, which assess the potential environmental and social impacts of the proposed subproject, serve to identify potential risks, formulate mitigation measures and ensure compliance with environmental and social standards regulations. This dumpsite remediation project comprises an overview of the current environmental conditions within the project area. Furthermore, the report delineates the environmental baseline data, Disaster Management Plan, identification of sensitive receptors and a Fire Risk Assessment. Key environmental risks include leachate and storm water from the site impacting the nearby areas, odour (including gas), visual blight, flies & pests, storage and disposal of retrieved materials, fire, accidents & other disasters, and health and safety of

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workers. Possible future dumping of wastes after biomining is also a concern. Mitigation and management measures for these in line with mitigation hierarchy are included in the EMP.

Proposed mitigation measures are designed to address environmental and social impacts effectively, with the goal of minimizing negative consequences while maximizing positive outcomes. Additionally, this report encompasses an Environmental Management Plan (EMP) and a Social Management Plan (SMP), providing detailed strategies for the management of the project's environmental and social facets.

In addition, a detailed Environment Monitoring Plan and Social Monitoring Plan will outline the monitoring procedures to assess the efficiency of mitigation measures and guarantee adherence to environmental and social standards. To ensure seamless and timely execution, the dumpsite remediation subproject report also includes an Environmental and Social Budget. This ensures a sustainable and responsible bio-mining process that prioritizes the protection of the environment and the well-being of nearby communities throughout the waste remediation process.

**Implementation Mechanism & Budget**

The Bio-mining project, with the objective of achieving 100% land recovery, will be carried out exclusively through an outsourcing model. The biomining process will be conducted separately at each ULB. If the land is found to be contaminated with hazardous wastes, the suproject shall be excluded. For solid waste/leachate contamination on site proper remedial measures will be followed before utilizing for future facilities. Retrieved materials and recyclables may be handed over to the authorized recyclers and the usage of these retrieved fractions is unknown today as it would be as per the Contractors proposal/plan. However, such reuse/recycling/disposal would be in line with National/State regulations which are stringent. . The land will be restored to its pre-waste dumping condition, necessitating the complete removal of all legacy waste until it reaches the original land surface. Following the completion of the bio-mining process, the machinery and vehicles belonging to the implementing agency must be vacated within 7 days. No waste material shall remain on site after contract period. The reclaimed land, free of any encumbrances, will then be transferred to the Urban Local Body (ULB).

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The total budget proposed for Environmental Management and monitoring and social budget is [redacted]

**Consultation & Disclosure**

A transect walk was also carried out to assess the social characteristics in the vicinity of the dumpsite. To understand the social dynamics, demographic profile, livelihood patterns, social dynamics of the community and to understand the needs, concerns, and aspirations of the community, a transect walk was carried out on 30.05.2023, (Attendees – 17 no.s)which was crucial for developing effective dumpsite remediation strategies that align with their priorities. The findings and recommendation of the transect walk is shown in the following table.

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*Table 1 Findings and recommendation of the transect walk*

| S.No | Social risks | Findings and Recommendations |
|---|---|---|
| 1 | Presence of 300 families, institutions, shops, establishments, near (200m) the dumpsite. | a. Free movement of the residents needs to be ensured<br>b. Since the school has two entrances, inside and outside of the dumpsite road, the mobility of the students will not be disturbed. Regulation on either of this road may affect the free movement of the students during school opening and closing time. Necessary traffic arrangements must be made.<br>c. Working hours of shops and establishments may be restricted, that should not affect the livelihoods of the workers attached to these facilities |
| 2 | Sound pollution, health issues and foul smell most affects 16 families residing very close to the site (50m). | GRM cell under the ULB needs to be made operational. Stress management including counseling services to be ensured |
| 3 | Health risk of vulnerable groups residing near to the site which includes patients with breathing issues, pregnant women, PWDs, cancer patients, children below the age of two and elderly above the age of seventy-five. | Health issues may aggregate duringwork operations.<br>These factors should be considered strongly especially for all vulnerable groups |

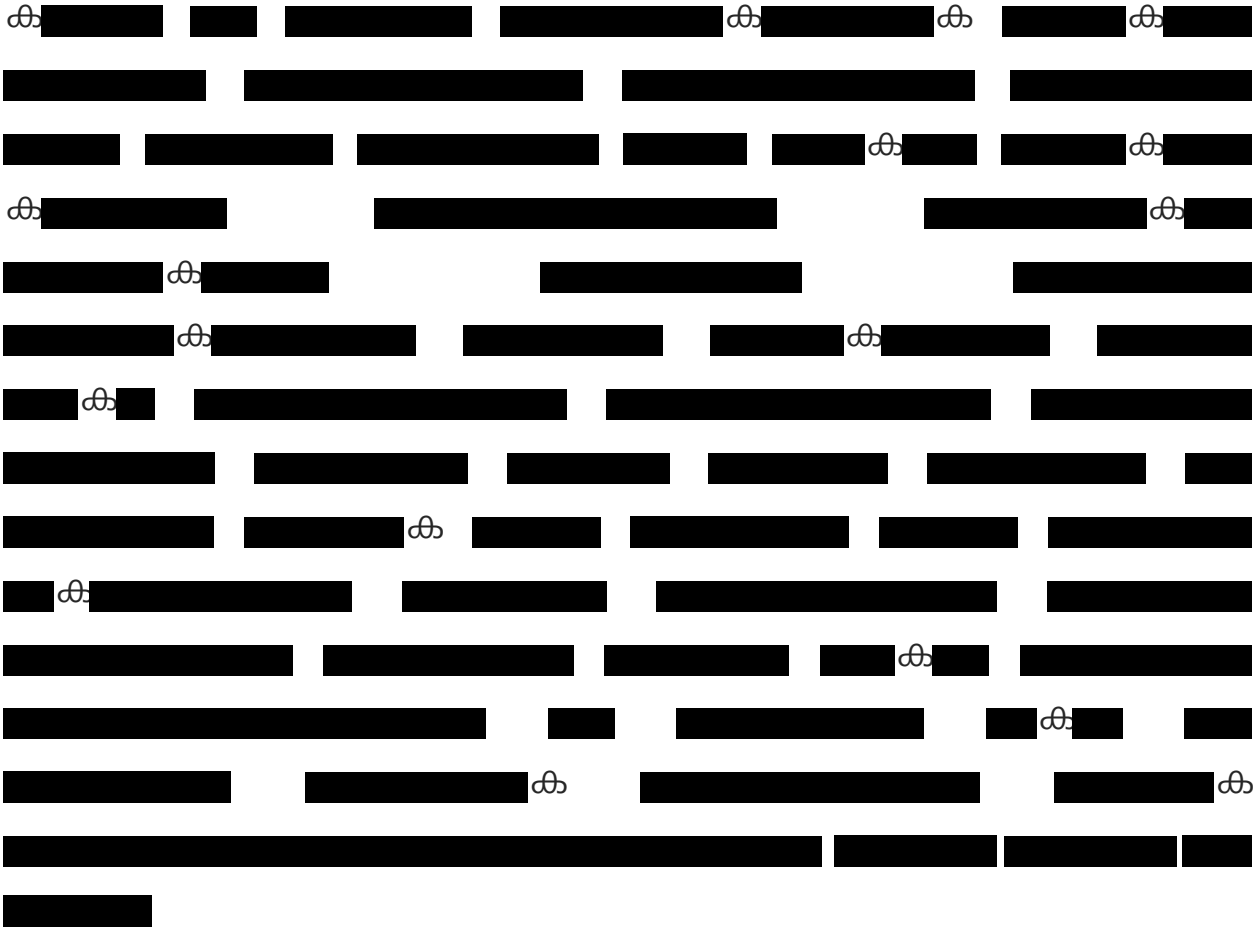
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## Summary [Malayalam]

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# 1. INTRODUCTION

## 1.1 Project Background

The Government of Kerala (GoK) utilizes financial support from the World Bank and Asian Infrastructure Investment Bank (AIIB) for KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project is jointly co-financed by the World Bank and AIIB (105m$ each). The AIIB has agreed to apply the environmental and social services of the World Bank described in Co-Financing Framework agreement and as agreed Project Co-lenders Agreement. The project will improve SWM service delivery of all Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes all (93) ULBs. The identified ULBs for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; and the overall project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

Under Component 2 of the KSWMP Project, the Government of Kerala intends to undertake biomining of multiple Legacy Waste Dumpsites in various districts. As per the Feasibility Study and methodology statement for implementing the subproject, proposed dumpsites for biomining are grouped into two clusters: It is expected that one single contractor bids for one Cluster. Biomining and bioremediation of Puthiyappa dumpsite figures in Cluster 2. However, bidding modality is yet to be finalized- whether as a single site, or as a clusters.

## 1.2 The rationale for the Proposed Sub-Project

Puthiyappa dumpsite in Vadakara ULB at ward no.20 has a total waste quantity of 29,140 Tons, spreading over 1.25 acres. The site is located between Lat- 11°35'39.0"N and Long - 75°36'20.7"E and has an elevation of MSL +46 (m), with a gentle slope towards the south-eastern part. During monsoon season, due to the geography of the site, Leachate from waste flows downhill towards residential areas located at south Eastern side of the site. Vadakara ULB proposes biomining and bioremediation of the Puthiyappa legacy waste dumpsite site under KSWMP supported by the World Bank, for which the present Feasibility Report has been prepared. Considering the environmental and social impacts associated with legacy dumpsite biomining and bioremediation, it is proposed to undertake an Environmental Impact Assessment and Social Impact Assessment in line with the ESMF for KSWMP.

## 1.3 Objectives and scope of Environmental & Social Impact Assessment

***Environmental Categorization and Assessment:***

As per indicative categorization for dumpsite biomining and bioremediation, this subproject is categorized as E1. Considering the residual positive impacts of dumpsite remediation, small extent of the dumpsite (1.52 acres) and waste spread (1.25 acres) and absence of

environmentally sensitive features around, this subproject is individually considered as E2, and EIA is prepared accordingly.

***Social Impact Assessment***

Under this category social impact assessment is also a key factor to be considered. Accordingly, detailed assessment of the environmental and social impacts was carried out.

### 1.4 Proposed sub project details

*Table 2 Proposed sub project details*

| Description | Details |
|---|---|
| Name of ULB | Vadakara |
| District | Kozhikode |
| Taluk | Vadakara |
| Total present population in the ULB | 41,572 |
| Name of the sub-project | Dumpsite Remediation at Puthiyappa |
| Location of the sub-project | Puthiyappa at ward no 20 |
| Total dumpsite area (in acres) | 1.52 |
| Total legacy waste accumulated area (in acres) | 1.25 |
| GPS Co-ordinate of the Site | Latitude: 11°35'39.0"N,<br>Longitude 75°36'20.7"E |
| Legacy waste quantity | 29,140 tons |


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*Figure 1 Legacy Waste Dumpsite at Puthiyappa*

The technology proposed is Bio mining, and bioremediation in line with CPCB's Legacy Waste Biomining Guidelines, 2019. The various phases in the biomining process (as per Legacy Waste biomining Guidelines of CPCB) are shown below.


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*Table 3 Phases of Bio mining*

| Phases of Bio-mining | |
|---|---|
| **Phase 1: Stabilization** | The legacy waste is formed into equal-sized windrows and which are turned frequently, bio-culture is added and de-odourizer (an odour-controlling agent) sprayed. This phase removes stench, reduces moisture and eliminates pathogens. |
| **Phase 2: Sorting & Segregation** | In this phase, stabilized legacy waste is sorted/segregated into bio earth, recyclables, refused derived fuel (RDF) and C&D through series of various sizes of Trommels/circular rotatory sieves and manpower. |
| **Phase 3: Disposal & Utilization** | In this phase, the non-combustible fractions such as soil and stones are disposed of for further processing into finer aggregates or for earth filling. The combustible fractions are called refuse-derived fuel (RDF) are sent for co-processing in cement industries. |

### 1.5 Site management plan

The plan aims to minimize potential adverse impacts on sensitive receptors while maximizing the recovery of valuable resources and promoting site restoration.

Mobile machineries will be used for biomining of the small Vadakara dumpsite, and they do not require a separate area for erection. The waste will be excavated and directly fed into mobile screeners for processing. This approach minimizes the need for additional infrastructure and optimizes the efficiency for the biomining process. The proposed plan is as follows.


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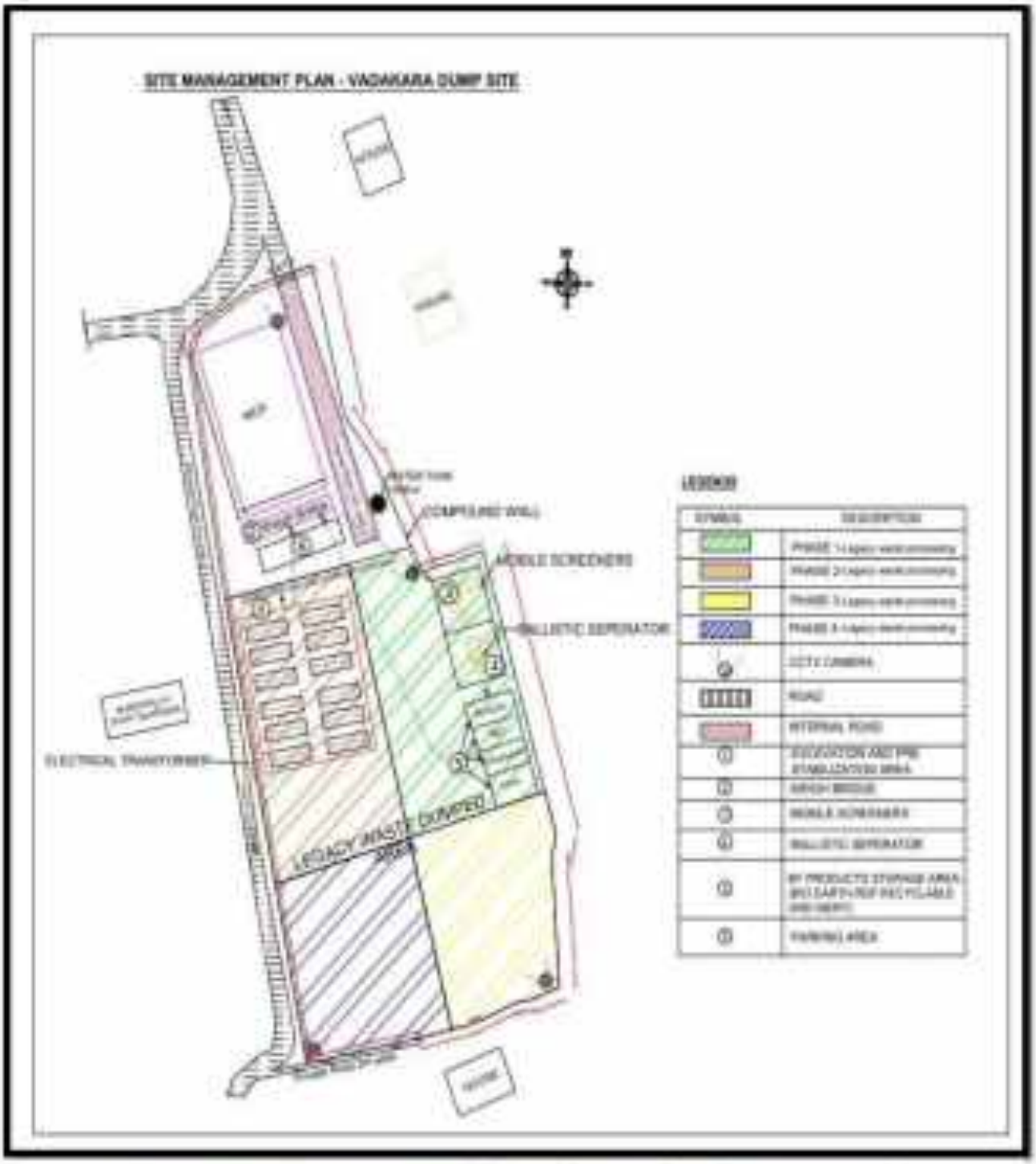



*Figure 2 Site Management Plan [Drawing attached as Annexure - E]*


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## 1.6 Structure of the report

*Table 4 Structure of the report*

| Chapter | Structure |
|---|---|
| 1 | Introduction |
| 2 | Policy and Regulatory Framework |
| 3 | Environment and Social baseline |
| 4 | Analysis of Alternatives |
| 5 | Assessment of Environmental and Social Risks and Impacts |
| 6 | Environmental and Social Management and Monitoring Plan |
| 7 | Institutional Arrangements |
| 8 | Public consultation and Information Disclosure |


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## 2. POLICY AND REGULATORY FRAMEWORK

### 2.1 National, State Legislations and Technical Guidelines related to environmental and social aspects of dumpsite remediation

*Table 5 Applicable rules and regulations for Vadakara dumpsite remediation*

| S. No | Rules and Regulations | Relevance |
|---|---|---|
| 1 | The Motor Vehicle Act. 1988 | All vehicles used for installation and operation will need to comply with the provisions of this act and should have valid Pollution Under Control Certificate. |
| 2 | Authorization from PCB for storing Hazardous material like diesel for DG sets as per Hazardous and Other Wastes (Management & Trans boundary Movement) Rules, 2016 | Hazardous waste (used oil from DG Sets) is likely to be generated during the erection and operation stage. Hence, authorization under the purview of the rule shall be requiring. |
| 3 | Labour Act. | Occupational safety and health administration. |
| 4 | Solid Waste Management Rules, 2016 (MSW Rules) | To operate the mobile Bio mining plant, it is necessary to follow the existing MSW rules. |
| 5 | The Water (Prevention and Control of Pollution) Act, 1974 | Consent to Establish and Consent to Operate to be obtained during the construction phase and operation of waste recycling/disposal facilities |
| 6 | The Air (Prevention and Control of Pollution) Act. 1981 | Consent to Establish and Consent to Operate to be obtained during the construction phase and operation of waste recycling/disposal facilities |
| 7 | safety of the workers as per the ILO Convention No. 62 | Safety aspects |
| 8 | NOC from fire department | Safety aspects |
| 9 | Tree felling permission:<br>If felling of trees as defined in Kerala Preservation of Trees Act, 1986 | If any tree needs to be cut or replanted concerned permission is required from Forest |


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| S. No | Rules and Regulations | Relevance |
|---|---|---|
| | | Dept. Government of Kerala. The ULB will take the necessary permission. |
| 10 | NGT guidelines upto date | Relevant to the subproject to be considered for the successful implementation of the project. |
| 11 | Building and Other Construction Workers (Welfare Cess Act) 1996, | Discusses Health and Safety and environmental aspects associated with construction and allied works |
| **Other Applicable Rules** | | |
| 12 | Solid Waste Management Rules, 2016 (SWM Rules) | |
| 13 | Plastic waste Management Rules, 2016 | |
| 14 | Construction & Demolition, Waste Management Rules, 2016 | |
| 15 | Batteries (Management and Handling) Rules, 2001 | |
| 16 | E-Waste (Management) Rules, 2016 | |
| 17 | SBM-Urban Advisory on Landfill Reclamation, CPHEEO, June 2020. | |
| 18 | Kerala Municipality Act, 1994 & Rules | |
| 19 | Hazardous & Other Wastes (Management And Transboundary Movement) Rules, 2016 | |
| 20 | The Operational Policies (Safeguards) of the World Bank and the Environmental and Social Management Framework; and the World Bank EHS Guidelines | |
| 21 | Bio-medical Waste (Management & Handling) Rules, 1998 | |


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## 2.2 The World Bank Safeguards Policies

*Table 6 World Bank Safeguard Policies*

| S.No. | WB Policy | Safeguard policy applicable | Description |
|---|---|---|---|
| 1 | Environmental Assessment (OP/BP 4.01) | Yes | The project has potential impacts and pose risks to various environmental factors during the implementation phase. Consequently, this policy is triggered, necessitating assessment and management of E&S risks and impacts, and ensuring a structured approach to safeguard management for risk mitigation including (health & safety risks, risks and impacts due to linked activities) in alignment with regulatory requirements, and Environmental and Social Management Framework (ESMF). |
| 2 | Natural Habitats (OP/BP 4.04) | Yes | Though the project will not support any activities that involve conversion or degradation of natural habitats. However, impacts on any flora/fauna on site during the proposed activity is important |
| 3 | Pest Management (OP 4.09) | Yes | Considering the possible pest related issues as the project deals with wastes and improvements to dump sites, OP 4.09 Pest Management is triggered. As per this policy the banned pesticides/insecticides listed by the Nation / State and the World Health Organization (WHO) other national/state bodies should not be used in the project, and as much as possible Integrated Pest Management Options shall be followed |
| 4 | Physical Cultural Resources [PCR] (OP 4.11) | Yes | The proposed project will not support any activities that could potentially harm nearby cultural heritage, archaeological sites and physical resources valuable to the community |


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## 3. BASELINE ENVIRONMENTAL SCENARIO

### 3.1 Project location of the site

Puthiyappa dumpsite in Vadakara ULB at ward no.20 is non-operational and dumping of waste stopped due to public protests during the year 2018. Up until July 2023, the disposal of waste from street sweeping was directed to a designated site. In accordance with the implementation of the Biomining Project, the disposal of street sweeping waste was subsequently discontinued and it is disposed in the Thumboormozhi units located in the Bus stand (Both New and Old) and Municpal office. The location detailed are described in the previous section of 1.1 and 1.4.

*Table 7 Sensitive receptor around the Dumpsite*

| S.No | Sensitive Receptors | Distance |
|---|---|---|
| 1 | Residential buildings | 300 households are located within 200 m radius of the dumpsite |
| 2 | Educational institutions such as Govt. Sanskrit HSS | 1.00 Km |
| 3 | Kuttiyadi river | 5.00 Km |
| 4 | Akkamadathodu Stream | 303 m |

### 3.2 Methodology for Environmental Baseline studies

Baseline Study in EIA process usually includes data collection and analysis of various aspects in the project area, such as: Physical Environment (e.g., topography, geology, soil, water, air quality, and climate) and Biological Environment (e.g., flora and fauna, Land/Soil, habitat, biodiversity, and ecological processes). The overall methodology of EIA comprises;

1) Scoping, Environmental Screening, Exclusion and Categorization
2) Environmental Baseline study like analysis of Air, Water, Soil and Noise/Vibration and impacts on biodiversity, workers and people around
3) Environmental Impact Assessment
4) Avoidance of adverse impacts, minimization, mitigation, and management measures
5) Environmental Management Plan (EMP)
6) Environmental Monitoring Plan (EmoP)
7) Budget for implementation of EMP and EmoP

The below table indicates the environmental attributes and frequency of monitoring


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*Table 8 Environmental Attributes*

| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| 1 | Meteorology | Temperature humidity and rainfall | - | Study area | Data collected from IMD |
| 2 | Ambient air quality | $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$, VOCs | A1 - N- 11°35'39.182", E -75°36'28.543"<br><br>A2 - N- 11°35'37.504", E -75°36'26.874" | 2 | 24 hourly samples |
| 3 | Noise levels | Noise levels in dB(A) Leq | N1 - N- 11°35'39.983", E -75°36'20.265 | 1 | Once |
| 4 | Surface water quality | Physical, chemical and biological parameters including pH, temperature, turbidity, magnesium hardness, total alkalinity, chlorides, sulphates, fluoride, Copper, DO, BOD, COD, salinity, Zinc, Lead, Arsenic. | S1- N- 11°35'29.729", E -75°36'24.791" | 1 | Once |
| 5 | Groundwater quality | Physical, chemical and bacteriological parameters including pH, temperature, turbidity, magnesium hardness, total alkalinity, chlorides, sulphates, fluoride, Copper, | G1- N- 11°35'39.614", E - 75°36'18.171<br><br>G2- N- 11°35'41.468", E - 75°36'22.459"<br><br>G-3 N- 11°35'29.581", E - 75°36'24.331" | 3 | Once |


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| S.No | Attributes | Parameters | Latitude & Longitude | No. of sampling locations | Frequency of monitoring / Data collection |
|---|---|---|---|---|---|
| | | DO, BOD, COD, salinity, Zinc, Lead, Arsenic. | | | |
| 6 | Biological environment | Existing flora and fauna | - | Study Area | Through field visits and substantiated through secondary data sources. |
| 7 | Soil characteristics | Physical, chemical and biological parameters including pH, Total Hardness, Nitrites, Phosphates, Organic matter, Fluorides, Total Iron, Nickel, Copper and Lead, TOC, Permeability. | - | - | Once |
| 8 | Land use/land cover | Land use for different land use Classifications. | - | Study Area | Land use / Land Cover Analysis using satellite imaging and GIS Technique |
| 9 | Leachate | pH, BoD, CoD, TSS, TDS, Fluoride, Cyanide, Nickel, Cadmium, Lead, Copper, Mercury, Zinc | L-1<br>N-11°35'29.581"<br>E-75°36'24.331"<br><br>L-2<br>N-11°35'39.260"<br>E-75°36'23.280"<br><br>L-3<br>N-11°35'34.263"<br>E-75°36'21.410" | 3 | Once |


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### 3.3 Existing Facilities on site and its Environmental Audit

There is a non-functional Material Collection Facility (MCF) for dry waste present on a part of the Puthiyappa dumpsite.

The MCF is not supported under KSWMP under this subproject. However, an environmental audit of the facility is important as this may be used as an associated facility to which some recyclables may be channelized to and is situated at the same site and might be impacted by the biomining activities.

*Table 9 Environmental Audit of MCF*

| S. No | Aspects | Remarks |
|---|---|---|
| 1 | Structural Characteristics | Area - 180 (in Sqm)<br>Buffer/setback around the MCF - 2 ft<br>Distance from waste pile of dumpsite- 35 m.<br>Roof: (GI Sheet Roof, Good condition)<br>Floor (Cement Floor, Good Condition)<br>Walls: (Concrete, Good Condition)<br>Doors & windows: Not available, need to furnish<br>Lack of ventilation, dust emission and odor can impact the MCF facility. |
| 2 | Functional Characteristics | Activities in the MCF: NIL<br>Materials and condition of stacking: NIL<br>Activities spilling out onto the dumpsite: NIL<br>Access to the MCF (Common access for MCF & Dumpsite. Both are in the same premises.)<br>No: of workers: NIL |
| 3 | Facilities | Parking area-NIL<br>Loading/unloading area-NIL<br>Storage room & area: NIL<br>Worker snack/rest areas: NIL<br>Worker / other washrooms & sewerage: NIL<br>Water supply for Cleaning, Washroom: NIL<br>Greenbelt: NIL |


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### 3.4 Analysis of Environmental Baseline

*Table 10 Environmental Baseline*

<table>
<tr><th>S No</th><th>Environmental Aspect</th><th>Discussion on Baseline Scenario</th><th>Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject</th></tr>
<tr><td>1</td><td>Topography</td><td>The elevation of the Puthuyappa site is MSL +46(ft), gentle slope towards the southern and eastern section from the site. The land falls under midlands of Kerala. Soil is predominantly lateritic in nature. The legacy waste is spread over an area of 1.25 acres with an average height of 5 m, having a portion of the dumpsite which is 7.12 cu.m of waste being capped by 2020. In accordance with the directive from the National Green Tribunal (NGT), the biomining process is mandated to remediate all deposited waste within the premises, encompassing both current and pre-existing accumulations.</td><td>Leachate from the dumpsite drains out to South East side, to a channel (Meppayil).</td></tr>
<tr><td>2</td><td>Climate</td><td>Vadakara falls within the tropical to sub-tropical climatic region with heavy rains mostly during the six months from June to November; and occasional rains during other times of the year. Maximum temperature in the region varies almost between 32°C to 37°C and minimum temperature ranges from 21°C to 24°C.</td><td>During heavy rains, as the site is at an elevated terrain, draining out of stored waste and leachate may happen during biomining & bioremediation works.<br><br>The biomining project has been scheduled during the off-season for rainfall in anticipation of reduced precipitation.</td></tr>
<tr><td>3</td><td>Hydrology/Hydrogeology & Soil</td><td><table><tr><th>Pre-monsoon (m) *</th><th>Post-monsoon (m) *</th><th>Avg. Fluctuation (m)</th></tr><tr><td>16.03</td><td>10.93</td><td>5.1</td></tr></table>*Groundwater level<br>Kuttiyadi river is at a distance of 5.00 Km from the site. Akkanadathode stream is at an aerial distance of 303 m leading to kuttiyadi river.</td><td>Lateritic soil is porous and may lead to contamination of nearby wells. Hence, any waste below 10m depth need to be remediated after sample analysis and adequate measures are necessary to collect and manage leachate during all times</td></tr>
</table>


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<table>
<tr><th>S No</th><th>Environmental Aspect</th><th>Discusssion on Baseline Scenario</th><th>Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject</th></tr>
<tr><td></td><td></td><td>Soil is predominantly laterite in nature. The land was historically used as a trenching ground. No study has confirmed the flow of leachate and its impact on groundwater. According to community feedback, they noted that the color of groundwater turns brown during the monsoon season.</td><td></td></tr>
<tr><td>4</td><td>Forests and Ecology</td><td>Site is not located in forest area. Distance to nearest Forests/Protected Areas is 22 km named as Janakikkadu. Listed are some of the common flora and fauna found near the site.
<table>
<tr><th>S. no</th><th>Scientific name</th><th>Common Name</th><th>Type</th></tr>
<tr><td>1</td><td>Funambulus tristriatus</td><td>Jungle palm squirrel</td><td>Fauna [Mammals]</td></tr>
<tr><td>2</td><td>Eutropis carinata</td><td>Brahminy Skink</td><td>Fauna [Reptiles]</td></tr>
<tr><td>3</td><td>Pycnonotus cafer</td><td>Red-vented Bulbul</td><td>Fauna [Bird]</td></tr>
<tr><td>4</td><td>Acridotheres tristis</td><td>Common Myna</td><td>Fauna [Bird]</td></tr>
<tr><td>5</td><td>Ictinaetus malaiensis</td><td>Black Eagle</td><td>Fauna [Bird]</td></tr>
<tr><td>6</td><td>Ailanthus sp.</td><td>Simaroubaceae</td><td>Flora [Tree]</td></tr>
<tr><td>7</td><td>Areca catechu</td><td>Arecaceae</td><td>Flora [Tree]</td></tr>
<tr><td>8</td><td>Artocarpus heterophyllus</td><td>Moraceae</td><td>Flora [Tree]</td></tr>
<tr><td>9</td><td>Cyathula prostrata</td><td>Amaranthaceae</td><td>Flora [Herb]</td></tr>
</table></td><td>The species listed were not classified as Critically Endangered by the IUCN. (INTERNATIONAL UNION FOR CONSERVATION OF NATURE)</td></tr>
</table>


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| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| | | 10 *Aporosa cardiosperma* Euphorbiaceae Flora [Shrub] | |
| 5 | Socio Economic Aspects | 300 households (residences) are located within 200 m radius of the dumpsite; Educational institutions such as Govt. Sanskrit HSS 1.00 Km.<br><br>Approximately 30 to 40 houses are situated in the southern direction which is within 100 m distance. Currently, there is no system in place for leachate drains or management because biodegradable waste was not dumped at site. However, during biomining activities, provisions for drains and leachate management will be established. In particular, this could prevent leachate runoff in the sloped area and its subsequent mixture with both ground and surface water.. | The dumpsite remediation process is anticipated to pose social risks, including pollution of food and beverages in nearby establishments and potential health issues for local residents, workers, laborers, and students. A Social Management Plan, based on social screening and transect walk findings, is essential to mitigate these risks. Furthermore, the proposed remediation will have a positive impact on nearby residents, as it will lead to the removal of legacy waste, improving both environmental and social conditions. |
| 6 | Land use, Development Pattern and Key Projects | Surrounding land use is mostly residential. Nearby cultural resources are temples situated at 280 m from the site. Neighbours complain about odour nuisance and leachate from dumping yard affecting the drains. No key development projects are there in the region.<br>Approximately 186 square meters of land is currently occupied by a partially constructed MCF (Material Recovery Facility), which is not in operation. This building lacks doors and windows.<br>It can be used for the labor resting room or storage of byproducts after renovation by contractor. | Odour, leachate and visual impacts on the surrounding landuses (residential, temples) and MCF |
| 7 | **Infrastructure and Services** | | |


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| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| 7.1 | Traffic and Transportation | A detailed incremental load by vehicles during the operation phase is assessed and given under the traffic assessment report. Through assessment it is identified an additional 9.4 trucks/day will be the traffic load due to this activity. | The implementing agency shall ensure staggering of the traffic movements from site considering peak hours/school timings. Also, night time vehicular movements can be implemented. More accurate information shall be available once Contractor is being on boarded. EIA to be updated by the contractor based on his work plan. |
| 7.2 | Water Supply<br>a) Surface water<br>b) Ground Water | A) Surface water: Kuttiyadi river is 5km from the site. Surface water sample was collected from Akkamadathodu, which is at an aerial distance of 303 m, and the test results showed – all parameters are well within limits except BoD.<br>B) Ground Water collected from 3 different locations (Residences within 200m radius)– all parameters are well within limits except for pH. | Site Drainage & leachate Impacts due to biomining activity (esp during any seasonal rain) is important as far as the nearby soil & water environment are concerned. |
| 7.3 | Drainage, Sewerage and Sanitation | Region has an unplanned network of drains eventually leading to Kuttiaydi- River. The nearest drainage channel is Akkamadathodu which is 303 m distance from the site. Site drains into this channel which finally ends at Kuttiaydi river.<br>Vadakara is mainly served with septic tanks for individual premises (No toilets onsite, even for MCFs).<br>Leachate samples collected at site, showed BOD value exceeding the limit and all other parameters were within limits. | |
| 7.4 | Air Quality | Air samples were collected from 2 locations within the dumpsite and results found to be well within the permissible limits. | |


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| S No | Environmental Aspect | Discussion on Baseline Scenario | Remarks on Demand Supply Gaps (Availability, Quality) & Aspects to be addressed in the Subproject |
|---|---|---|---|
| 7.5 | Noise Level | Noise Level monitoring samples collected within the dumpsite in order to identify the present noise level and results found well within permissible limit | Proper remedial measures for increased noise level shall be ensured by the contractor while bio mining activity. |

### 3.5 Description of Environmental Parameters

The baseline environmental attributes viz., ground water, surface water, noise level, leachate, were analyzed for assessing the existing baseline conditions in and around the dumpsite. What follows is a brief description of baseline environmental attributes.

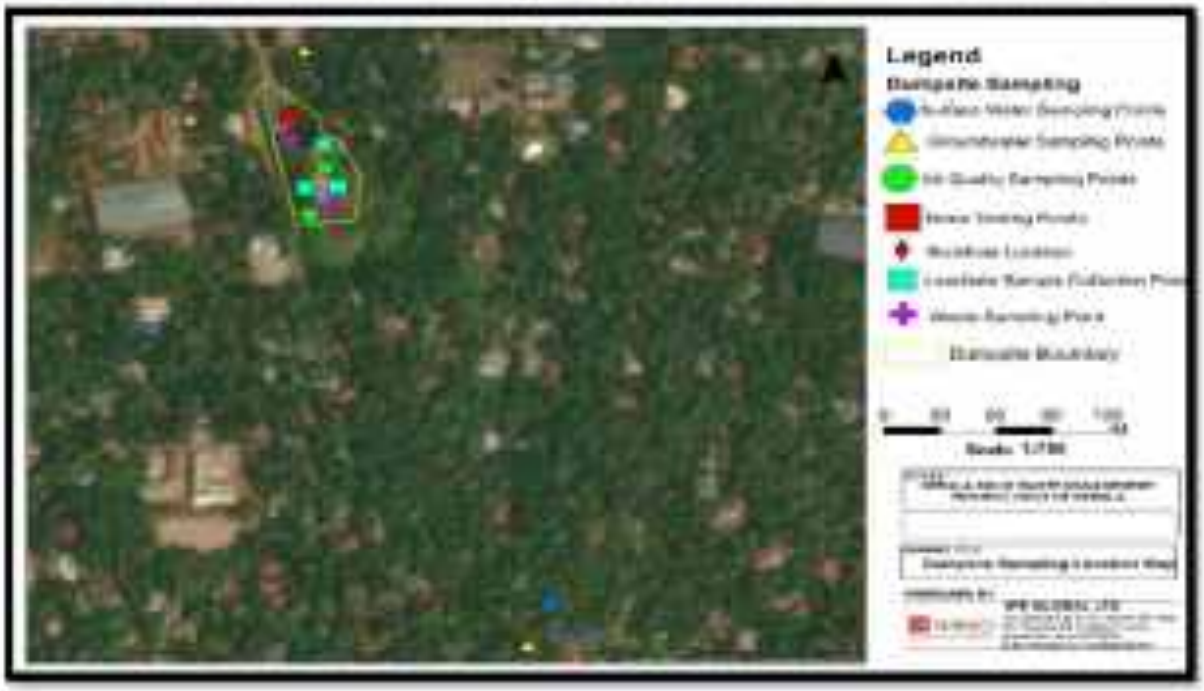



*Figure 3 Distance of the Sampling locations*

*Table 11 Distance & Direction of Sampling locations*

| S.No. | Description | Direction | From Boundary of the dumpsite (m) |
|---|---|---|---|
| 1 | Surface Water | South East | 222 |
| 2 | Ground water-1 | West | 40 |


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| | | | |
|---|---|---|---|
| 3 | Ground water-2 | North East | 33 |
| 4 | Ground water-3 | South East | 247 |

**3.6 Identification of sampling location:**

*Table 12 Identification of sampling location*

| S.No | Description | Place identified | Justification |
|---|---|---|---|
| 1 | Air sampling (2 Locations) | Inside the dumpsite | As per the wind rose diagram, the direction and speed of the wind are determined and based on the existing wind rose data, the air sampling sites were fixed at two locations near residential area. |
| 2 | Noise (1 Location) | Inside the dumpsite | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. The adjacent MCF is non-operational. |
| 3 | Surface water (1 Location) | Surface water near to the dumpsite [stream] | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope. This steep slope on southeast direction which is having residential buildings possesses a potential risk of leachate runoff, which could result in the contamination of surface water on that particular side of the site. So, the location of surface water is taken on the south east direction. |
| 4 | Ground water (3 Locations) | 3 wells identified near the dumpsite area | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope (SE). The infiltration of leachate which could result in the contamination of ground water.<br>Based on the possible infiltration and slope direction the ground water samples were collected from the West, Northeast and |


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| S.No | Description | Place identified | Justification |
|---|---|---|---|
| | | | Southeast directions outside of the dumpsite from the open wells |

### 3.7 Sampling Methodology

*Table 13 Sampling Methodology*

| S.No | Description | Method |
|---|---|---|
| 1 | Air sampling | Calibrated High Volume Sampler, Calibrated rotameter & calibrated Dry gas maters and sampling locations selected based on wind rose and impacts on surrounding land uses. |
| 2 | Noise | Calibrated sound level meter and sampling locations selected based on highest noise level on site and impacts on surroundings |
| 3 | Ground water | Water samples were collected in polyethylene containers and sampling locations were selected based on leachate and run off flow and anticipated impacts on surroundings. |
| 4 | Surface water | Samples were collected in polyethylene bottles and sampling locations were selected based on leachate and run off flow and impacts on surrounding surface water bodies and drains (line sources of pollution) used by communities. |
| **NOTE: Sampling Photographs added as Annexure-C in the FR Report.** | | |

### 3.8 Site Connectivity

From the town centre, vadakkara meppayil road leads to the dumping yard. This is a internal road with black top. From access road, there is a small portion of around 10 m kucha road leading to the site. The same road leads to --- temple, and is used for processions of the temple during festivals.... Etc etc. The kutcha road is 3 m wide and 10 m long. It is not surfaced.

The width of site access road is approximately 5 m. The nearest major highway, NH 66, is only about 1.5 kilometers away. This highway provides access to other major cities in Kerala, such as Thiruvananthapuram and Kochi. The state highway, SH 17, is also about 2 kilometers away. This highway provides access to other parts of Kozhikode city. The local road, Mambaram Road, is about 0.5 kilometers away. This road provides access to the nearby residential areas.


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Site Access Road to Main Road



Site Access Road to Meppayil Road



Site Entry

*Figure 4 Access Roads for the Site*

### 3.9 Traffic Assessment

Traffic assessment refers to the process of evaluating and analyzing the flow of vehicles, pedestrians, and other modes of transportation on roadways, intersections, or specific areas. This assessment helps in understanding current traffic conditions, identifying potential issues, and developing appropriate strategies to improve traffic flow, safety, and efficiency.

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**Traffic load:**

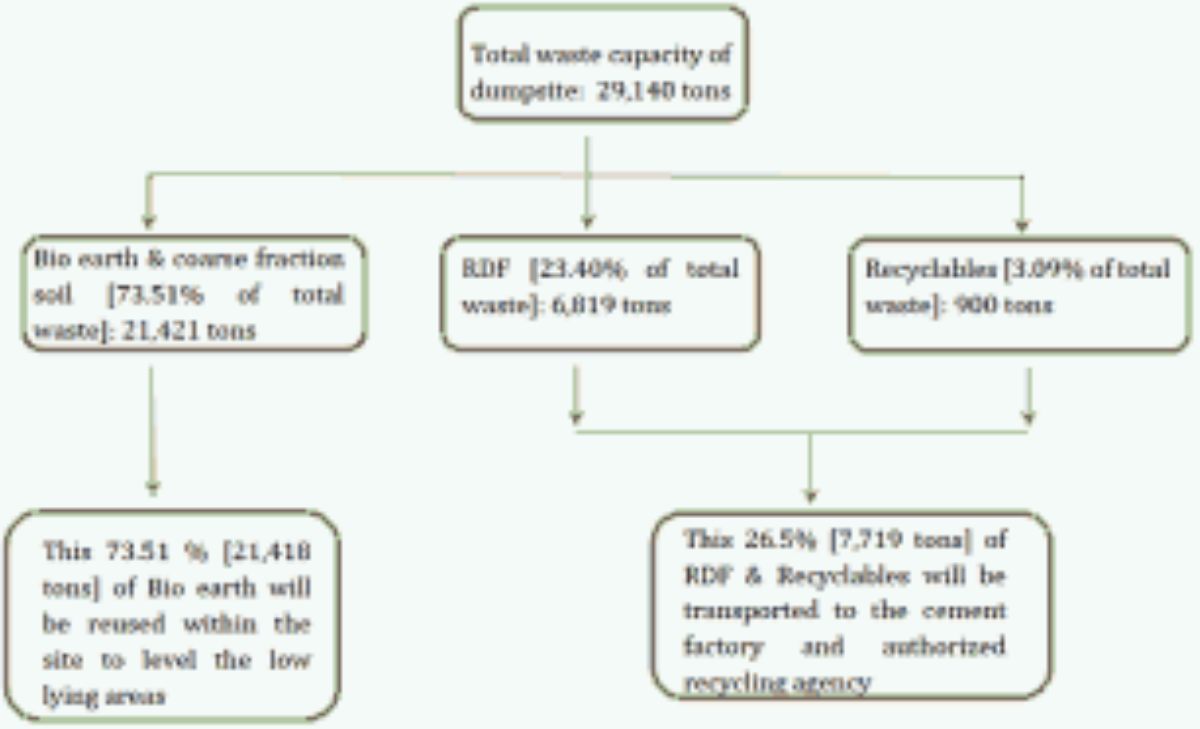



*Figure 5 Traffic load – Incremental due to Project*

The access road to the dumpsite is Vadakara- meppayil road which is 5m width. Considering 90 days of operation phase the trips are planned and the inward & outward of the vehicle to be made during off peak hours.

To promote safety and avoid traffic congestion, it is recommended to impose restrictions on the movement of vehicles used for the Biomining process. These restrictions should be enforced one hour prior to the commencement of school hours and one hour after the conclusion of school activities.


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*Table 14 Truck Capacity*

| S.No | Materials | % of Materials | Weight of each materials(t) | Vehicle Type | Max Capacity of load carrying Truck (t) | No. of Trips |
|---|---|---|---|---|---|---|
| 1 | RDF | 20 | 5828 | 12 Wheeler Dumper | 18 | 324 |
| 2 | Glass | 3 | 874.2 | 12 Wheeler Dumper | 25 | 35 |
| 3 | Rubber & Footwear | 2.8 | 816 | 10 Wheeler Dumper | 8 | 102 |
| 4 | Metals | 1.4 | 408 | Goods Truck | 2 | 204 |
| 5 | Wood | 2.8 | 816 | 10 Wheeler Dumper | 5 | 163 |
| 30% of Total Weight | | | 8742 | Total No. of Trips | | 828 |

*Table 15 Total Trips planned*

| S.No. | Materials | Total Trip | Total Days for Disposal | Trip/Day | Remarks |
|---|---|---|---|---|---|
| 1 | RDF | 324 | 90 | 4 | Four Trips per day |
| 2 | GLASS | 35 | 90 | 0.4 | Three days once one trip |
| 3 | Rubber & Footwear | 102 | 90 | 1 | One trip per day |
| 4 | Metals | 204 | 90 | 2 | Two Trip Per day |
| 5 | Wood | 163 | 90 | 2 | Two Trip per day |

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## 4. ANALYSIS OF ALTERNATIVES

### 4.1 Alternative 1: No project (without project scenario)

The proposed Bioremediation aims to develop an effective and scientific method for the removal of waste and prevent further contamination of the site.

If the waste remains unattended (without project scenario) it may lead to degrade the baseline quality and unfavorable environmental conditions as follows.

1. Foul Odor Emission: Accumulated waste can produce foul odors due to the decomposition of organic matter. This can negatively impact the quality of life for nearby residents and create an unpleasant living environment.
2. Disease Spread: Unattended waste sites can become breeding grounds for disease-carrying organisms like flies, rats, and other pests. These vectors can spread diseases to nearby communities, posing a significant health risk.
3. Air, Soil, and Water Pollution: The waste may release harmful chemicals and pollutants into the air, soil, and water of the surrounding area. This pollution can have long-lasting negative effects on the environment and human health.
4. Environmental Degradation: The pollution resulting from unattended waste can lead to degradation of the surrounding environment, disrupting natural habitats and causing long-term ecological imbalances.
5. Aesthetic and Economic Impact: Unsightly waste piles can reduce property values and economic development in the area.

### 4.2 Alternative 2: Mode of execution / Management Alternative

Regarding the execution strategy, the outcomes of a Transect walk have substantiated the impracticality of waste transfer between ULBs. As a result, the imperative is for the waste remediation procedure to take place on the premises, allowing only the byproducts to be considered for potential transfer.

The logistical aspects of arranging machinery and designating storage space for these byproducts will hinge upon the extent of land available. At the outset, the existing underutilized, partially constructed Material Collection Facility (MCF) may be considered to cater to the initial storage requirements after improvement, which will, in turn, be known whether the contractor will use this facility for storage. Budget provision is provided in the FR for such arrangements.

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### 4.3 Technology Alternative

The selection of the appropriate method or technique for remediation is determined by considering several parameters. These include the significant aspects and suitability of remediation types such as

1. Capping without land recovery,
2. Bio-mining – reclamation/recovery of 100% land
3. Capping with partial land recovery.

Additionally, factors like available resources such as manpower, machinery, finances, and physical site conditions, including the quantity and characteristics of legacy waste, environmental baseline, social concerns, regulatory compliance (KSPCB/NGT), the need for complete land recovery, and opportunities for utilization of processed aggregates/by-products are taken into account.

After a comprehensive assessment of these selection parameters, it has been determined that Bio-mining – reclamation/recovery of 100% land is the most suitable method. This approach ensures long-term sustainability and environmentally sound treatment of the legacy waste, leading to complete remediation and recovery of the dumpsite.

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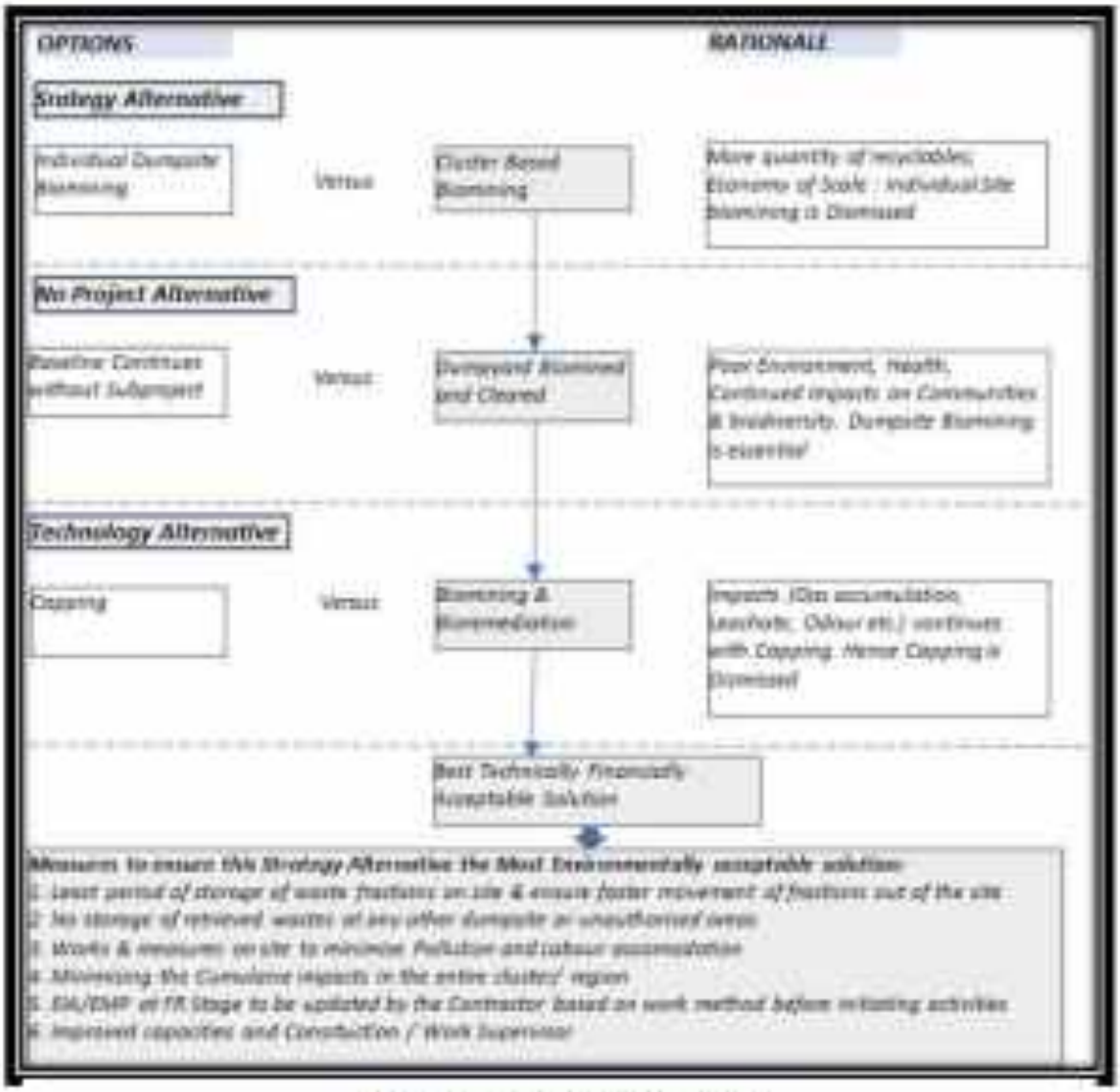



*Figure 6 Alternative Analysis*


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## 5. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL RISK IMPACTS

Biomining and bioremediation of existing legacy dumpsites brings in overall environmental improvement and positive impacts on the health of the communities around. Other benefits include more man-days at work, overall improvement in socio-economic (upliftment in social status) aspects and land value increase. The access road improvement will reduce dust/pollution related to traffic and result in better access to communities. However, biomining activity would result in temporary impacts on the environment during the process. In addition, disposal of retrieved waste fractions is important rather than allowing to pile on land. Else this would continue to pollute the environment and create health impacts for a longer term. Impact on air, water, land/soil, and fauna/flora and communities (incl. noise and vibration) are important in this case. In addition, cumulative impacts of simultaneous biomining of multiple such legacy waste sites on the environment is important. Especially with respect to

(i) Drainage and leachate flow into regional waterbodies (& esp. used as sources of supply/use by people, animals) or ecologically important areas from multiple dumpsites during usual days and during emergencies,

(ii) Pollution on land/soil, dust and odour nuisance and fire risk to communities, flora & fauna due to recovered materials at multiple sites due to poorly planned forward linkages, during emergencies, and extended storage considering climate risks,

(iii) Noise/vibration impacts of heavy vehicle movement, traffic on main roads in the region, and

(iv) Pollution possibilities due to dumping/storage & use of recovered fractions at various recyclers, WTE facilities for reuse/disposal. Some of these impacts and risks are identifiable at this stage, while some would be known only based on the project details that would be known from the work plan of the contactor once on board.

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### 5.1 Impact Assessment Methodology

Impacts are assessed based on Magnitude, Duration, and Significance of the impacts and sensitivity of the receptors present within the 500 m aerial distance of Vadakara dumpsite.

#### 5.1.1 Magnitude and Duration of Impacts

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the Dumpsite Biomining are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Average, Low, or negligible based on consideration of the parameters such as:

- Temporal extent (duration) and the likelihood of the potential impact;
- The spatial extent of the potential impact;
- Reversibility of the Impact;
- Legal standards and established criteria.
- Likelihood of the impacts

The magnitude of the potential impacts of dumpsite under KSWMP is identified according to the categories outlined in Table 15 Aspects for Determining the Magnitude of Impacts. Magnitude is assessed as medium, considering shorter duration of the activity. However, magnitude of cumulative impacts of various dumpsite remediation might be High.

*Table 16 Aspects for Determining the Magnitude of Impacts*

| Aspects | Large | Medium | Small | Negligible |
|---|---|---|---|---|
| **Duration of the potential impact** | Long term (more than 20 years) | Medium Term Lifespan of the Program (5 years) | 1 to 2 years or Less than the lifespan of the program | Temporary with no detectable potential impact |
| **Spatial extent of the potential impact** | Regional – much beyond project boundaries | Beyond immediate Program components, site boundaries or local area | Within program boundary (but cumulative impact of various dumpsite biomining activities will | A specific location within program component or site boundaries with no detectable |


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| | | | | |
|---|---|---|---|---|
| | | | be on larger extent) | potential impact |
| **Reversibility of potential impacts** | Potential impact (including positive impact) is effectively permanent, requiring considerable intervention to return to baseline | Potential impact requires a year or so with some interventions to return to baseline | Baseline returns Naturally or with limited intervention within a few months | Baseline remains constant |
| **Legal standards and established professional criteria** | Against national/approved standards and or international guidelines/obligations | Complies with limits given in national standards but not confirming to international lender guidelines in one or more parameters | Meets minimum national standard limits or international guidelines | Not applicable |
| **Likelihood of potential impacts occurring** | Commonly occurs under typical operating or construction conditions (Certain) | Usually seen occurring under most situations (Likely) | Occurs under abnormal, exceptional or emergency conditions (Occasional) | Unlikely to occur |

**NOTE: Anticipated Project Duration – 5 to 6 months**


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### 5.1.2 Sensitivity of Receptor

The dumpsite is surrounded by residential buildings and some commercial establishment. During the time of site assessment, some sensitive receptors within 500m from the site were identified, such as schools, religious places and households. The project site lies near to residences, within a 200-meter radius, and it may cause potential impacts on air, noise, surface water, and ground water that will directly or indirectly affect over 200 families (1000 people) for a duration of 5 to 6 months. The sensitivity of these receptors is High. In addition, there is a drain which flows through the residential areas of Meppayil which drains the runoff and leachate from the site. The sensitivity of this receptor is also estimated as High.

### 5.1.3 Significance of the impact

- Significance if the impact is high as it would even result in community resistance to biomining and bioremediation.

Since the project operational duration is 5 to 6 months, then the magnitude of the negative impact can be considered as small and medium sensitivity. In other hand magnitude of the positive impact, after the biomining of the existing land can be used for the recreational park for the public use.

## 5.2. Cumulative Impacts in The Region / Cluster

The impacts that may arise due to clustering of different dumpsites. The following impacts could result from the clustering while implementation, requiring thorough assessment.

1. If a sensitive environmental component (River, mangrove, wetland, etc.) is served by the leachate/drainage from one or more nearby dumpsites, the impacts can be regional.
2. Presence of other projects outside KSWMP; existing or forthcoming landfills, transfer stations or those considered under Track 1 investments may together create a cumulative impact with this activity.
4. Impact of vehicular movement from various subprojects on biomining of dumpsites may have cumulative impacts on air, odour, traffic issues, and pollution in case of spills/accidents/emergencies due to this clustering approach.
5. Storage of materials if any at common sites, impacts during rains, floods/emergencies in multiple sites of same water/air shed.

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**Source-Pathway-Receptor Analysis**

**A) Source**: The source of contamination is the legacy waste remaining and being deposited at the Puthiyappa closed dumpsite, more specifically the landfill gas and leachate generated from it. The waste type, age and volume determine the quality and quantity of the leachate and landfill gas. In this case the waste is 50 years old, as dumping had started in year 1962 and ceased in 2018. Initially the dumpsite was acting as a trenching ground, depositing sewage (night soil) from pit latrines. The total waste volume is 38367 cu.m with the dumpsite spread over 0.51 ha and rises to a height of approximately 6.7 m from the base. Waste is seen 5m above ground level and 1.7m below ground level. In addition to the landfill gas and leachate, windblown dust and litter are also considered as sources of contamination.

**B) Pathways**: The following pathways for migration of contaminants have been identified: Wind- The main pathway for litter and dust dispersion is the wind. As long as the waste is kept uncovered, the dust and litter will continue to be blown off the dumpsite to the surroundings. In addition to the dust and litter, the wind also causes spreading of landfill gases from the dumpsite. Rainwater runoff through the dumpsite acts as a pathway for transport of leachate to the soil and groundwater. The rainwater flowing off the dumpsite along the slope towards South East direction acts as a pathway for the uncovered waste to flow into the unlined unnamed drainage canal along the boundary to south eastern side, which runs through the residential areas and terminates at Akkamadathodu canal at 303 m aerial distance from the dumpsite which ends at Kuttiyadi river.

Lateritic Soil acts as a pathway for transport of leachate to the groundwater and for uptake of contaminated surface run-off.

The leachate flows with groundwater and acts as the pathway. Surface water contaminants like run-off from the dumpsite, leachate and windblown dust and litter that reach nearby surface water bodies like canals, rivers and streams are further transported by surface waters and in this case the surface water acts as the pathway.

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**Receptors:**

Receptors are air, surface water (drain passing through residential areas) and ground water. For drinking purpose, they mainly use municipal water supply (30 nearby Households within 50 m and 1 school within 250 m), soil, flora, fauna and humans. In the case of remediated dumpsite, the most prominent group of receptors are the nearby residences and institutions in Meppayil. As the dump is not contaminated by hazardous wastes, remediation would improve the pollution scenario provided the bioearth used is pollution free and of good quality. However, other impacts are expected on the final destinations of the retrieve waste fractions – such as WTE plants/Cement Plants and MCF/MRFs in the region. Depending on the locations of end use of fractions retrieved from biomining, the contractor shall assess the impacts on communities and workers on site & nearby; and near locations of end-use. Key impacts may result from direct contact of communities, workers, flora & fauna with contaminants (waste, soil, sediment, leachate and surface water); during and after biomining activity, activities in biomined dumpsite, Inhalation of dust and gases emanating from the dumpsite and stored wastes if any, during and post biomining activity.

### 5.1 Impacts on Air Environment

Key impacts on air include:

- Emission of Methane and other Greenhouse gases; and its impacts on scavengers, workers on site/other facilities on site (MCF in this case), nearby communities of Ward 20.
- In case of accidental or deliberate burning of wastes (esp. plastics), it releases smoke and gaseous contaminants. These contain particulates, carbon monoxide and other contaminant gases including dioxins; all emitting noxious odour, hazardous to health. Another direct hazard may be expected from the generation of hydrogen sulphide due to disposal of certain types of waste, or the development of anaerobic conditions in the wastes.
- When the legacy site is opened, existing gases would get emitted. Further, any delay /unexpected stoppage of biomining activity, might further aggravate the process of gas formation depending on waste composition, leading to odour and fire risks. In the


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case of Puthiyappa, since the analysis of wastes shows calorific value of 2000 for combustibles with around 17 percent plastics, 4 % paper and 2% cloth rags, it's well combustible; and the risk of fire is high during summers.

### *5.2. Impacts on Water Environment*

Ground water

- Pre and post -monsoon water levels are 16 and 10 mbgl. Borehole data indicates waste upto depth of 6.7m with hard lateritic strata after that. Hence it is expected that the ground percolation of leachate from existing dump may not contribute to large scale pollution of the ground water resources. Nevertheless, leachate and runoff through the legacy waste dump are important contributors to poor water quality. With the slope of the dumpsite, this tends to get accumulated at low-lying gradients and flows into unlined drain up to 303 m and terminates at Akkamadathodu. Slightly high BOD levels of the drain and ground water wells around are indicative of leachate and runoff pollution. Oozing & pooling of leachate & it draining to nearby areas during rains would be an important aspect to be managed during biomining to prevent ground water contamination. There I a need to separate out site drainage and leachate.
- Leachate samples: BOD, COD, TDS, E.coli, and heavy metals exceeding limits may impact the ground water quality in nearby schools, residences, wells, and long term soil pollution.
- Borehole data: Dump below water table may impact water resources and wells nearby.
- Ground beneath the dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. There are no parameters exceeding the permissible limits for heavy metals.

Surface water

- The dumpsite experienced flooding during 2018 floods. The site is at a higher elevation, and hence no submergence was experienced at the site during the floods.

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The site is not in CRZ zone, and hence activities would not impact sensitive coastal areas.

- There are no surface waterbodies near the site, except Akkamadathodu canal at 303 m distance.
- Predominant slope is in the South East Direction. At Southeast direction, (end direction) there are residential households and mixed vegetation. The drainage and leachate from the site flows to nearby open drainage channel which flows through residential areas, and ends at Akkamadathodu. It is important to contain and treat leachate from the proposed biomining activities on site. Treated leachate may be recirculated or used for other purposes.

### *5.3 Impacts on Land/Soil*

- Historic land use assessment and Contamination Assessment of the waste, land/soil is an important pre-project activity. If the site has hazardous waste contamination, it shall be excluded from the site as biomining, or bioremediation would not help improve such sites. Such subprojects are hence included in the exclusion list of KSWMP ESMF, also considering the capacities and purview of the project.
- Spillover of activities to nearby road and land would result in pollution of all types on these areas. Hence it is important to restrict all activities to the site for legacy waste biomining. If the waste is transferred and stored for any other use, that shall be after assessment of the quality of materials so transported / proposed to be used. The process and result shall be discussed with Pollution Control Board and the user agency and there shall be testing, discussions and written certification of acceptance by the user agency to determine if the retrieved material would meet the requirements for end use and is devoid of pollution to ensure no harm to the environment. Communities if the site of end use shall be consulted on such end use as applicable and determined by the SMP/SEP.
- Ground beneath dump remain polluted if heavy metal/other parameters exceed limits in leachate, soil, water. In Puthiyappa, all heavy- metals are falling within the limit as per Fertilizers Control Order 1985 and its amendments. Puthiyappa does not figure in the CPCB list of contaminated sites of Kerala. In case hazardous waste

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(including legacy asbestos), e-waste or biomedical waste is found while biomining, same shall be retrieved, transported, treated and disposed as per specific waste guideline of the Central Pollution Control Board, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste), Feb 2019) and World Bank EHS Guidelines. A plan shall be prepared to auditing of all wastes, management, eliminating pollution & OHS risks; and monitoring of such wastes, cleared and implemented. The site shall have a register maintained on quantities and movement of all retrieved fractions including these.

- Wherever fuel, combustibles and retrieved waste is stored, it shall be on impervious surface, at appropriate elevation, protection against rains, flooding (such as cut off drains, berms etc.), wind and fly / pest menace (screens, green cover etc), intruders (compound wall existing at Puthiyappa), watch and ward, lighting, remote monitoring measures etc). Risk of fire, dust and leachate contamination shall be well assessed by the contractor. Emergency Action Plan shall be prepared and mitigation measures shall be updated based on work plan/DPR, and implemented. Communities shall be made aware of works and advice to follow measures such as use of fly/dust covers/nets on wells etc.
- Of the waste samples analysed, 50 to 60 percent comprises of Bio earth; 30% being <4.75mm size; C/N ratio (15:01) indicating slight unpleasant odour (high Nitrogen; releasing ammonia) less than that suitable for good compost.

### *5.4 Impacts due to Noise and Vibration*

- Various machines and vehicles activities contribute to noise and vibration on and off site. This includes vehicles carrying recyclables, operation of JCB, and other machines, diesel generator sets, motors on site, etc. In addition, if a functional MCF/RRF is present, vehicles transporting dry waste from households to MCF, loading / unloading of collected waste materials, and workers activities on site would add to noise and vibration. Impacts include disturbance to fauna flora on site, health impacts on communities around due to exposure to large volume of sound.

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### *5.5 Other impacts on Biodiversity - Fauna/Flora*

- There are no sensitive biodiversity areas within 10 km of the site. However, since the project involves transport of wastes, it is important to consider the impact beyond the project boundaries. Within 50km from the site is Western Ghats, World Heritage biodiversity site, and 4 key biodiversity areas; including Aralam WLS, Brahmagiri Wildlife Sanctuary, Camel's Hump Mountains, and Kottiyoor Reserve Forest which hosts multiple species. Depending on the contractors plan for disposal of retrieved waste fractions, EIA shall be updated for biodiversity impacts.
- Fauna: impacted by direct consumption of the solid wastes, sharps, entanglement, or by consumption of plants and/or animals contaminated by wastes, or as a result of leachate effects on groundwater and surface water.
- Flora: Plants near open dumpsites can be impacted directly by the waste, dust or smoke from burning. Disturbance to vegetation due to machinery, trampling by foot, vehicle or animals, or contamination by waste or leachate, the migration of landfill gas, or as a result of burning or smoke.
- Disturbance to other fauna and flora on site: SWM activities onsite including those related to MCF may also impact fauna/flora through high noise levels of pre-construction / construction activities.
- Biodiversity of existing site: Available biodiversity of existing site is mentioned in the Environmental Baseline session and there is no key species listed by IUCN.

### *5.6. Other impacts on Workers and Communities*

- Contaminants in soil and water: Direct or indirect contact with polluted soil or water by neighboring water users. Additionally, because of their locations, recovered lands are subsequently used as parks, or for SWM facilities or office spaces etc. This may pose risk of bioaccumulation of metals which can constitute a health risk. Also impacts on buildings due to gaseous emissions, risk of fire etc if used after clearing.
- Health Risks: One of the primary health risks of dumps is the spreading of diseases - diarrhea, hepatitis etc. The ways such infection can be spread are numerous but are often related to direct contact with the waste (e.g., clinical waste, fecal matter) by

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scavengers and other unauthorized persons being on the site. The other main pathway is by vectors such as, foraging animals, rats, birds, flies and mosquitoes etc. Flies, mosquitoes, rodents, crows, pigeons, pest menace on site, for workers & communities & their assets (such as wells) due to exposure of putrefied wastes.

- Impacts if separate common site/s or a site among these dumpsites is chosen to store wastes from other dumps till it is disposed, or as transfer stations or for common processing of certain fractions: Such activities would result in Air, odor, dust, noise, water, vibration, flora, fauna, communities around the new site. There is also risk of contamination due to newly placed wastes, and pollution impacts and disturbances to communities due to works/activities on this site. Such sites and activities shall be avoided, and if quintessential for the project, be carefully chosen and approved only after thorough discussions with KSPCB, and all stakeholders. An assessment of their sensitivity and appropriateness shall be undertaken considering the environmental risks. They shall be audited and assessed for existing and future environmental impacts of such activities and mitigation shall be implemented. However, details on such sites shall be known only based on the final schema of implementation proposed by the contractor. Hence, the Contractor shall update EIA based on this before starting any activity on site.
- OHS impacts: Infectious wastes, fecal matter, clinical wastes and sharps; batteries, e-waste and possible bursting; Hazardous wastes like asbestos and other chemicals dumped; pesticides / insecticides, inoculum storage, handling and use on wastes/land leading to diarrhea, hepatitis, insect & reptile bites, interactions with foraging animals like rats, dogs, cattle, vector (mosquitoes, flies etc) transmitted diseases etc.
- This activity would result in large influx of workers from the region and beyond as this involves 19 dumpsites in two clusters. Worker facilities in the labour Camp if any, & site are important, as the density of population is high in Kerala. It is important that camp sites are not set up in the land to be remediated. Periodic health checkups (once a week) are very important as the work involves handling of waste. It is important to also provide periodic health checkup and co-ordination with local Primary Health

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Center/Central Health Services for medical camps for residents, schools and others during the biomining period.

- Risk of Fire during biomining and due to retrieved material storage; possible Burning of retrieved materials; storage and use of firewood for various purposes, fuel for vehicles. The smoke from burning solid waste can result in respiratory complaints, dizziness, and headaches in the short-term, as well as potentially more serious diseases such as cancers and heart disease in the long term.
- Impacts of other site development works shall be well assessed, EIA/EMP updated, and mitigation measures included in Project costs and implemented by the contractor/ULB (whoever is responsible as per FR/Final Bid document)

### *5.7 Visual impacts, Noise, Odour, Vibrations*

- Odour & impacts on workers and communities during biomining, storage and Transport are key determinants of community agreement to the activity. Such odour would attract flies and vectors in large numbers, that may also contaminate the food, and water sources of nearby communities. It is important to minimize odor emission as guided by the CPCB Guidelines on Legacy Waste Biomining, 2019. Also provide periodic health checkup and co-ordination with local PHC/CHS for medical camps for residents, schools and others during the biomining period.
- Visual impacts of the waste being dug up, screened ad heaped/stored is not appealing. It is important to mask this appropriately.

### *5.8 Traffic impacts*

- Impacts due to new access road construction/upgradation. Access road to the site is unpaved and slushy during rains. It is important to minimize temporary pollution due to increased movement men, and materials from and to the site during biomining activity and beyond as it is proposed to store material on site including air and noise pollution, access restrictions to properties nearby, and vehicular conflicts
- Large vehicles moving in and out of the site carrying materials, tools, equipment & pedestrian/worker -vehicular conflicts; increased traffic on roads, large equipments & vehicles, noise, air pollution: vehicle emissions, DG sets

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- Vehicles, equipment's not adhering to pollution standards

### *5.9 Other Impacts on existing or proposed activities on site/s*

- There may be approvals from various agencies for biomining activities and associated facilities; depending on utilities and uses on site & associated activities. These permits shall be obtained prior to initiating activities on site.
- Impacts of biomining on existing facilities on site such as MRF, MCF, composting yard etc. (disturbance to activities & people due to dust, leachate, noise, odour; additional load of wastes to these facilities, vibration impacts & structural damage, etc).
- Post biomining impacts: retention of contaminants on site if bioremediation was not well implemented, emission of gas, leachate, visual blight of stored wastes, fire risks and pests on stored waste if not disposed on time, are the impacts post mining which shall be mitigated.
- Impact on forward/backward linkages: Wastes brought normally to site shall be stopped, or if this is dumped elsewhere or not processed, it will lead to health and environmental issues. This alternate location, being associated facility need mitigation measures to avoid/minimize pollution, Health & Safety impacts on workers, communities. Also, forward linkages are considered as associated facilities/linked activities. Impacts of transportation of these fractions (traffic increase, odor, leachate, dust), impacts during rains & emergencies, handling, storage at the identified locations, reuse etc. shall be mitigated.

### *5.10 Cumulative Impacts*

- Cumulative impacts on VECs to be considered for each Cluster & combined: Impact may be *known impacts* viz., impacts of floods, rains, emergencies; Air, Odor, Water (Ground & Surface), biodiversity, communities, storage of retrieved fractions at each site during bio mining activity. *Unknown cumulative impacts* to be updated by contractor viz., storage of materials at common sites, impacts during rains, floods/emergencies in multiple sites of same water/air shed; material transported from multiple sites through same roads, same time, to same destinations; disposal of materials across the region at various destinations.


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## 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT & MONITORING PLAN

### 6.1 Scope of Environmental Management & Monitoring Plan

An Environmental Management Plan (EMP) is a comprehensive strategy designed to manage and mitigate the impacts of activities on humans and the environment, particularly concerning air, water, soil, land, and biodiversity.

### 6.2 Environmental Management Plan

The detailed anticipated impacts and corresponding mitigation measures/management of the impacts are given below.

*Table 17 Impacts & mitigation measures on Planning and installation phase*

| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| ***A*** | | **Planning and Pre-Construction Stage** | | |
| ***1*** | | ***Planning for biomining facility*** | | |
| 1 | Biomining & Bioremediation Plan & Capacities | ▪ Contractor to update the EIA, EMP & EMoP before start of any activity on site, based on his work plan and disposal plan for retrieved / biomined material. This shall be made a bid condition. The EMP shall also include mitigation, management & monitoring measures for the location of reuse/disposal of these biomined material in line wit the agreements with such facility owners and National, State regulations and WB EHS<br>▪ Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate Management Plan.<br>▪ The contractor to have qualified & experienced environmental health & safety personal during all days to manage EHS aspects including EMP, EMoP, reporting and training of workers. | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • Contractor to get all required licenses & permits before start of any activity on site | | |
| 2 | Site Access Closure | • The total cessation of dumping in the site will be implemented before any works.<br>• All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public.<br>• The site will be fully closed to any SWM operation and appropriate signage must be established at the site entrance to indicate that the waste dump has been closed from the operation.<br>• To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground.<br>• Grading shall be performed where necessary to provide a neat appearance | ULB or Contractor as per Bidding mechanism | SPMU/DPMU/ULB |
| 3 | Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – *impact on air quality, odor, water contamination due to* | • Carry out site assessments as per Guidelines for Biomining of Legacy waste Dumpsites of CPCB<br>• Consider safe biomining & gas / leachate generation from existing capped portion of the site<br>• Assess the depth of contamination or the depth to which the site need remediation (to minimize impacts due to legacy waste and leachate) and type of remediation required by conducting bore and auger test and test pit, or standard penetration tests or other suitable means<br>• Provision of appropriate PPE's to the team undertaking the site assessments<br>• Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits | TSC, ULB, Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | *leachate, health and safety impacts of the people working in the site assessment* | • Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound.<br>• Plan for machinery operated which will be operated by skilled operators at all times.<br>• Arrange adequate PPEs full-body suits, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures.<br>• Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound | | |
| 4 | Absence / Delay in Permissions for Developing the biomining facility and associated works as per National regulations | • Required permissions for undertaking biomining at the existing dumpsite and assessments conducted for undertaking biomining as per existing Laws, Regulations; including for associated infrastructure, DG Sets, Consent to Establish; and other licenses including those as per Labor Laws, before the start of works on site | Contractor, ULB | SPMU/DPMU/ULB |
| 5 | Dust impacts due to Site works, screening & stacking of retrieved wastes | • Plan to Provide temporary high screen, buffers around the site before the start of work to curtail dust emissions<br>• Arrange a green belt as early as possible on the area of the site with no / less dump. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers)<br>• PPEs to be used by workers<br>• Awareness to communities & suggest to use PPEs | Contractor and or ULB depending on agreement | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | *(Air Pollution) and Visual Blight due to excavation* | | on bidding mechanism/DPR | |
| 6 | Material sourcing, transport, and stacking of construction materials<br><br>*(Occupational Health and Safety issues and Air noise pollution)* | • Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism<br>• Prior intimation to nearby Primary Health Centre on work activities need for medical support, emergency support needs, type of laborers on-site and labor camp if any<br>• Materials shall be sourced only from approved quarries<br>• Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions.<br>• The driver should be with required license and follow speed regulations<br>• Materials shall be transported preferably through well-surfaced roads. If road it kuchcha, water sprinkling shall be done to prevent dust emission before and after truck passes<br>• Material transport and unloading activities should not result in noise disturbance to locals and should be during day time<br>• Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors.<br>• Provide vehicle wheel wash area on site<br>• Workers to be provided with Personnel Protection Equipment (PPE) including safety boots, jackets, ear muffs, gloves.<br>• Proper rest area on site shall be provided with water, first aid, toilets | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 7 | The layout of Labour camp *(Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)* | • Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp<br>• Nearby health center shall be informed about the labor camp & appropriate medical checkup shall be arranged periodically<br>• Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters)<br>• It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with land owners wherever the labour is accommodated<br>• Camp must not be provided in an area prone to Hazards<br>• Camp should be adequately at higher plinth levels to prevent water intrusion<br>• Rooms shall be of appropriate sizes with adequaate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG)<br>• Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female labourers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc.<br>• The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security<br>(Refer ECOP section 06 and section 11 of EMF for KSWMP) | Contractor | Site engineer of SPMU, Labour Commissioner, PCB |
| 8 | Nearness/disturbance to sensitive areas such as forests, wildlife | • Ensure site selection for any support facilities or activities (such as vehicle storage etc. if no in biomining site) based on the screening checklist and the master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate, Reduce. Obtain requisite | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | habitations, etc. especially in case of providing support facilities<br><br>*(Impacts on Fauna / Flora)* | permissions from respective authorities such as Pollution Control Board, ULB etc.<br>• Identify appropriate government site to avoid land acquisition and resettlement impacts<br>• Covered and well-marked storage area with cut off drains & odour/fly/dust/ fire prevention shall be ensured for excavated wastes and washing. segregation of the same are to be arranged with due consideration to nearby residences (20 no's near South side of the site), slope (towards south east) other landuses | | |
| 9 | Contamination of groundwater due to leaching. Leachate parameters: BOD, COD, TDS, Ecoli, Heavy metals exceeding limits & impacts on ground water quality in nearby schools, residences, wells; long term soil pollution | • During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant<br>• Depending on the contractors plan for biomining of the capped area on site, adopt plans to manage leachate | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 10 | Impacts on flora, fauna" consumption of wastes, leachate impacts, dust smoke – burning, trampling/machinery | • Movement routes of vehicles to be planned to avoid key fauna/flora on site such as *Ailanthus sp.*(Tree) & *Funambulus tristriatus* ( Jungle Palm Squirrel).<br>• Special precautions must be taken to avoid any harm to on-site biodiversity during operations. This includes the installation of bird netting and temporary fences based on site conditions and work schedules. Additionally, visual deterrents such as bird spiders and scarecrows should be employed as deemed appropriate.<br>• Leachate collection & storage/treatment and recirculation shall be planned to avoid impacts on flora, fauna | Contractor | SPMU/DPMU/ULB |
| 11 | Nuisance hazards to neighboring areas | • Ensure proper design and adequate compound wall: high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements<br>• In case of waste mound and site edges are sliding or unsafe; provide engineered retention walls.<br>• Implementing a flexible work schedule to accommodate nearby temple festivals, aiming to minimize the impact on the community during the festive period. | Contractor | SPMU/DPMU/ULB |
| 12 | Treatment & Disposal of wastes and rejects | • Contractor to Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & intert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventorised and quantified, including Biocarth, rejects, inerts. These shall be tested and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertiliser Control Order 1985 and their amendments. Asbestos Management Plan shall be prepared for management if Asbestos wastes retrieved if any | | |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | • Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period. | | |
| **B** | **Implementation or Biomining & Bioremediation stage and Construction of ancillary facilities such as access road improvements, compound walls, greenbelts, drainage etc.** | | | |
| | **Implementation of biomining of the dumpsite** | | | |
| 1 | Impact due to the vehicular movement<br><br>*(Air and noise environment & Vehicular - Vehicular & Vehicular - Pedestrian Conflicts)* | • Vehicles and machinery are to be maintained so that emission conforms to National Ambient air quality standards.<br>• All vehicles and machinery should obtain Pollution Under Control Certificates<br>• HORN PROHIBITION signpost to be erected.<br>• Rumble strips/speed breaker to be provided on access roads.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed.<br>• Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle<br>• Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements.<br>• Avoid heavy vehicle movement through Vadakara roads during peak hours 7 a.m to 10 a.m mention: school hrs / peak hrs; and during important period / festivals when people use the road to access temple<br>• Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents. | Contractor, ULB | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| 2 | Impact due to the use of heavy vehicle and equipment<br><br>*(Air and Noise environment)* | • Mixing equipment (in case of construction of ancillary facilities) should be well sealed and be equipped with a dust-removal device.<br>• Equipment Operators & labourers should wear dust masks, ear protection, and hard hats.<br>• Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load.<br>• Labor to be provided masks / PPEs.<br>• Construction / Biomining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spreading into neighboring sensitive land uses<br>• Noise standards at operation machines are to be strictly monitored to prevent exceeding of GOI noise standards.<br>  ▪ Strictly adhering to designated working hours (day time): Sensitizing construction truck drivers and equipment operators to switch off idle engines.<br>  ▪ Using modern, well-maintained and regularly serviced vehicles.<br>  ▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>  ▪ Provision of earmuffs and ear protection to workers and employees in high noise areas.<br>• Workers in the vicinity of strong noise to wear protectors and their working time should be limited as a safety measure.<br>• As Puthiyapa dumpsite has sensitive receptors and settlement areas within 150m of it, noisy works shall be stopped from 22:00 to 06:00.<br>• Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum.<br>• Avoid noisy activities/machines near South side of the site where settlement exist within 50m. Noise barrier shall be provided at all noise- | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | sensitive locations / for noise generating equipment such as DG sets, mixers (for ancillary facilities) especially near South side of the dumpsite<br>▪ Adopt required measures as per CPCB guidelines, and site & work specific safety requirements | | |
| 3 | Impact during the construction activities<br><br>*(water environment)* | ▪ Labour camps if *any* (depending on Contractors work plan & arrangements) are to be located away from water bodies.<br>▪ Vehicle washing or maintenance near water bodies are to be avoided.<br>▪ Contaminated water from construction / biomining activities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated on site. | Contractor | SPMU/DPMU/ULB |
| 4 | Leachate and Runoff from biomining activities<br><br>*(Soil contamination and groundwater contamination)* | ▪ Provide site cut off drain around the site to divert off stormwater from entering the site, and to prevent contaminating downstream resources with run off from the dumpsite<br>▪ Depending on the contractors plan for biomining of the capped area on site, implement leachate management to cause no harm to communities & environment<br>▪ Ensure stormwater drains will lead to drain outlets (along the south east boundary of the site) on roads adjoining the dump yard<br>▪ Provide leachate drains lined from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area preferably to the South East corner of the site<br>▪ Provide proper treatment of leachate and stormwater that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by biomining activities like excavation and waste segregation and stabilization<br>▪ The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB.<br>▪ The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata<br>▪ Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff and hence reduce infiltration<br>▪ Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism<br>▪ Plan the works on-site only during non-rainy seasons and to complete the works before rains<br>▪ Store leachate preferably in above ground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide for emergency containment additionally.<br>▪ An assessment of the strength and alignment of the retaining wall on the southern side will be conducted for mitigation. Additionally, a line of vegetation or plantation will be established along the southern perimeter inside the compound to prevent the outflow of leachate. | | |
| 5 | Soil decontamination from accumulated waste levels | ▪ Decontaminate the soil / stabilized layers remaining after sieving out wastes using windrow and bioculture of appropriate quality in line with standards / regulations or appropriate means as per CPCB Guidelines<br>▪ Vegetative layer using contaminant absorptive root varieties like Vetiver may be tried on soil and along the edge of the green belt or floating wetlands may be deployed in water channels nearby to maximize absorption of | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | *(Impact on leachate, odor)* | leachate in the soil by root-zone phytoremediation<br>▪ Soil and water testing shall be done and changes in contamination shall be noted. | | |
| 6 | Excavation of waste from the waste mound<br>*(Health and safety impacts)* | ▪ The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound.<br>▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided<br>▪ Machinery operated for excavation should be operated by skilled operators at all times.<br>▪ Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on wastes.<br>▪ Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound<br>▪ In case of the waste mound and site edges are sliding or unsafe; provide engineered retention walls or string boundaries.<br>▪ When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection & treatment mechanism. | Contractor | SPMU/DPMU/ULB |
| 7 | Transportation of wastes or retrieved or other material in | ▪ All vehicles shall carry only approved load of weight<br>▪ Regular cleaning of roads & drains and removal of spills if any.<br>▪ All waste transport vehicles shall be covered and movement shall be during non-peak hours. | Contractor | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | overloaded and open vehicles<br><br>*(Air, Odour nuisances: spills and littering impacts on Air, Water, Land)* | • Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities.<br>• Adopt required measures as per CPCB guidelines, and site specific safety requirements. | | |
| 8 | Spreading and compaction of waste<br><br>*(Safety)* | • Follow technical details in line with CPCB Guidelines<br>• The active working face should be minimized as much as practical an appropriate size is about 2 to 3 times the width of the compactor vehicle.<br>• Waste should be spread and compacted in layers not greater than 0.6m (2ft.) after compaction.<br>• Compaction of the waste should be on a slope of about 20-30% as guided via the permissible levels and worked from the bottom of the slope to the top | Contractor | SPMU/DPMU/ULB |
| 9 | Occupational health and safety impacts of the workers during the biomining & construction of support facilities: | • Avoid direct & double handling of wastes through avoidance measures(suitable planning & equipments), engineering controls & use PPEs<br>• Work area & Labour camps shall be provided with First Aid and other related activities.<br>• Emergency Preparedness plans shall be prepared and implemented for all manpower working centers and its field extension centers.<br>• An Environment Health & Safety policy shall be prepared and implemented<br>• Adequate manpower shall be provided & manager & staff shall listen and act upon the manpower related grievances.<br>• Workers will be provided with PPE such as face mask, gloves, shoes, nose | Contractor, ULB | SPMU/DPMU/ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | • Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage of chemicals/other materials, biocultures or wastes etc; by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | masks & goggles<br>▪ Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed with out slip, trip, fall especially on waste, leachate or trenches<br>▪ Proper training will be provided regarding the maintenance of health<br>▪ Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks & water supply), food, and water in a hygienic environment (with proper handwash). Provide clean eating areas where workers are not exposed to contaminated, hazardous or noxious substances.<br>▪ First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus<br>▪ Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health checkups. Arrange daily health checkup for workers working on waste heaps<br>▪ Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals.<br>▪ Measures such as deferred timings and stretch break to be adopted<br>▪ Secure all installations from unauthorized intrusion and accident risks;<br>▪ Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every days start of works / activities. Key hazards would be (but not limited to) are flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and leachate from existing capped area on site, electric shocks, works with heavy machines & equipments, slips of men & material | | |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc.<br>• EHS specialist with adequate experience & third party supervision are important for biomining activity<br>• Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites<br>• Provide visitor orientation if visitors to the site need to gain access to areas where hazardous conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible<br>• Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas:<br>• Ensure moving equipment is outfitted with audible back -up alarms & flag men with whistles or speakers:<br>• Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit.<br>• Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenance to be marked well & safe kept before activity start near thoseIn close proximity to this location, there is a transformer. Disallow worker exposure to noise level greater than 85 dBA for more than 8 hours a day without hearing protection | | |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • All workers shall be registered as per prevalent labor laws (including a workforce of subcontractors) and provided insurance cover & others as per existing acts/laws<br>• Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractors person/insurance agent<br>• While using heavy machinery like JCB, cranes, etc, inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle.<br>• While using heavy machinery like JCB, cranes, etc, inform communities to prevent children and others from going near operating / movement areas including roads.<br>• Flagmen shall be arranged if work is near schools, hospitals, major roads, and traffic control is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if possible<br>• A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs:<br>• No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor<br>• All works related to working at heights will be undertaken only during the daytime when sufficient sunlight is available;<br>• Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done:<br>• All excavation activities to be conducted in supervision of the site contractor; | | |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | | • Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured.<br>• All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans prepared and implemented, as per Banks Incident Reporting Tool | | |
| 10 | Risk of fire due to conditions leading to spontaneous combustion<br><br>*(Air environment, disturbance to communities and workers, health impacts, safety issues)* | • Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for Implementation of SWM Rules 2016 – regdg Fire Incidents at MSW Dumpsites (https://cpcb.nic.in/openpdffile.php?id=UHVibGliYXRob25GaWxlLzQvNDRfMTY1NDE2Mzk3N19tZWRpYXBob3RvNzYxMi5wZGY= ), LSGD Kerala Government GO on Fire Safety of MRF, MCFs (for the MRF on site if used for storage of wastes)and other Regulations, guidelines applicable<br>• Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3; and National/State regulations & WB EHS<br>• Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes<br>• Avoid conditions that can lead to spontaneous combustion such as:<br>  ○ Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard<br>  ○ Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.<br>• Design the facility for access by firefighting equipment, including clear aisles among waste heaps or work areas and access to adequate water supply.<br>• Ensure workers are briefed of fire hazard & its management<br>• No unauthorized entry shall be permitted to the site; including of workers | Contractor, ULB | SPMU/DPMU |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | during holidays, night time, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating "trespassers not allowed"<br>▪ The following activities should be implemented to prevent fires from occurring at the facility<br>○ adequate fire-fighting equipment should be made available on-site and stored in an accessible manner.<br>○ all operating staff should be trained and able to manage fire outbreaks at any part of the facility.<br>○ clear signage should be established to inform workers and the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area.<br>○ Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows.<br>○ all fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the biomining, storage, and processing areas.<br>○ all flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating stormwater.<br>▪ The local fire brigade shall be informed of the activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the biomining activity in line with National State regulations, guidelines and international good practices | | |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | | • Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.<br>• Contain all local smokes/small fires inside the dump asap. Fire brigade help shall e sought on all smokes/fires outside the dump asap<br>• Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured.<br>• Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers | | |
| 11 | Construction of new facilities in retrieved land | • The excavated site shall be protected from any dumping during or after the biomining activity and shall be reserved for SWM activities in line with SWM Rules 2016<br>• Any new facility under KSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations | ULB | SPMU/DPMU |
| 12 | Pest / Vermin Control & Visual impacts<br>(Odour, flies, rodent / other pest menaces) | • Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center<br>• Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups<br>• Biopesticides / biological control shall be followed. However, biopesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials<br>• Banned pesticides/insecticides shall not be used.<br>• Workers shall be made aware of storage and use of pest control measures and PPEs to be used<br>• Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate management | Contractor, ULB | DPMU, SPMU |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 13 | Odour nuisance | • Waste with a strong odor to be covered immediately they are emptied from vehicles.<br>• Control and manage leachate treatment to minimize odor.<br>• Provide buffers screens to curtail odor from reaching surrounding communities especially to North side of site.<br>• Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor. | Contractor, ULB | DPMU, SPMU |
| 14 | Storage, Collection, Transport, Treatment & Disposal of wastes and rejects | • Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste.<br>• Adequate covering is necessary for the waste or stored fractions.<br>• Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters<br>• Waste handling shall be inline with existing regulations & guidelines & avoid health & safety impacts<br>• No material is allowed to remain on site after the contract period<br>• Adequate fire safety arrangements & awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported<br>• Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/interts in designated or agreed area & are in line with schedule; using GPS.<br>• Given that the access road is used by the public, it is imperative to implement the required safety precautions and environmental protection measures when transporting the waste. | Contractor, ULB | DPMU, SPMU |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 15 | Other activities | • No activity other than biomining shall take place on site & any activity shall cause no adverse impacts on the environment or people<br>• If existing MCF shall be used for soring biomining wastes, its safety shall be ensured in terms of fire & structural safety before starting to use the facility. Further usage of the MCF after biomining works shall be after proper cleaning / washing & disposal of all rejects/inerts & tools to ensure good housekeeping & no H&S impacts<br>• If existing MCF shall be used by the ULB for storing dry wastes from Town, during biomining period, alternate access shall be arranged & workers shall be adequately protected against any health & safety impacts | | |
| 16 | Energy Efficiency & Water Use efficiency | • All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & biomining / construction techniques<br>• Landscaping & green belts to use local / indigenous plants & trees<br>• Waste water and Leachate to be treated & recycled/reused | Contractor | ULB |
| **C** | **Future Site Usage (EMP shall be updated in line with EMF & used if future site usage is proposed under KSWMP). This section is not the responsibility of the Contractor for Biomining, but of the future facility operator & ULB** | | | |
| 1 | Future use of the biomined site: Green Park, MCF, MRF, RRF, Treatment plants, landfill cell or any | • ULB to ensure that the site will not be used for future dumping.<br>• Activities at existing MCF to be upgraded to ensure that no waste (even dry wastes) gets dumped around.<br>• ULB shall plan the future use of the site shall be in consultation with the communities.<br>• Phase 1 Environmental Assessment to be caried out, EA for existing facilities & EIA for proposed development in line with EMF in case this is proposed to be developed under KSWMP<br>• All applicable clearances, permits shall be arranged in line with applicable regulations for the proposed new use of the site, and appropriate | Future Facility Developer / Operator & ULB | ULB (SPMU in case it is under KSWMP) |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
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| | other, preferably for SWM | designs/plans to be prepared & implemented | | |
| 2 | Vehicle movement for new activities: MCF/MRF, RRFs, Treatment plants, landfill cell<br><br>*(Air, water environment, a nuisance to biodiversity, communities, Health impacts)* | ▪ The movement route shall be scheduled for each vehicle.<br>▪ Enforce speed limits applicable and make drivers aware of this<br>▪ Vehicles movement shall be tracked by Health Supervisors to ensure keeping up to schedule; preferably using GPS<br>▪ Any adulterated fuel shall be avoided. There shall be periodic emission tests for vehicles<br>▪ Provision of Personal Protective Equipment such as face mask, gloves, nose masks & goggles to all workers in C&T vehicles, Maintenance yards<br>▪ Proper lubrication shall be provided to minimize squeaking noise due to friction<br>▪ Honking shall be minimized to eliminate any possible discomfort to the nearby people.<br>▪ The most optimum route is planned with minimum no. of vehicles with the help of GIS mapping and apps for the general public<br>▪ Traffic will be managed at the site by providing adequate space for parking of vehicles<br>▪ Timely transfer and disposal of retrieved material shall be carried out by vehicles and should transfer materials only to designated areas as per design<br>▪ No waste or material shall be disposed in any place other than the designated area; including water bodies, coasts/forests, or sensitive areas. | Future Facility operator | ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 3 | Exhaust emissions<br><br>*(Air impacts)* | • No idling of vehicles on site.<br>• Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed | Future Facility operator | ULB |
| 4 | Plying of vehicles through kutcha / unsurfaced roads and idling<br><br>*(Air pollution: SPM, CO, CO2)* | • Vehicle movement shall be well planned – through topped roads. In case of necessity to move through Kutcha roads, ensure sprinkling of water to suppress dust before and after the movement of the vehicle | Future Facility operator | ULB |
| 5 | Odor<br><br>*(Nuisance, Air)* | • Daily soil covers to compacted wastes to manage odors.<br>• Waste with a strong odor to be covered immediately they are emptied from delivery vehicles;<br>• Control and manage leachate treatment plant to minimize odor.<br>• Adhere to air quality regulations with quarterly air quality monitoring Maintenance of the buffer zone and protective berms<br>• Provide buffers screens to curtail odor from reaching surrounding communities | Future Facility operator | ULB |
| 6 | Impact on the ambient noise quality during the operations | • Strictly adhering to designated working hours (day time): Sensitizing construction truck drivers and equipment operators to switch off idle engines;<br>• Using modern, well-maintained and regularly serviced vehicles; | Future Facility operator | ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| | *(Noise, nuisance to sensitive receptors, health impacts)* | • Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.<br>• Provision of earmuffs and ear protection to workers and employees in high noise areas | | |
| 7 | Occupational health and safety impacts of the workers:<br>• Health impacts of exposure to a variety of harmful materials of waste-related pollutants.<br>• Accidental spillage by moving vehicles.<br>• Cut & Bruises during handling of materials/rejects<br>• Allergies from pathogen and airborne dust<br>*(Air environment, Health impacts)* | • All OHS and CHS measures to be followed in line with applicable regulations, guidance<br>• Workers & communities shall be made aware of OHS, CHS risks and impacts & mitigation measures adopted<br>• Emergency management plan to be prepared & followed<br>• Workers shall be appropriately trained or OHS during construction & Operation of all future facilities | Future Facility operator | ULB |

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| S No | Probable Negative Impacts | Mitigation Measures | Implementation Responsibility | Monitoring Responsibility |
|---|---|---|---|---|
| 8 | Pest / Vermin Control (Odour. flies. rodent / other pest menaces) | • Regular cleaning and approved pest control measures to be adopted<br>• Biopesticides / biological control shall be followed.<br>• Banned pesticides/insecticides shall not be used.<br>• Workers shall be made aware of storage and use of pest control measures and PPEs to be used | Future Facility operator | ULB |
| 9 | Fire Safety | • The local fire brigade shall be informed of the activity. and fire safety plan shall be submitted for their comments/feedback & implemented in line with National State regulations. guidelines and international good practices | Future Facility Operator | ULB |
| 10 | Energy Efficiency & Water Use efficiency | • All activities to consider energy efficient & clean fuels: and use of energy efficient equipment & construction techniques<br>• Landscaping & green belts to use local / indigenous plants & trees<br>• Waste water to be treated & recycled/reused | Future Facility Operator | ULB |

**Disposal phase of By-products from Bio-mining process**

The bio-earth and coarse fraction soil recovered from dumpsite will be used for filling low lying areas. The RDF material recovered from dumpsite will be transported to nearby cement factory and recyclable material will be handed over to the authorized recycling agency. If the by-products are not removed from the site within a three-month period, penalties will be imposed on the contractor.

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### 6.3 Emergency & Disaster Management Plan

**Hazards Associated with Dumpsite Activities**

The Disaster Management Act, 2005 mandates every Government Department to prepare, review and update Disaster Management Plan

#### 6.3.1 Identified Emergency Situations

*Table 18 Hazards associated with Dumpsite Biomining & Bioremediation*

| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| **As per World Bank EHS Guidelines** | |
| **Waste Storage** | **Regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases** |
| **Waste Segregation** | **Regular audit of segregation of biomined wastes** |
| **Monitoring records for hazardous waste collected, stored, or shipped should include** | **1. Material Identification:**<br>- Name and identification number of the hazardous material(s) present in the waste.<br><br>**2. Physical State:**<br>- Indicates whether the waste is in a solid, liquid, gaseous form, or a combination of these.<br><br>**3. Quantity:**<br>- Specify the amount of hazardous waste, and biomedical waste retrieved from site typically measured in kilograms or liters, or by the number of containers. All such waste shall be staked in appropriate places / containers for disposal; duly marked & records kept<br>-<br>**4. Waste Shipment Tracking:** |


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| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| | Documentation tracking details include:<br>- Quantity and type of hazardous waste.<br>- Dates of dispatch, transportation, and receipt.<br>- Records of the originator, receiver, and transporter involved in the waste shipment.<br><br>**5. Handling and Treatment:**<br>- Describes the method and date of various actions taken with the retrieved waste, such as storing, repacking, treating, or disposing it<br>- Cross-referenced with specific manifest document numbers relevant to the hazardous waste.<br><br>**6. Location within Facility:**<br>- Specifies the specific locations within the facility where retrieved waste – various types shall be stored or processed.<br>- Includes information about the quantity of waste at each location. |
| **Falls and Slips at the dumpsite**<br>**Slippery surfaces or uneven surfaces and poor access to work areas climbing on and off the facility, equipments/machinery or the waste segregation / other facilities set up.** | Tidy workplace by maintaining good housekeeping. Handholds wherever necessary and clear/ safe access to work areas with proper PPE to the persons working at the site. |
| **Fire Hazard**<br>**Fire risk may occur due to the following**<br>**Storage of flammable liquids / Gas like LPG, Diesel**<br>**Any combustible materials** | Combustible/flammable materials should be properly managed and stored/used. Fire extinguishers and Fire hydrant Network with reserve water (As per |


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| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| **Sparks<br>Open flames<br>Absence of Fire hydrant network may increase the risks in case of major fire accident** | NFPA Code) should be made available. Emergency Plan in case of fire. |
| **Absence of Personal Protective Equipment Lack of adequate footwear, Helmets, hearing/ eye protection, gloves & goggles may lead to injuries and death.** | Proper footwear, Helmets, hearing/ eye protection, gloves & goggles should be given to the workers at the dumpsite. Proper training should be given to the workers on the use of PPE. |
| **Electrical Hazard<br>Electric wires if any damaged<br>Poorly insulated<br>During temporary repairs<br>Circuits overloaded may lead to major accident** | Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit. |
| **Ladders<br>Risk may occur due to the following<br>Not secured against dislodgement<br>Defective ladders<br>Not sufficient length<br>Incorrectly placed** | Ladder risk can be mitigated by the following<br>Secured against movement or footed<br>Ladders in good condition<br>Regular inspection<br>Ladder should be extended one (1 m) meter above platform to avoid injuries |
| **Excavations<br>Risk may occur due to the following<br>Trench collapse<br>Gas emission** | Risk can be mitigated by the following<br>• Soil stability should be known before excavation<br>• No water accumulation<br>• V500 mask should be used in order to counter the gas emission.<br>• Emergency Plan |


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| Hazards Associated with Dumpsite Activities | Control / Mitigation Measures |
|---|---|
| **Defective or wrong Hand Tools**<br>Wrong/defective tool may end up with injuries to the workers using the tool | Right tool for the job should be used properly and it should be in good condition |
| **Accidents due to vehicular movement**<br><br>**Vehicle movement inside the site** | Vehicle should move at control speed inside the dumpsite and reverse horn must be installed in every vehicle to avoid the accidents. |
| **Noise Hazard**<br>**Noise levels over 85 decibels would cause trouble to the people working at the site** | Noise Levels should be maintained below 85 decibels and with proper protection |
| **Falling Material**<br>**Fall during carrying/Lifting of waste and materials from overhead work areas.** | Risk can be mitigated by preventing the falls by barriers, training, strengthening the materials used for works and the following<br>Use of hard hats.<br>Person operating the jcb/machine must be provided with walkie talkie/hand signals to know about the clearances. Also the services of flag staff with flag & whistle to be arranged. |
| **Visitors Presence at site**<br>**Insufficient fencing may lead to attract pedestrians to enter the site.** | Fencing and barricades with proper signage boards indicating "trespassers not allowed" |

### 6.3.2. Proposed Organizational Structure for Disaster Management

The Organizational structure for the Disaster management contains the following team members.

**Emergency Response Team:**

A response team needs to be set in assistance with a senior executive (Site controller), Manager Safety (Incident controller), Shift in charge, and Emergency Coordinators.


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Incident controller would be reporting to the Site Controller. Incident Controller organizes a team responsible for controlling the incidents with the personnel under his control.

Shift In-charge would be the reporting officer, who would bring the incidence to the notice of the Incidence Controller and Site Controller.

Emergency Coordinators would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential support services. For this purpose, security in-charge, personnel department, essential services personnel would be engaged. All these personnel would be designated as key personnel.

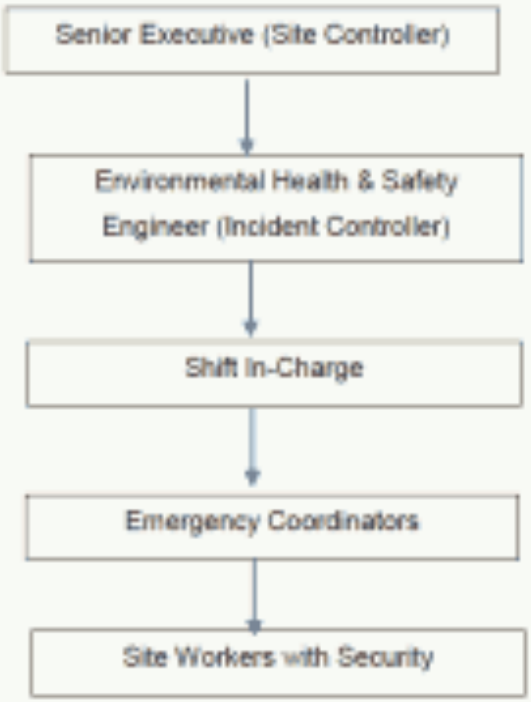



*Figure 7 Organizational structure for the Disaster Management Team*

### 6.3.3 Emergency Response Facilities

Emergency Control Center – with access for emergency shutdown procedures, duties and contact details of key personnel and government agencies, emergency equipment, etc.

- Assembly Point – with minimum facilities for safety and rescue
- Emergency Power Supply – connected with diesel generator, flame proof emergency lamps, etc.


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- Fire Fighting Facilities – first aid fire-fighting equipment, fire alarms, etc.
- Location of Wind Stock – located at appropriate location to indicate the direction of wind for emergency escape
- Emergency Medical Facilities – Stretchers, gas masks, general first aid, emergency control room, breathing apparatus, other emergency medical equipment, ambulance The medical centre should display poster for treating burns and first aid. Some medicines and facilities to be kept in the medical centre are suggested.

**Health and Safety Measure for the workers**

All workmen employed in working conditions will be provided with adequate personal safety equipment as applicable to the work including (but not limited to):

- Safety shoes/boots
- Safety Helmets
- Hand gloves
- Ear muffs

**Monitoring Plan**

The considerations in an emergency planning include the following:

- Identification and assessment of hazards and risks
- Hazard consequences analysis
- Alarm and communication procedures
- Identification and equipping emergency control centre identify assembly, rescue points, medical facilities
- Emergency preparedness plan, procedure, steps to be taken before during and after emergency
- Formulation of plan and emergency sources
- Training rehearsal, evaluation and updating the plan
- Machinery should be examined regularly

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- Medical examination:every employee shall be examined by doctors at least 3 months in a calendar. Health register should be maintained by the individual industry coming in the project site

**Emergency Action Plan for Fire**

In case of Fire the immediate plan of action will be “RACE” that stands:

R - Rescue: When you discover a fire, rescue people in immediate danger if you can do so without endangering yourself.

A - Alarm: Sound the alarm by pulling a fire pull station and call fire station, from a safe distance, notify security of precise location of fire.

C - Confine: if possible

E - Evacuate: Evacuate the place

Immediately inform the response team on site and local fire brigade. Response team moves to the point of fire and take all necessary steps to stop the fire. Fire brigade to join at the earliest. If the fire is not controllable and spreads, then the manager in charge should inform the district authorities and call for additional external help. Complete an Incident/Accident Report within 24 hours.

Firefighting system is proposed to prevent and control fire outbreaks. The firefighting system will consist of portable fire extinguishers, hose reel, wet riser, yard hydrant, automatic sprinkler system, and manual fire alarm system. In case of dumpsite biomining it is also important to shave fire lines in the biomining area & also in the storage area where material retrieved is stored.

**Emergency Action Plan for Electric Fire**

- Disconnect the affected areas electric supply
- If fire is small scale, then $NAHCO_3$ or Sand will be effective.
- Attempt to extinguish fire with the help of $CO_2$ based extinguisher

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Seek support of Fire Brigade

Action Plan of on-site Emergency Plan

The action plan considered is given as follows:

- To constitute Disaster Management Committee under senior officer not below the rank of General Manager
- To identify potential hazards areas in the layout map
- To predict degree of burns and distance of the risk zone by using model
- To evacuate the area within risk zone
- To localize the emergency and if possible eliminate it
- To minimize the effects of accidents on people and property
- To take remedial measures in the quickest possible time to contain the incident and control it with minimum damage
- To mobilize the internal resource and utilize them in the most effective way
- To get help from the local community and government official to supplement internal manpower and resources
- To minimize the damage in other sections
- To keep the required emergency equipment in stock at right places and ensure that they are in working condition
- To keep the concerned personnel fully trained in the use of emergency equipment
- To give immediate warning to the surrounding localities in case of emergency situation arising
- To mobilize transport and medical treatment of the injured
- To educate the public in the surrounding village regarding hazards
- To arrange treatment of causalities
- To safe guard the people
- To identify the causalities and communicate to persons known to them
- To render necessary help to concerned
- To rehabilitate area affected

**Urban Floods:**

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Floods are extreme events, usually triggered by extreme precipitation (river/inland floods) and/or storms (coastal floods). If these rainfalls exceed the retention capacity of the basins, drainage speed and volume, it causes floods.

**Different Types of Flooding:**

1) Localized flooding due to inadequate drainage;

2) Flooding due to overflows from Rivers/channels/drains, where the dumpsite is on or near flood plains or when flood plains are occupied by various settlements & other infrastructure without space for water to flow.

**Stakeholders in Disaster Management:**

The policy also systematizes a frame work of operation for the following set of stakeholders that play key roles in disaster management.

- Kerala State Disaster Management Authority
- State and Central Government Departments and Disaster response forces
- District Disaster Management Authorities
- Local authorities including Municipal Corporations/Municipalities, District/Block/Grama Panchayaths, Taluk/Village Officers etc.
- Voluntary and Civil Society Organizations
- Red Cross, multilateral aid agencies and U.N agencies
- Community – Village Disaster Management Committees / Task Forces
- Public sector Undertakings
- Private sector undertakings
- Army, Navy, Air Force, Coast guard, Airport Authority, National Disaster Response Force etc.

District disaster teams shall be informed of the proposed activity and its schedule.

### 6.4 Environmental Monitoring Plan

Monitoring at dumpsite will be carried out in four physical zones as follows:

i. On and within the dumpsite

ii. In the unsaturated subsurface zone beneath and around the dumpsite


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iii. In the groundwater (saturated) zone beneath and around the dumpsite

iv. In the atmosphere/local air above and around the dumpsite

The Environmental Monitoring Program involves the following:

- Conducting survey and sampling program.
- Analysis of samples, data/information collected, and their interpretation.
- Preparation of reports for submitting to management and statutory authorities.
- Environmental monitoring is carried throughout the project operation to detect changes in the key environment quality parameters, which can be attributed to the project.

The results of the monitoring program will be used to evaluate the following.

- Extent and severity of the environmental impacts against the predicted impacts.
- Performance of the environmental protection measures or compliance with pertinent rules and regulations.

### 6.4.1 Air Environment

The potential sources of air pollution from the dumpsite include vehicular movement, emission of dust from biomining activities & wastes retrieved and stacked, and passive leakage of landfill gas from the disposal site. Other important contributor is odour emissions from the existing legacy site disturbed. Monitoring of the air environment will be carried out during the operational phase in and around the project site.

### 6.4.2 Noise Environment

The operations shall induce noise due to operations of transport trucks (men & material), JCB loaders and other types of machinery required at the dumpsite for moving wastes, screening, stacking, turning etc, and the biomining activity per se. Monitoring of ambient noise levels and also the exposure of the workers to that environment is essential.

### 6.4.3 Water Environment

Water quality to be monitored during the operational phase. The monitoring frequency needs to be increased if higher concentrations are expected. Both groundwater regime and

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surface water domain is anticipated to be most-affected, through leachate contamination. Therefore, surface & ground water will be periodically monitored for the parameters particularly increase in BOD, heavy metals and the hazardous chemicals.

### 6.4.4 Land Environment

The soil in the dumpsite & neighboring areas will be analyzed for relevant parameters.

The details of Environmental Monitoring Programs are given below:

*Table 19 Environmental Monitoring Parameters*

| Environmental components | Locations | Frequency | Parameters |
|---|---|---|---|
| Ambient Air quality | Nearby habitations and downwind locations | Quarterly [1 sample] | $PM_{10}$, $PM_{2.5}$, $NO_x$, $CH_4$, CO, Ammonia |
| Noise | Outside the site – towards residential area | Monthly | Noise levels |
| Ground and Surface water | Ground water from the nearest well, drain upstream & downstream of where leachate is disposed, and Thodu upstream & downstream of were the drain joins | One Year | IS 10500:2012 drinking water parameter for ground water wells, class D, E for drain & Thodu (if these are not used as drinking water source) |
| Accidental release | Chemical, oil and fuel spills | Daily | Near chemical, oil storage areas Incident reports |
| Health safety Hazards | Medical records, documentation of injuries and accidents, Health and safety assessments | As and when accident/injury occurs | Incident reports |


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| Environmental components | Locations | Frequency | Parameters |
|---|---|---|---|
| Leachate | 1 point per leachate pond | Weekly during biomining activity | • pH<br>• Biological Oxygen Demand- BOD<br>• Chemical Oxygen Demand-COD<br>• Nitrogen (Ammonia, Nitrate, Nitrite)<br>• Oxidation-Reduction Potential- ORP<br>• Electrical Conductivity-EC<br>• Total Organic Carbon (TOC),<br>• Dioxins |

In case, any deviation from FR, this would be updated and mitigation and monitoring measures would be revisited. Currently the location of disposal of biomined material, or type of transport of biomined material is unknown & hence, these impacts & mitigation, monitoring requirements will be updated & implemented by the Contractor. This aspect should be made a Bid condition.

### 6.5 Environmental & Social Safeguard Budget

The details of Environmental Budget for Implementation and Supervision of Environmental Management Plan (EMP) is given below:


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*Table 20 Detailed Cost Breakup*

| S. No. | Description | Frequency | Unit Price | Qty | Amount in Rs |
|---|---|---|---|---|---|
| | **Environmental Safeguards** | | | | |
| 1 | Deodorizer equipment (power sprayer) | Only Once | | | |
| 2 | Green Net ( Approx., 250 m Length – Height – 3 m) and installation charges | Based on requirement | | | |
| 3 | Spillage Kit | Only Once | | | |
| 4 | Monitoring of Environmental parameters [Air, Ground water, Surface water, Noise, Soil and Leachate] Actual Noise abatement, odour management, dust management measures to be included in DPR cost | Quarterly, first six months by contractor and next two years by ULB | | | |
| 5 | Gas monitoring to check the gas accumulation at the dumpsite (including existing capped area at Puthiyappa dump) | Gas monitoring should be conducted at least twice a day for about 7 consecutive days | | | |


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| S. No. | Description | Frequency | Unit Price | Qty | Amount in Rs |
|---|---|---|---|---|---|
| | **Environmental Safeguards** | | | | |
| 6 | Personal protective equipment | Entire Process | [redacted] | [redacted] | [redacted] |
| 7 | Training on capacity building | Entire Process | [redacted] | [redacted] | [redacted] |
| 8 | Leachate Management (Full costs included in DPR. This is only for incidental mitigation of odur, leaks, spillage, flies etc. ) | Only gap incidental costs. The rest are all included in DPR | [redacted] | [redacted] | [redacted] |
| 9 | Access Road Improvisation | Only Once | [redacted] | [redacted] | [redacted] |
| | **Social Safeguards** | | | | |
| 9 | Overall Budget for Social Safeguards | | [redacted] | [redacted] | [redacted] |
| **TOTAL** (actual costs for works involved for mitigation measures are to be included by the contractor in DPR costs based on his work method. This is only indicative cost for incidental mitigation & management measures. EHS in Labour camp also not included here; but shall be included by the contractor based on his work plan as this is combined with multiple other dumpsite biomining works) | | | | | [redacted] |


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## 7. SOCIAL SAFEGUARD ASPECTS

### 7.1 Introduction

Dumpsite remediation refers to the process of mitigating the adverse effects of existing dumpsites and restoring them to a safe and environmentally sustainable state. It involves a series of systematic actions aimed at minimizing pollution, reducing health risks, and rehabilitating the affected areas. The bio mining process of Vadakara municipal dumpsite has been included in the World Bank supported KSWMP project. The dumpsite, which is located at Puthiyappa, ward 20 of the municipality has been operational since 1953, in a land extend of 152 cents owned by the ULB. However, it has not been used for any dumping purpose for the last five years. Currently, street sweeping trash is put in the dumpsite. Around 300 households reside within a 200-meter radius of this dumpsite that is prone to some sort of risks. The sixteen families living very near to the site is at most risk. A few institutions are also functioning near this dumpsite include a school, two colleges, one Anganwadi, a mini theater, staff quarters, library, and a veterinary hospital.

The site is located at 3 km from the National Highway 66. The access road to the site is of six-meter width. Mixed types of families of different socio-economic groups such as High-Income Groups (HIG), Middle-Income Groups (MIG), and Low-Income Group (LIG) reside within 200m radius making a cross section of the society. Most common livelihood sector is agriculture and farming, about 40 persons engaged with service sector jobs and eight persons employed with the government sector jobs. The information on socio-economic profile is being gathered adopting social tools like transect walk, Key Informants Interview (KII) etc.

### 7.2. Output of The Social Screening

Social screening of the dumpsite remediation, by a joint team of DPMU, DPMC, TSC and PIU, was carried out on 8.2.2023 following a screening checklist. Social screening was done to identify the potential social risks anticipated during dumpsite remediation. Vadakara dumpsite has a high density of population, presence of public utilities/facilities, educational institutions, library and a film society. The presence of chronic illness among the people who are staying very near remains as a risk factor.

**High density of population**

The dumpsite is in a densely populated area with about 300 households residing within a 200m radius. The municipality stopped dumping of biodegradable waste like slaughter waste, hotel waste, market waste etc since 2005. The land value of the nearby area is very low, which attracts low-income people prefer to find dwelling spaces near the site. As a result, the population density became very high. 16 families residing 50m radius from the


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boundary of the dumpsite are very prone to risk. At present, there are no aesthetic or odor issues due to the dumpsite. In the process of transect walk and KIIs, it has been noted that the nearby households extend support for the dumpsite remediation activities.

**High proximity of educational institutions, public utilities and facilities.**

Educational institutions, library cum mini theater, warehouses, shops, veterinary hospitals, staff quarters etc are the public utilities near the dumpsite. A good number of people used to gather in the library regularly for reading and learning purposes. Dailies, journals and other periodicals are available in the library. It is also found as a venue for public gathering and recreation. Phalke Film Society (mini theater) organizes film shows regularly, organizing debates and discussions and also conducts annual film festivals. Municipal ward level programmes are being conducted at this space. Six shops and commercial establishments exist in the vicinity of 200m to the dumpsite which includes stationery and other small shops.

**Community Health and vulnerability**

The vulnerable groups such as persons with respiratory illness (30 nos), pregnant women (5), PWDs (4), terminal illness (4) children below the age of two (12) and elderly (18) may exhibit health issues during the remediation process. The biomining process may create vulnerabilities such as mobility, sound, water, and air pollution etc..

### 7.3 Transect Walk

To understand the social dynamics, demographic profile, livelihood patterns, social dynamics of the community and to understand the needs, concerns, and aspirations of the community, a transect walk was carried out on 30.05.2023, which was crucial for developing effective dumpsite remediation strategies that align with their priorities. The findings and recommendation of the transect walk is shown in the below given table.

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| S.No | Social risks | Findings and Recommendations |
|---|---|---|
| 1 | Presence of 300 families, institutions, shops, establishments, and other public utilities near (200m) the dumpsite. | • Free movement of the residents needs to be ensured<br>• Since the school has two entrances, inside and outside of the dumpsite road, the mobility of the students will not be disturbed. Regulation on either of this road may affect the free movement of the students during school opening and closing time. Necessary traffic arrangements must be made.<br>• Working hours of public utilities including shops and establishments may be restricted, that should not affect the livelihoods of the workers attached to these facilities |
| 2 | Sound pollution, health issues and foul smell most affects 16 families residing very close to the site (50m). | . SIA and SMP will consider the detailed impact and proper mitigation measures |
| 3 | Health risk of vulnerable groups residing near to the site(especially 16 families) which includes patients with breathing issues, pregnant women, PWDs, cancer patients, children below the age of two and elderly above the age of seventy-five. | Health issues may aggregate during work operations.<br>These factors should be considered strongly especially for all vulnerable groups |

**Findings of the consultation meeting.**

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1. The local residents are much supportive for the entire proposed dumpsite remediation process
2. All concerns related to the health care of the vulnerable communities residing near to the dumpsite needs to be taken care properly.
3. Free movement of the residents needs to be considered while preparing the project. There should be adequate provision for necessary traffic regulations / rearrangements to manage the movements of vehicles as well as machineries.
4. The local residents wanted to get some sort of assurance from the authority that the present dumpsite should not be used for any kind of waste management activities.

1. 7.4 Scoping of Social Impact Assessment and Management Plans

Since the site is surrounded with a greater number of families and considering the major work to be implemented, the Vadakara dumpsite falls into a substantial social risk category. Proximity of public facilities and institutions, use of sophisticated technologies and machinery are also the reasons to consider the site to be a substantial risk category. All the social risks identified through social screening process need to be addressed. A detailed Social Impact Assessment will be carried out to understand the social impacts. The SIA will help to identify the possible positive and negative social impacts due to the biomining process. The SIA will consider the following risks in detail

**Community health and safety**: As per the screening, it was understood that vulnerable communities including persons with respiratory illness (30 nos), pregnant women (5), PWDs (4), terminal illness (4) children below the age of two (12) and elderly (18) may report illness due to sound and air pollutants. The risk possibilities due to the emission of gasses, dust etc is to be considered while preparing detailed SIA and SMP.

**Access to institutions and public utilities**: Access for 300 families to the public utilities such as a public library, film institute, 4 stationary shops and 2 petty shops, veterinary hospital, 1 school and 2 colleges, a supplyco warehouse may get affected during the biomining activities. Traffic restrictions in access roads may be imposed. A detailed SIA will cover all such issues in detail.

7. **Residents in the steep southern side**: A retention wall was constructed to protect the site from land erosion and leachate to the south side of the dumpsite which is a steep area. During rain, it may lead to water flow along with leachate towards the downstream.


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4 families are staying within 50m of the compound wall. Considering the negative impact, the dumpsite remediation activities are scheduled to start by the end of November when monsoon season ends.

8. **Routine life:** Since the area is thickly populated, it may affect the routine daily life of the people. Restriction in public roads, disturbances in gathering spots, shops etc are the expected issues. Detailed impact assessment is needed to identify the ill effect on routine life and hence mitigation measures can be developed.

9. **Labor Management Plan:** Approximately 30 to 40 laborers would be engaged in a day for the biomining process on a regular basis for a period of 5 months. The contractor must get all the mandatory registrations and licenses and to comply with all relevant labor laws.

**OVERVIEW OF LABOUR LEGISLATION: TERMS AND CONDITIONS**

| S. No | Applicable Acts | Details |
|---|---|---|
| 1. | Employees Compensation Act 1923: | The Act provides for compensation in case of injury, disease or death arising out of and during employment |
| 2. | Contract Labour (Regulation & Abolition) Act 1970 | The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. |
| 3. | Minimum Wages Act 1948: | The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. |


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| S. No | Applicable Acts | Details |
|---|---|---|
| 4. | Payment of Wages Act 1936: | It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the workers. |
| 5. | Equal Remuneration Act 1976: | The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training, and promotions etc. |
| 6. | Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: | The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc. |
| 7. | Child Labour (Prohibition & Regulation) Act 1986: | The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in the Building and Construction Industry. |
| 8. | Employees State Insurance Act 1948: | The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the Central Government. The Act also provides for benefits to dependents of insured persons in case of death because of an employment injury. |


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| S. No | Applicable Acts | Details |
|---|---|---|
| 9. | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: | This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee |
| 10. | Industrial Disputes Act 1947: | the Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing the establishment. |
| 11. | Trade Unions Act 1926: | The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. |

The project expects a labor influx. The labor influx may have some negative effects on the host community. A detailed SIA is required to understand the labor related issues and derive suitable mitigation measures in terms of labour compliance and labor influx. According to the findings from SIA, the Labor management plan, labor influx management plan and GBV action plan will be prepared.

**Action plan for the preventive Gender Based Violence:** The bio-mining activities may require women laborers in the workforce. It is necessary to ensure better working conditions, a gender friendly working environment, and improved social security for the women workers. Provision for portable drinking water and toilet facilities needs to be separately arranged. The preventive gender-based violence action plan would be prepared after assessing the gender issues. Therefore, a comprehensive social impact assessment needs to be carried out.


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### 7.4 Methodology for Social Impact Assessment

A predetermined methodology can be used to conduct the SIA. Baseline Study in SIA process usually includes data collection and analysis of various project aspects. The SIA methodology includes.

a) Social Screening

b) Stakeholder meeting

c) Household level survey

d) Baseline study /data collection

e) Focus Group Discussions(FGD)

f) Key Informants Interview

g) Data analysis (Quantitative and qualitative)

### 7.5 Costing For SIA

The scoping of SIA identifies the areas where impact assessment is required. After identifying social impacts, it would refer to suitable mitigation measures further. The mitigation measures include stakeholder consultations, activities to ensure community health and safety, mitigation to disruption of access to public utilities, GBV prevention activities, Labour management activities, influx management actions, strengthening of GRM. The cost for the implementation of mitigation measures can be derived from the programmes/ activities proposed under mitigation. Detailed cost estimation will be done during SMP and LMP, influx management and Preventive GBV action plan preparation. As a lump sum, [redacted] ([redacted]) would need to adopt mitigation measures. The total cost can be bifurcated into different heads based on SIA

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## 8. INSTITUTIONAL ARRANGEMENTS

### 8.1 Proposed Institutional Arrangements

Technical support for preparation and implementation of safeguards instruments at the ULB level will be provided by district-level TSCs hired by each DPMU, which will include environmental engineers (preferably with qualifications and experience in SWM), natural habitat/biodiversity specialists for projects near Natural Habitats, social cum communication experts (preferably with experience in SWM). The Terms of Reference for TSCs will include the scope of work to ensure compliance with ESMF, and to support screening and categorization of the subprojects using the screening tools presented in the ESMF. The results of the screening will be forwarded to the DESDU for confirmation on the categorization and issuance of ToR for the preparation of safeguard instruments. In the case of subprojects that may impact Natural Habitats, the Biodiversity Management Committee of the ULB will review the screening and guide the ToR preparation. The Support Organisation will be overall responsible for various IEC activities for sensitizing the communities and undertaking consultations as part of the citizen engagement plan for wider acceptance of the proposed investments. They will facilitate the integration of community needs, carry out Free Prior Informed Consultation required to prepare the DPRs and Safeguard Instruments. Safeguard documents pertaining to E1 category investments will be prepared by independent consultants other than the TSC who is in charge of DPR preparation. For E2 projects TSC will prepare the ESIAs as part of DPR preparation. For E3 projects, TSC will compile the filled-in screening Formats and applicable Indicative ESMP and will submit to DESDU for approval and records. ESIAs of E1 and E2 subprojects will be sent to S-ESDU after reviewing by D-ESDU. ESIAs of E2 projects will be cleared by S-ESDU; while those of E1 category projects or any special projects/under any special circumstances will be sent to the World Bank for review and clearance after reviewing by S-ESDU. Each contractor / DBOT operator will have an environmental / EHS expert who will supervise the implementation of ESMP at sub-project level. The PIU Engineers, Health officer, and support organization will directly supervise the contractor / DBOT operator and guide the implementation of ESMPs with TSC support. The PIUs will support and co-ordinate for government approvals and statutory clearances. The PIU will submit the compliance reports on clearances, permits, and environmental and social safeguards to D-ESDU

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### 8.2 Capacity Building

- Sensitize and orient different stakeholders of the project with adequate communication of benchmark standards on various project components. Ensure up gradation of awareness generation at different levels. Special focus: Health Hygiene and sanitation Sub Activity
- Training program for HKS (Health & Hygiene, source level waste segregation and source level treatment, Fire and Safety)
- Training program for ULB Councilors and Ward convener (Proposed SWM project plan of KSWMP)
- Training program for Political and trade union leaders (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for Residence Association leaders (Health, Hygiene different composting methods and source level waste segregation, littering of waste, Public Health, Fire and Safety)
- Training program for workers of Municipal Sanitary workers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for school / college students (Health, Hygiene and source level waste segregation, Fire and Safety)
- Training program for ULB officials (Proposed SWM project plan of KSWMP, proposed policies, existing policies etc... to improve the existing pattern into zero waste concept of the municipality)
- Training program for School children, Parents and Teachers (Health, Hygiene and source level waste segregation, Fire and Safety)
- Massive awareness campaign on 5R (Reuse, Recycle, Repurpose, Reduce and Refuse)

**Importance of Capacity Building**

Capacity building is defined as the "process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in the fast- changing world. It is the development of knowledge, skills and attitudes in individuals and groups of people relevant in the design, development and maintenance of institutional and operational infrastructures and processes that are locally meaningful. It is generally defined 'capacity building' as the creation of an enabling environment with appropriate policy and legal frameworks, institutional development, including community participation, human resources development and strengthening of managerial systems. It is a long-term, continuing process, in which all stakeholders participate. The main aim of capacity building under solid waste management is to build a basic understanding regarding the solid waste management project at each step of value chain (waste generation, segregation & storage at source, primary collection, secondary collection, transportation, processing and

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disposal) and importance of their work and develop a sense of belonging towards the work.

### 8.3 Grievance Redressal Mechanism

All grievances relating to the Project and SWM services will be resolved within the legal framework of the State. A robust GRM system will be functioning at ULB level and state level. Citizen can lodge complaint either directly to ULBs, toll free number or through digital platforms (website/email – https://kswmp.org/grievances / grmkswmp@gmail.com / Toll free number-18004250238). The complaint will automatically be recorded in login of ward level official of ULB and an escalation system is constituted according to the category of each complaint to close the complaint in time. The complainer can close the complaint through a feedback form according to their satisfaction.

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## 9. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

"Public Consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate.

Initially the public opposed the dumping of waste at Vadakara dumpsite and the same has been inactive from year 2018. Now this proposal is to remediate the existing site in order to protect the environment and human health of the nearby area. The summary of the document will be made available in the website, which will also be featured in a newspaper advertisement in Malayalam language for public disclosure.

### 9.1 Public Consultation

In connection with the dumpsite remediation, a consultation meeting was conducted on 30.5.2023 at Puthiyappa, the place where the dumpsite was located. Stakeholders from different social entities participated in consultation meeting followed by a transect walk. Local municipal ward councilor, ex councilor, political party leaders, trade union representatives, local residents, representative from Haritha Sahaya Stahapanam (Hariyali, a dedicated agency in charge of managing solid waste in Vadakara Municipality), officials from DPMU, ULB, PIU and TSC were participated.

In the meeting, ward councilor Smt. PP Leeba explained about the proposed dumpsite remediation activities with a positive note on how the remediation activities beneficial to the local community. The ward councilor extended all the support from the local people for the dumpsite remediation activities. Further, a detailed description on dumpsite remediation was given by Smt. Jannet TA, Social and Communication expert, DPMU. Participants expressed their concerns regarding the proposed project activities and its implementation modalities. The participants were happy that the believed that the life long bad image of 'trenching ground' would get removed since it was highly a stigmatized usage.

Shri. Valsan, Ex-councillor reiterated that that they were supporting the dumpsite remediation process believing that the activity would bring a positive impression and impact over the lives of local communities. He raised concerns regarding the use of reclaimed land and opined that land should be developed in such a way that must be beneficial to the local community. The participants, especially the local people were concerned about the further

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usage of the land as they expressed their doubt related to the chance of further dumping of solid waste even after the dumpsite remediation. This was because the locals experienced ill treatment from the ULB for the past several years.

### 9.2 Outcome of the meeting

A transect walk was followed by the meeting with the participation of local residents. The local community, after the meeting and interactions, decided to extend all sort of support for the dumpsite remediation activity, provided there should be an assurance from the ward councilor that the land would not further be used for the same dumping purposes. The meeting also discussed various aspects of dumpsite remediation in detail including the possible social and environmental issues that may affect their routine life as well as the free movement during the time of operation

### 9.3 List of stakeholders attended

Stakeholders from various entities participated in the transect walk. The details of the participants are shown below

*Table 21 List of stakeholder attendeding the transect walk*

| S. No | Name | Designation |
|---|---|---|
| 1 | Leeba PP | Ward Councilor |
| 2 | Valsan | Ex councilor |
| 3 | Janatte TA | S&CE, DPMU |
| 4 | Sobha | HKS member |
| 5 | Kamala | HKS member |
| 6 | Nirmala | HKS member |
| 7 | Pradeep | Local residence |
| 8 | Latheef | Local Residence |
| 9 | Sanooj | Local residence |
| 10 | Manu | Interns |
| 11 | Neeraj | Interns |
| 12 | Livin Pramod | PIU – SWM Engineer |
| 13 | Manalil Mohanan | Director, Hariyali |


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| S. No | Name | Designation |
|---|---|---|
| 14 | Jaison TJ | SDE-TSC |
| 15 | Parasuraj TS | C&CEE – TSC |
| 16 | Shinto John | C&CEE – TSC |
| 17 | Bibin Manuel | SCS - TSC |



*Figure 8 Discussion with Stakeholders – Transect Walk*


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## 9.4 Information, Education and Communication (IEC) Plan

*Table 22 IEC Plan for Vadakara dumpsite*

| IEC Plan for Vadakara dumpsite remediation | | | | |
|---|---|---|---|---|
| **Programme** | **Methodology** | **Topic** | **Responsibility** | **Monitoring** |
| **Sensitization/ Awareness programme** | Meeting with all concerned Stakeholder's with prior notification to discuss about the process and remediation methods | Process of dumpsite remediation Developing as a Recreational park | Contractor | TSC/DPMU /DPMC |
| **Pamphlet** | Distribute to all households within the limits in connection with the dumpsite remediation programme. | Awareness through community participation Different locations in the neighboring area | Contractor | TSC/DPMU /DPMC |
| **Informative standees in all** | Visible places nearby the dumpsite | Protocol to the public who residing in nearby areas and also trespassers. | Contractor | TSC/DPMU /DPMC |
| **Announcement vehicle** | All across places near the dumpsite | Health and hygiene protocols during the dumpsite remediation process | Contractor | TSC/DPMU /DPMC |

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| IEC Plan for Vadakara dumpsite remediation | | | | |
|---|---|---|---|---|
| **Programme** | **Methodology** | **Topic** | **Responsibility** | **Monitoring** |
| **Digital campaign (Social media)** | Areas surrounding waste dumping and all affected areas | Arrangement of a public audio system to address all people in the surrounding areas.<br><br>Short video presentations to communicate through different digital platforms like WhatsApp pertaining to the existing scenario and proposal of Recreational Park with self-explanation | Contractor | TSC/DPMU /DPMC |
| **Cautionary notification boards** | About vehicle movement and the transit of waste | precautionary measures should the general public take. | Contractor | TSC/DPMU /DPMC |

**Conclusion**

The dumpsite remediation activity at Vadakara involves moderate social and health risks. However, a set of risk mitigation activities are proposed in the social management plan to overcome the identified risks and its negative impacts on the people residing near to the site. Formation and regular meeting of GRM & stakeholders committee, capacity building, awareness generation, regulated working hours, controlled operation at school working hours, counseling for the aggrieved parties, gender sensitization, legal awareness, providing safety are the major mitigation measures. This proposal is made to reduce the social risk associated with dumpsite remediation and to minimize the negative social impacts.

**KML File**



Vadakara dumpsite boundary (1).kmz

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# ANNEXURES

## Annexure 1 – Environmental Screening

**Environmental Screening**

**Sub Project Details**

| Name of Subproject: | Dumpsite Remediation |
|---|---|
| Sub project Components: | Dumpsite Remediation |
| Subproject Location (City / Town/ Village with ward numbers): | Vadakara ULB, Ward 20 Puthiyappa, Kozhikode District. |

**Stage 1: Exclusion List**

| Sl.No | Non-permissible Activities |
|---|---|
| 1 | Projects in sites/locations which should be excluded as per prevailing Rules / Laws, near Natural Habitats and Forests: (i) any construction in demarcated Forest areas or protected areas or their buffers, (ii) landfills, not confirming to siting criteria as per SWM Rules 2016 (iii) treatment facilities for Solid Waste, Biomedical Wastes and C&D Wastes not conforming to Pollution Control Boards siting criteria for specific industry (various types of treatment plants) types (where mitigation measures are not possible) |
| 2 | Projects which would involve decontamination of hazardous waste dumpsites or those would potentially result in further pollution of sensitive areas |
| 3 | Projects involving (i) any impact on or due to Dams or embankments or (ii) purchase, storage and use of Banned Pesticides |
| The project does not fall under the above conditions as mentioned under exclusion list | |


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**Stage 2: Environmental Screening Checklist**

| S.No | Components | Details |
|---|---|---|
| 1 | Project Components | Dumpsite Remediation |
| 2 | Details of Components (main components including collection and transportation, decentralized household solid waste management, community-level solid waste management, centralized non-biodegradable waste management facilities, centralized biodegradable waste management facilities, sanitary landfills, biomining of dumpsites, including for Linked activities / associated facilities) | This proposed project involves biomining of existing dumpsite.<br>This remediation process involves<br>**Pre-processing of legacy waste**<br>1. Clearing and grubbing of site<br>2. Windrow formation for stabilising the excavated waste<br>3. Windrow turning, tilling and cone formation<br>**Machinery erection**<br>1. Site levelling for Plant erection on the site and commissioning of machineries.<br>2. Operation of plant for processing the waste.<br>3. Office set up and fire safety measures<br>The byproducts of the process are<br>1. Bio earth and coarse fraction soil – will be used within the site |


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| S.No | Components | Details |
|---|---|---|
| | | 2. RDF – will be send to nearby waste to energy plants like cement plant and power plant which further processing it will be used as fuel<br><br>3. Recyclables – will be send to the authorised recycling agency |
| 3 | Location of the Project Sites & Current Land use (Provide information for all sites involved in the project; including for Linked activities / associated facilities), any historic land use (related to heritage, or contamination) Site Survey No./s (attach map) with ownership details, Geographical co-ordinates of the site location (including any off-site sub-components (attach map)<br><br>Also, mention disaster zones? (Earthquake, Cyclone, etc.) | Latitude: 11°35'39.0"N, Longitude 75°36'20.7"E<br><br>Land ownership: Vadakara Municipality<br><br>Land use: Public<br><br>Disaster Zone: It falls under Zone III (Moderate) |
| 4 | Land Area proposed to be used: Location wise (in sq. km / sq. m) | It is remediation of land and hence no land required |
| 5 | Quantity of Water Required for Construction and Annual Operations with Details of Source/s | Operational phase – 0.5 KL/day<br>Domestic use – 1.0 KL/day |
| 6 | Power Required and Source of Power | Demand load for the proposed equipment during the remediation process is available and additional power required will be made available by DG sets |


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**Baseline Environmental Conditions**

| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| 1<br><br>(i) | Is the project site located on or adjacent to any of the following (Provide Distance to these features in meters/kilometers)<br><br>Critically Vulnerable Coastal Areas (CVCAs), Eco sensitive Areas (ESAs) | | No | The project site is not located near any Critically Vulnerable Coastal Areas (CVCAs), Eco sensitive Areas (ESAs) |
| (ii) | Cultural Heritage site, protected monuments – listed by ASI/State | | No | The project site is not located near any cultural Heritage or protected monuments as listed by ASI/state |
| (iii) | Natural Forests / Protected Areas / Bio-Reserves Is the subproject in an eco-sensitive or adjoining an eco-sensitive area, with any schedule 1 species? If yes, which is the area? | | No | The project site is not located near Natural Forests / Protected Areas / Bio-Reserves |
| (iv) | Other Wetlands/ Mangrove/ Estuarine Region | | No | The project site is not located near any Wetlands/ Mangrove/ Estuarine Region |
| (v) | Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves | | No | The project site is not located near any Natural Habitat areas, roosting / nesting areas, spawning areas, breeding areas; areas with natural features like waterfalls, sacred groves |
| (vi) | Other Sensitive Environmental Components listed in EMF | | No | No other sensitive environmental components listed in |


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| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| | | | | EMF exist nearby the project site |
| (vii) | Drinking water source, upstream and downstream uses of rivers, etc | | No | No river source is resorted for drinking water use<br>Downstreams the ground water source is available |
| (viii) | Low-lying areas/areas of Tidal Influence (provide CRZ details) | | No | The sea is located 3 km (Aerial Distance) from the project site. There won't be any influence of tidal influence |
| (ix) | Sensitive Receptors – a) Habitations / Households / Hostels, other special areas, etc. b) School c) Religious Places d) Tourist Areas | Yes | | a. **Nearest Habitation**- 30 Houses are located at an Aerial distance of 50 m<br>b. **Religious Place**- Mundayanparambu Temple is located at an aerial distance of 200 m<br>c. **School** – Govt Sanskrit school is located at an aerial distance of 250 m<br>d. **Tourist Places** – Nil |
| 2 | Is the site in Critical / Over Exploited Ground Water Block. Provide the level of the groundwater table | | No | Semi critical |
| 3 | Is the site vulnerable to major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, Earthquakes, Fire, Explosion, Other (specify) | | No | The site does not fall under major natural or induced hazards such as Landslides, Flooding, Storm surge, Severe wind damage, |


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| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| | | | | Earthquakes, Fire, Explosion.<br>There may be chance of fire due to<br>1. Fire breaking due to high temperature<br>2. Electrical short circuit due to poor maintenance.<br>3. Smoking in the premises near the waste storage.<br>4. Burning of the waste by unauthorized persons<br>5. Keeping highly flammable materials like, cooking gas, kerosene, match boxes, etc.<br>6. Not having provision for proper fire/smoke detecting system. |
| 4 | Describe the type of soil and vegetation on site | Yes | | Hard laterite soil with few trees present in the site |
| 5 | Is the site present in the flood plains as recorded in the last 100 years. Provide the HFL level of the site/region | | No | The sea is located 3 km (Aerial Distance) from the project site.<br>During 2018 peak flood the site experienced minimal problems or issues. |
| 6 | Existing pollution/contamination or degradation on site | Yes | | Dumpsite located in Vadakara ULB is the |


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| S.No | Environmental Aspects | Yes | No | Details |
|---|---|---|---|---|
| | | | | existing contamination and detailed under section 3.11 |
| 7 | Any other remark on baseline condition | Yes | | Based on the test result of environmental baseline for Vadakara dumpsite certain parameters exceeds the permissible limits and test report are given under section 3.11 |

**Anticipated Environmental Impacts: Impacts on Air, Noise, Land, Geology, and Soils**

| S.No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Total extend of land to be covered/built | Yes | | 1.25 acres |
| 2 | Total extend of land where the waste will be dumped openly / or expected to get contaminated by waste or leachate/material storage | Yes | | Due to open dumped area |
| 3 | Extend of Land to be remediated | Yes | | 1.25 acres |
| 4 | Extend of land expected to be under green belt | Yes | | Will be under the scope of contractor |
| | proposed project cause the following on Land / Soil: | | | |
| (i) | Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains | | No | There will be no major impact other than the operational phase as this project is remediation project. During operational phase the anticipated impacts are identified |


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| S.No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| | | | | and mitigation measures are provided |
| (ii) | Substantial removal of Top Soil (mention area in sqm) | | No | Nil |
| (iii) | Any degradation of land / eco-systems expected due to the project? | | No | There will be no Land degradation instead it will be a remediation of land from further contamination |
| (iv) | Loss or impacts on Cultural/heritage areas/properties | | No | There will be no loss or impacts on Cultural/heritage areas /properties |
| (v) | Does the project activity involve cutting and filling/ blasting etc? | | No | The project does not involve cutting and filling/ blasting as the building is existing |
| (vi) | Will the project cause physical changes in the project area (e.g. changes to the topography) due to excavation, earthwork, or any other activity? | | No | The project will have change in a positive way by clearing the waste dumped into vacant land |
| (vii) | Will the project involve any quarrying/ mining etc? | | No | The project does not involve any quarrying/ mining |
| (viii) | Will the project / any of its component contaminate or pollute the Land? | | No | Presently there is contamination and due to the project activity the further contamination shall be eliminated and natural system shall be restored |


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| S.No | Impacts on Land / Soil Environment | Yes | No | Remarks |
|---|---|---|---|---|
| (ix) | Will the project contribute to any long term significant adverse (negative), large scale, irreversible, sensitive impact at a regional scale or area broader than the project sites? | | No | There will be no negative impact due to the proposed project |
| (x) | Will the Project or related activities cause negative impacts on the land in combination with other anticipated / existing projects in the region? | | No | There will be no negative impact due to the proposed project |

| S.No | Impacts on Air and Noise Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the project cause or increase air pollution due to dust and / or vehicle emissions? | Yes | | It will be temporary and adequate mitigation measures will be taken to reduce the impact during the operational phase. |
| 2 | Will the project cause or increase pollution due to GHG emissions? | | No | Nil |
| 3 | Will the project cause or increase odour nuisance? | Yes | | The Biomining project will be create odour nuisance but it is temporary and once the process is completed there will be no odour nuisance. |
| 4 | Is there a potential for release of toxic gases or accident risks (eg: potential fire outbreaks) | Yes | | There may be chance for any release of toxic gases or potential fire outbreaks which will be mitigated through proper mitigation plan |


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| S.No | Impacts on Air and Noise Environment | Yes | No | Remarks |
|---|---|---|---|---|
| | | | | by adopting gas collection system. |
| 5 | Will the project generate or increase noise levels which will impact surrounding biodiversity or communities? | Yes | | The Biomining project will create increase in noise level but it is temporary and once the process is completed there will be no noise. |

| S.No | Impacts on Water Environment | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the activities proposed at the site(s) impact water quality (surface or ground) – leachate, runoff, wastes deposition, erosion? | | No | The leachate generated will be properly collected in leachate collection tank and thus avoiding the impact with the surface or ground water |
| 2 | Will the activities proposed at the site(s) impact water resource availability and use - leachate, runoff, wastes deposition, erosion? | | No | The leachate generated will be properly collected in leachate collection tank and thus avoiding the impact with the surface or ground water |
| 3 | Chances of Pollution of Water bodies / groundwater wells, nearby or downstreams | | No | This remediation project will transform the existing polluted area into a healthier and improved environment. Hence there will not be any chance of pollution of |


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| S.No | Impacts on Water Environment | Yes | No | Remarks |
|---|---|---|---|---|
| | | | | water bodies / groundwater wells, nearby or downstream |
| 4 | Will the activities proposed at the site(s) hinder natural drainage | | No | As the existing dumpsite will hinder the natural drainage pattern. The proposed activity once completed will improve the natural pathway without any obstacles. |
| 5 | Will the activities proposed at the site(s) decrease permeability /rainwater percolation | | No | The activities proposed at the site will not decrease permeability /rainwater percolation |

| S.No | Impacts on Bio diversity & Host Communities | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Will the project necessitates cutting of Trees /Loss of Vegetation | | No | There will be no cutting of Trees. But there will be Loss of Vegetation due to this project |
| 2 | Will the project necessitate substantial removal of Top Soil (mention area in sqm) | | No | There will be no Substantial removal of Top Soil. |
| 3 | Any degradation of land / eco-systems expected due to the project? | | No | There will be no degradation of land / eco-systems expected due to the project activity.<br>Also, the proposed activity will protect the land from further contamination |


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| S.No | Impacts on Bio diversity & Host Communities | Yes | No | Remarks |
|---|---|---|---|---|
| 4 | Will the project result in Health & Safety Risks in the neighbourhood including the release of toxic gases, leachate, accident risks | Yes | | There may be chance of accidental risks due to leachate and toxic gases, which will mitigated by proper lined leachate drain and PPE kits |
| 5 | Potential Noise, Light Pollution/movements causing disturbance to nearby habitats/communities | | No | There will be no major impact.<br>During operational phase there will be noise pollution due to movement of vehicles which will be curtailed by adopting mitigation measures. |
| 6 | Potential disruption to common property, accessibility, traffic disruptions, conflicts, or disruption to the local community within the subproject area? | | No | There will be no major impact.<br>During operational phase there will be slight increase in traffic due to movement of vehicles which will be mitigated by adopting movement of vehicles during off peak hours.. |

**Project Categorization and Need for Safeguards Instruments**

| Project category | ☐ F1 ☑ F2 ☐ F3 |
|---|---|
| Key Reasons | During screening, it has found that the proposed subproject is moderately causing impact to the base line environment, land/ soil / water /noise environment, biodiversity or to the community. Site is not close to any |


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| | |
|---|---|
| | Environmental Sensitive Receptor. Moreover, Project results positive impacts on Environment. The Environmental Baseline analysis reveals that dumpsite not having any Heavy metal contamination. Hence it is categorized as E2. |
| **Safeguards Instruments Required?** | a) E1: Project-specific EIA (impact assessment considering the project details & location) by Independent Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>b) E2: Project-specific EIA by DPR Consultant (with signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities)<br>c) E3: signed/sealed Screening Form, Consultations, EMP, Budget, Responsibilities |

| Status | Agency / Official | Name, Signature with Date and Seal |
|---|---|---|
| **Prepared by** | PIU or ULB (project in charge) | |
| | Environmental Engineer | |
| **Checked, categorised as __ (E1, E2, E3) & ToR issued by:** | DESDU / SESDU | |
| | Environmental Specialist | |


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## Annexure 2 – Social Screening Checklist

**Social Screening**

| PROJECT INFORMATION | |
|---|---|
| **Location of the sub-project** | Vadakara ULB Ward 28 Puthiyappa |
| **GPS coordinate of the Site** | Latitude: 11°35'39.0"N, Longitude 75°36'20.7"E |
| **Name of the sub-project** | Puthiyappa Solid waste Dumpsite Remediation - Bio mining |
| **Name of ULB** | Vadakara |
| **District** | Kozhikode |
| **Taluk** | Vadakara |
| **Total population in the ULB** | 80,356 |
| **Proposed dumpsite area (in acres)** | 1.52 acre |
| CHECKLIST FOR POTENTIAL SOCIAL RISKS | STATUS /REMARKS |
| Is there a risk that ULB do not have the capacity to meet their obligations in the project? | Lack of proper management of the dumpsite invited agitation from all areas causing negative impact. Since the site is a historical Dumpsite more than 75 years of dumping, Approx. 30,000 cum of legacy waste accumulated, ULB is struggling to implement any project even though which would solve the issues due to the resistance. Presently funds are available under KSWMP to provide the financial and Technical Support to The ULB for dumpsite remediation including bio mining. |
| Number of HH staying within 200 meters from dumpsite | 300 households are residing within 200 m to the dumpsite. This site has been in use since 1962. |
| Common Property Resources Affected: (Please give each type by number) | |
| Inventory of Kudumbasree / Harithakarma Sena's physical assets located at the dumpsites likely to be affected | 1. Newly constructed MRF building cannot be used until the completion of sub project- Bio mining |


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| | |
|---|---|
| Are there any public utility/facilities (educational institutions, religious institutions, Airport, railway station, shops, market, public parks, etc.) within 200 meters to the dumpsite? | Yes. 1 school, 2 college,1 Anganwadi, 1 PCI/ supplyco godown, 6 shops.<br>1 library, 1Staff quarters, 1 Vetenary hospital and a Mini theatre. . |
| Is there a road access to the dumpsite? | Yes, A 8mt width road is already existing |
| Will the road require to be widened? | No |
| Does this road have public utilities/ facilities within 200 meters? | Yes, local public using this road for their daily transport. |
| Will people permanently or temporarily lose access to facilities, services, or natural resources? | No, people will not loss permanent or temporary access to facilities, services, or natural resources during the sub project activity |
| Is this site/location have any archaeological/historical importance | No, this site/location have no archaeological/historical importance |
| History of any hazards/fire accidents | Yes, three incidents of fire have been reported till the date |
| Rag pickers | |
| Are there any rag pickers staying within 200 meters from the dumpsite? | Yes, two families are staying within 200 meters from the dumpsite who are currently doing scrap dealer business. |
| Are these rag pickers have permanent/ temporary houses near the site? | Yes, they have permanent( rented) houses near the dumping site |
| Livelihood risk for the rag pickers | Dump site is currently not in use, It was closed 5 years ago. There is no livelihoods risk |
| Existing Dumpsite | |
| What is the current usage of the proposed dump site? | Site is being used for dumping street sweeping waste. |
| Is there any resistance observed at the site? | Yes, it had been witnessed continues protest from the public against waste dumping. Bio mining project has got appreciation from the public |
| Harm or losses due to failure of structural elements of the existing | No |


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| | |
|---|---|
| facilities (e.g. collapse of buildings or infrastructure)? | |
| Influx of migrant workers to the site? | As of now there is no influx of migrant workers to the dump site. Since HKS is managing the waste there would not be having any migrant flow to the site even in the near future |
| LAND REQUIREMENT | |
| Government land | *1.52 acre of existing ULB land available* |
| Forest land | No |
| Private land | No |
| Are the actual plot size and ownership status known if the land parcel has to be acquired? | NA |
| Is there space on the currently designated plot or right-of-way for the transportation or mobilization of construction materials? | Yes |
| The total number of Community Property Resources affected/if yes description needed | About 30 open well water sources nearby would get polluted due to dumping of waste. |
| Economic displacement (e.g., the loss of assets or resources due to access restrictions resulting from land acquisition or other restrictions - even in the absence of physical relocation)? | NA |
| Is there a possibility of forced evictions? | No |
| What are the consequences of or changes to land tenure arrangements and/or community-based property rights/customary rights to land, territories, and/or resources? | NA |
| Land availability risk | Nil |
| DETAILS OF SCHEDULED TRIBES | |


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| | |
|---|---|
| What is the total scheduled tribal population in ULB/ ULBs | NO |
| What is the population of ST staying near the dumpsite? (within 200 m) | NA |
| Are there any STs among the PAPs? | NA |
| Are there any STs losing land due to the project? | NA |
| Are there any STs losing their customary rights on land due to the project | NA |
| Forced eviction or total or partial physical or economic displacement of ST peoples, including restrictions on access to lands, territories, and resources? | NA |
| Are there any threats to the physical and cultural survival of ST people? | NA |
| Are there any agriculture or livelihood loss to the ST HH | NA |
| LIVELIHOOD ACTIVITIES AND COMMUNITIES TO BE AFFECTED | |
| Total no of HH affected due to proposed project activity. | 30 families who are staying within 50 m to the dumpsite are the most affected by the dumpsite. However, remediation activities only affect about 16 families who are very close to the dumpsite. |
| Total no of vulnerable HH affected due to proposed project activity | 08 vulnerable HH affected by the project as there were 6 differently abled, 2 single women, 6 widows 20 elderly people and 3 children (below the age of 05) are staying near to the site. |
| Total number of livelihood activities affected (Cattle shed, petty shop etc) | Nil |
| Livelihood activities of Artisans, small traders, and certain others to be affected | Nil |


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| | |
|---|---|
| Discriminatory working conditions and/or lack of equal opportunity? | Nil |
| Occupational health and safety risks due to physical, chemical, biological, and psychosocial hazards (including violence and harassment) throughout the project life cycle? | Yes. Even though there is less occupational risks, health and safety risks are common due to the usage of heavy machineries including excavators, conveyors etc.<br>Smoke, dust and water pollution can cause health hazardous and social risks. |
| Total area of agriculture land to be affected (Title holders/non-title holders/squatters) | Nil |
| DWELLINGS (RESIDENTIAL) AFFECTED DUE TO SUB-PROJECT | |
| Total no of HH affected due to proposed project activity. | 30 HH are directly affected by the proposed project activity |
| Non titleholders (Encroacher) affected | Nil |
| Non titleholders (Squatter) affected | Nil |
| Are there any non-titled people who living/doing business on the proposed site | Nil |
| BPL Families/other vulnerable communities losing dwellings | Nil |

**PART – A**
**Summary of Risks/Impact identified**

| S. NO | IDENTIFIED RISKS | AFFECTED PERSONS/FAMILIES | REMARKS |
|---|---|---|---|
| 1 | Health hazards | 300 HH residing near to the dumpsite, college and anganwadi students | Regular medical check up to be conducted for the related health issues to the HHs |
| 2 | Environmental issues Air and water pollution | Residents near to the dumpsite, college and anganwadi students | Regular water sprinkling for dust and proper investigation of the water bodies as well as ground water. |


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| S. NO | IDENTIFIED RISKS | AFFECTED PERSONS/FAMILIES | REMARKS |
|---|---|---|---|
| | | | Green belt and plantation can reduce these environmental issues. |
| 3 | Social issues including stigma and discrimination | Nearby households who were discriminated in participating in some common functions. | Social stigma is attached to the dumpsite as the nearby households were discriminated in participating in some common functions. |

**Date: 08-02-2023** **Place: Vadakara**

Findings/ Suggestions

1. The dumpsite area is a thickly populated with more than 200 residential units within 200 meters to the site.
2. The dumpsite is not currently in use for the purpose. However, a small portion of the site were used till July'23 for dumping street sweeping waste. In connection with the dumpsite Biomining project, the street sweeping waste dumping is stopped.
3. Health hazards' especially vector born diseases are very common due flies/ snakes and other vectors
4. There are health issues due to the bad quality of air and water. In monsoon season, water born diseases are very common to the people who are staying in the down streams.
5. People who are residing near to the dumpsite have been facing the issues of social stigma; and have been discriminated in different levels and occasions.
6. There is no livelihoods loss for rag pickers and scrap dealers


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**Annexure 3 – Fire and Risk Assessment**

A fire and risk assessment is a systematic evaluation of potential fire hazards and associated risks within a particular environment or premises. The assessment aims to identify potential fire hazards, assess the level of risk they pose, and recommend measures to mitigate or manage those risks effectively. Fire and risk assessments are essential for ensuring the safety of the workers, protecting property, and complying with fire safety regulations.

The existing legacy waste dumpsite, occupying about 1.25 acres in ward 20 Puthiyappa, aims to fully reclaim the land for future development. Bio-mining, a technique chosen after careful evaluation will be used to recover the land and ensure sustainable and environmentally friendly treatment of the waste. The process will yield various by-products, which require immediate attention to prevent fire hazards.

The by-products are as follows:

1. The bio earth (19375.34 $m^3$) & C&D (8824.41 $m^3$) waste
2. Retrieved plastics, rags, paper & other combustibles that cannot be recycled, but may be used as Refused derived fuel (RDF) of 9169.71 $m^3$
3. Recyclables of 997.54 $m^3$

The retrieved plastics, rags etc that cannot be recycled and the recyclables if stored on site poses a potential fire risk and requires proper handling. To mitigate the risk, a storage and disposal process spanning 3 to 4 months shall be devised by the contractor in line with his work plan. During this period, the contractor shall implement various protective measures to prevent the possibility of a fire outbreak. These following measures are important for preventing fires, ensuring the safety of workers and nearby communities, and minimizing risks to the environment and property.

**Pre-Construction/Planning Stage:**

1. Fire Safety and Emergency Plan: Develop a comprehensive fire safety plan and emergency response plan to address potential fire incidents.
2. Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard.
3. Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the landfill.
4. Fire Equipment: Ensure that the site is equipped with fire extinguishers.

**Storage of Waste & RDF:**

**Fire Standards and Facilities:** Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once.

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Below equipment and their required quantities should be strategically positioned according to the site's specifications.

- Fire extinguisher (A, B, C powder): It will be used to immediately put off fire caused by wood, Paper and textiles, flammable liquids and flammable gases. Commonly can be placed anywhere inside the site
- Fire extinguisher (Foam spray): Mainly used to put off the fire caused by flammable liquids. It should be placed in diesel storage area, lubricant storage area and DG sets.
- Fire extinguisher ($Co_2$): Mainly used to put off the fire caused by Electrical short circuit. It should be placed near the control panel room/operation room.
- Fire bucket filled with sand: It should be placed near the diesel storage area

To ensure rapid response in case of a fire, it's essential to have a water tanker filled with water, equipped with a fire-fighting hose, readily accessible along with the portable motor. The presence of this equipped water tanker ensures timely and effective action during fire emergencies. All requirements in line with National / State regulations and as advised y the Local Brigade shall be arranged & followed

The following points to be considered for assessing the fire risk and procedure to mitigate it.

1. **Identification of Fire Hazards:** The first step involves identifying potential fire hazards in the premises. These hazards could include sources of ignition (e.g., electrical equipment), combustible materials (e.g., flammable liquids, paper, cardboard), and other factors that could contribute to the outbreak of a fire.
2. **Assessment of Risk:** Once the hazards are identified, the next step is to assess the level of risk associated with each hazard. This involves evaluating the likelihood of a fire occurring and the potential consequences if a fire were to break out.
3. **Escape Routes**: Since operational phase occurs in an open environment, the need for conventional escape routes in the event of a fire emergency may not be required.
4. **Fire Safety Measures:** The assessment reviews existing fire safety measures in place, such as fire alarms, fire fighting equipment, and fire suppression systems. Proper assembly point is required in case of fire break out
5. **Emergency Procedures:** The assessment evaluates the effectiveness of emergency procedures and evacuation plans in the event of a fire, ensuring that workers can safely evacuate the premises.
6. **Fire Training and Awareness:** The assessment considers the level of fire safety training provided to workers and the awareness of fire hazards and evacuation procedures.
7. **Record-Keeping:** Detailed records of the assessment process, findings, and recommended actions are maintained for future reference and regulatory compliance.

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8. **Recommendations:** Based on the assessment, the fire risk assessor provides recommendations for improving fire safety, which may include installing additional fire safety equipment, conducting training programmes, or implementing any changes to reduce fire risks.
9. **Review and Updates:** Fire and risk assessments should be regularly reviewed and updated to account for any changes in the premises or regulations.

Fire and risk assessments play a crucial role in preventing fires and minimizing their impact if they occur. They are particularly important for dumpsites and other places with a higher risk of fire hazards to ensure the safety and well-being of workers.

NOTE : The major assessments had been referred based on the EMF Vol-II Part A – Indicative EMP

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## Annexure 4 – Dumpsite screening checklist

Checklist for screening of dumpsites for potential landfill/ processing facility

| Name of the contact person from ULB/ Phone number and email Address | Vadakara |
|---|---|

| S.No. | Item | Norm | Information |
|---|---|---|---|
| 1 | Land ownership (including that required for approach road) (in line with revenue records) (supporting data to be provided as annex) | | Vadakkara, Municipality |
| 2 | Name of the location of site and Map of the site (include as an annex) | | Puthiyappa, Vadakkara |
| 3 | GPS coordinates of site | | Latitude: 11°35'39.0"N, Longitude 75°36'20.7"E |
| 4 | Is there a Pollution Control Board permit for dumping/SWM activity? | | Yes |
| 5 | Is there a notified no development zone or buffer or green belt around the dump? | | No |
| 6 | Possible area to be kept as buffer green belt around (within / outside the site for purchase) | | Not available |
| | Site Selection Criteria - give distances, wherever applicable | | |
| 7 | Groundwater (m below liner bottom) | 2m | No |
| 8 | Private water sources (well etc.)- distance from site boundary (to be | 100 m (river) | No |
| | | 200 m (Pond) | No |


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| S.No. | Item | Norm | Information |
|---|---|---|---|
| | adjudged based on approx. distances during screening exercise) | 30 m (Local Canal) | 1 km from the dumpsite. |
| 9 | Env. Sensitive Areas/ Wetlands | Not Permitted | No |
| 10 | Site having Rare and Endangered Species | Not Permitted | No |
| 11 | Site should not be within Protected/ Reserve Forests | Not Permitted | Site is Not within the Protected/ Reserve Forests |
| 12 | Residential Development within prescribed buffer zone of 200 m | Not Permitted | Yes. Local Residents nearby Dumpsite within 150 m |
| 13 | Perennial Stream within site | Not Permitted | No |
| 14 | Airport | 20 Km | No |

| SNo | Item | Norm | Information |
|---|---|---|---|
| 15 | Distance to the nearest village in the predominant wind (m)direction | | Puthiyappa |
| 16 | Flood prone site | | No |
| 17 | Accessibility - Road access for heavy vehicles | | 4 m wide Approach road, Meppayil - Vadakkara |
| | i. Starting point of the access road | | Meppayil |
| | ii. length and width of the access road | | 4 m wide |
| | iii. Current condition of the access road (visual assessment) | | Tarring Road with good condition. |


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| S.No | Item | Norm | Information |
|---|---|---|---|
| 18 | Is the site that/stopping to nearby uses | | Flat |
| 19 | Soil base-soft soil/murram,soft rock etc | | Hard Laterite soil |
| 20 | Direction of Leachate flow out of the site, if any | | No. The biodegradable waste dumping stopped since 2018 |
| 21 | Othee uses within the dumpsite(recycling yard, compost pad etc) | | Proposed MRF building but not yet used |
| 22 | Boundary conditions-walls/fence/what land uses along boundary | | Compound wall |
| 23 | Year since the dump site is existing | | 1962 |
| 24 | Is the dumping Operation Ongoing | | Stopped the Biodegradable waste since 2018 |
| 25 | Any underground utilty/gas line etc near the site | | No |
| 26 | Existing power supply, water supply, electric poles going through/over/in the site etc. | | Yes. Nearby Transformer |
| 27 | Are there pools of leachate ,rat and fly infestations, domestic animals roaming freely, odours,dust, vermin and birds,waste being burnt at dumpsites or families of scavangers picking through the wastes | | No |


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| | | | |
|---|---|---|---|
| **Geography and Climatic aspects** | | | |
| 28 | Average annual rain fall | | 3500 mm |
| 29 | Duration of rainfall | | May to August |
| 30 | Whether any incidents of flooding reported at site/other hazards | | |
| | No | | |
| | Very Rare | | Very Rare |
| | Some times | | |
| | Frequent | | |
| 31 | Any geological fault | | No |
| **Waste Characteristics** | | | |
| 32 | Characteristics of the dumps, such as the height and area, characteristics of solid waste based on visual inspection and degree of compaction (subjective), and any details of variability of wastes within the site. | | Since the biodegradable waste dumping stopped from 2018 due to public protest because of the leachate issues. Only the Non-Biodegradable waste only present in the dumpsites like Plastic wastes and street sweeping wastes |
| 33 | Type of waste (MSW/HW) (subjective assessment based on visual inspection) | | MSW |
| | i. 100% MSW | | |
| | ii. 75% MSW +25% (domestic and/ or biomedical/ HW/EW) | | Yes |
| | iii. 50% MSW +50% (domestic and/ or biomedical /HW/EW) | | |
| | iv. > 50% (domestic and/ or biomedical /HW/EW) | | |


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| | | | |
|---|---|---|---|
| 34 | Expected waste contamination (visual check of ground water, littering, dust pollution, Smell/odour, Is the ground water being used for drinking purpose) | | Ground water not used for drinking. |
| 35 | How much quantum of fresh waste is dumped every day? | | Stopped the dumping of waste. |
| General Information | | | |
| 36 | Any reported Environmental and health impacts of existing dump (from ULB eg-media report or complaint) | | NO |
| 37 | Any ongoing litigation or disputes related to site usage | | NO |
| 38 | Potential for mining decomposed organic materials (compost from the existing dumps (By visual inspection) | | NO |
| 39 | Presence of rag pickers and approx., How many? Male/Female and age group | | Not available as on visit time. But as per SWM data file 168 rag pickers |
| 40 | Number of sensitive receptors close to dumpsite (approx.200 m which is buffer zone criteria) (mention distance to closest residence, social profile of the people, school, religious structure, wetland, forest, river, canal, Eco sensitive area, well, lake/pond) | | Nearby Small canal within 1 km named as Akkamadathodu Sanskrit School within 280 m. |


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| | | | |
|---|---|---|---|
| 41 | Available open / clean space in the dump yard which can used to develop a treatment facility till such time the dump is cleaned, and land is recovered (percentage of land available for use) | | Yes |
| 42 | Space / covered shed (which may be renovated to house segregation & storage facility) | | 450 Sq.ft |
| 43 | Estimated time for dumpsite capping/ mining/ remediation. Does it fall within the project lifetime? | | 150 days |
| 44 | Possible Range of solutions: rehabilitate existing open dumps through landfill mining where the resource recovery might serve as a source of energy, recycle and reuse of metals, plastic and glass ware, use of compost as fertilizer for agriculture and as a cover material for future landfills, etc. | | RDF materials can be processed and used for cement kilns. |
| 45 | Is dumpsite remediation likely to benefit in regaining a suitable site for an engineered landfill cell or for setting up any other waste management facility? If yes, what could be set up? | | According to feedback from nearby residents, there is a demand for the establishment of a Recreational Park. |
| 46 | Likely area of the site which can be salvaged for future use More than 70%, 50-70%, 30-50%, Less than 30% | | 50 % . |


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| | | | |
|---|---|---|---|
| **Upstream Linkages required** | | | |
| 47 | Stop the waste coming to the site or delineate a separate area for proper processing of waste. | | Dumping of waste stopped |
| 48 | Intention of anchor ULB (where the site is located) to allow the facility to be used as a regional facility, with other ULBs falling in the cluster, on a cost sharing basis. | | After thorough stakeholder consultation, the recommendation is to process the waste at a standalone site. |
| **Downstream Linkages required** | | | |
| 49 | Off-take of all the products coming out of the biomining - Plastic & RDF - cement factories, soil/bio-earth - farmers or gardens, inert - SLF/closure | | Forward linkage for the RDF yet to be finalized |
| 50 | Any wastewater treatment facility whether available within 10 km where leachate can be transported for treatment. | | No |


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## Annexure 5 - Occupational Health and Safety

Occupational Health and Safety Risk Assessment for Dumpsite Remediation is as follows

**1. Introduction:**

The purpose of this Occupational Health and Safety (OHS) Risk Assessment is to identify, assess, and mitigate potential hazards and risks associated with the implementation of a Biomining project for dumpsite remediation. Biomining is a sustainable and environmentally friendly method used for the disposal of dumped waste and reclamation of land.

**2. Scope:**

This risk assessment focuses on the occupational health and safety aspects of the Biomining process for dumpsite remediation. It covers the potential hazards and risks that workers may encounter during site preparation, Biomining operations, and waste disposal activities. The assessment will also outline control measures to minimize or eliminate these risks.

**3. Hazard Identification:**

Biomining process identifies potential hazards, which include but are not limited to:

a. Chemical Hazards: Exposure to hazardous chemicals present in the dumpsite waste and chemicals used in the Biomining process.

b. Biological Hazards: Potential health risks associated with the presence of pathogens, disease-causing microorganisms, and vectors within the waste. These hazards can arise from the decomposition of organic matter, the presence of infectious materials, and the attraction of disease-carrying organisms such as rodents, insects, and other vermin.

c. Physical Hazards: Potential for slips, trips, and falls on uneven terrain or during equipment operation.

d. Mechanical Hazards: Risks associated with operating and maintaining heavy machinery.

e. Ergonomic Hazards: Strain and injuries related to improper handling of equipment or materials.

f. Environmental Hazards: Adverse effects on air and water quality during the Biomining process.

**4. Risk Assessment:** The risk assessment will categorize the identified hazards based on their severity and likelihood of occurrence. Each hazard will be evaluated using a risk matrix to determine the level of risk and priority for mitigation.

**5. Risk Mitigation Measures:**

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To ensure the safety of personnel involved in the Biomining project, the following risk mitigation measures will be implemented:

a. Engineering Controls:

- Regular maintenance and inspection of machinery to prevent mechanical failures.

- Providing appropriate personal protective equipment (PPE) to workers.

b. Administrative Controls:

- Developing standard operating procedures (SOPs) for Biomining operations.

- Implementing a comprehensive training program for all personnel involved in the project.

- Scheduling regular breaks and rotation of tasks to minimize fatigue.

c. Environmental Monitoring:

- Regular monitoring of air and water quality to ensure compliance with safety standards.

- Establishing emergency response protocols in case of any unexpected environmental events.

d. Emergency Preparedness:

- Developing and practicing emergency response plans for potential accidents or incidents.

- Providing workers with first-aid training and easily accessible medical facilities.

e. Personal Protective Equipment (PPE):

- Mandating the use of appropriate PPE, such as respirators, gloves, safety goggles, and protective clothing.

**6. Worker Health Surveillance:**

Implementing a health surveillance program to regularly monitor the health of workers involved in the Biomining project. This may include medical examinations and assessments to detect any health issues related to exposure during the remediation process.

The work site to be equipped with first aid and the contractor must have tie-up with nearest primary health center/ medical facility for the welfare of the labors.

**7. Training and Education:**

Conducting comprehensive training and educational programs for workers and supervisors to raise awareness of potential hazards, proper handling of equipment, and the correct use of PPE.

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## 8. Conclusion:

By proactively identifying potential hazards, assessing risks, and implementing appropriate control measures, this Occupational Health and Safety Risk Assessment aims to ensure the safe and successful execution of the dumpsite remediation Project through Biomining. Continuous monitoring and improvement will be essential throughout the project to maintain a safe work environment.

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FEASIBILITY REPORT

# DUMPSITE BIOMINING AND BIOREMEDIATION, PUTHIYAPPA, VADAKARA MUNICIPALITY




November 2023

KSWMP

LSGD

LSGD

State Project Management Unit

Kerala Solid Waste Management Project (KSWMP)

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## EXECUTIVE SUMMARY

Vadakara Municipality is one of the rapidly developing urban local bodies in Kozhikode district. Even though the ULB has an excellent practice of waste management, the primary environmental issue currently faced by municipal authorities revolves around a longstanding existing legacy waste dumpsite. Despite discontinuing the dumping activities, these dumpsites remain as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Consequently, these sites pose significant environmental, social, and economic challenges for the communities and ecosystems surrounding them. The SWM Rules 2016 directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the project for the remediation of legacy waste dumpsites in all the ULBs. As part of the project, in phase1 the existing dumpsite at Vadakara, ward 20, Puthiyappa was proposed for remediation.

The Vadakara municipality has an area of 21.34 sq.km with 47 wards. The municipality, with the financial and technical support of KSWMP, has taken up steps to remediate the existing legacy waste dumpsite located in around 1.25 acres of land inward 20, Puthiyappa and to recover land for future developmental activities. The Puthiyappa dumpsite was used for dumping municipal solid waste from the year 1962 to 2018. The dumping of solid waste (biodegradable waste) was stopped as a result of the protest from the local residents due to the serious health and environmental issues created by the odor and leachate from the dumpsite. The local residents are demanding to remediate the legacy dumpsite and to utilize the remediated land for social cause. Since the cessation of dumping activities in 2018, only sweeping waste from towns and streets were dumped at the facility daily and has now been discontinued since July'2023. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes.

To assess the quantity & composition of legacy waste & also evaluate the environmental baseline of the dumpsite, samples from representative locations were collected and analyzed for various parameters viz., physical and chemical analysis of Legacy waste, Soil, Air, Noise, leachate, Groundwater and Surface Water. As part of the study, detailed site investigations were carried out for; – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical and Environmental Analysis by M/s Poluchem Laboratories. From the results of the investigations, it was found that the waste was seen upto a depth of 6.7 m (Above Ground 5 m & below Ground 1.7 m). The total estimated quantity of legacy waste is around 38367 $m^3$ Considering the density of the material to be 0.76 tons/cum the total quantity of waste disposed before conducting the survey is estimated as 29140 tons.

As per the SWM Rules 2016, selection of an applicable method/type or technique for dumpsite remediation needs to be arrived from the Feasibility study carried out, and based on the results, remediation can be done by a) Capping without land recovery, b) Bio-mining – reclamation/recovery of land and c) capping with partial land recovery. The selection of technology shall also depend on the available resources viz., manpower, machineries, money, and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for land recovery and forward linkages/utilization of processed aggregates/by- products.

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Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite.

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by-products as per the requirements of the utilization/forward linkage. Based on the detailed assessment of the selection parameters, mobile/compact screening machineries shall be optimum for processing the legacy waste of 38367 $m^3$ within the stipulated timeline of 31st March 2024.

Environmental & Social safeguards: The project attracts E2 Environmental category based on the project activities and status of the environment baseline. The project attracts moderate social risks based on the social mapping, transect walk and consultation with the people living around the proposed project site to assess the problems associated with the legacy waste dumpsite and the impact during the execution of the project.

By-products utilization/forward linkages/Usage

1. The approximate quantity of bio earth (19375.34 $m^3$) & C&D (8824.41 $m^3$) waste will be utilized for the development of the reclaimed legacy waste dumpsite as a Recreational Park/facility.
2. Refused derived fuel (RDF) of 9169.71 $m^3$ will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the process.
3. Recyclables of 997.54 $m^3$ will be sold to authorized recyclers.

The activities of bio-mining will be commenced from Oct 2023 and are expected to end by Mar 2024. An area of 1.25 acres will be reclaimed and will be developed into a recreational park based on the ULB decision for public use. Total cost of the project is [redacted] /-. The cost per $m^3$ for processing and disposal of the legacy waste is [redacted] /-.

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## 1. INTRODUCTION

Vadakara Municipality, the first declared zero-waste municipality in the State, is one of the rapidly developing urban local bodies in Kozhikode district. Even though the ULB has an excellent practice of waste management, the primary environmental issue currently faced by the municipal authorities revolves around a longstanding existing legacy waste dumpsite. It has a long history of more than three decades of continuous dumping of both bio- and non-biodegradable wastes. Though the waste dumping activity has been stopped, the dumpsite remains as the remnants of a time when waste disposal methods were not as advanced or environmentally conscious as they are today. Improper management of such sites pose significant environmental, social, and economic challenges for the communities and ecosystems in the vicinity.

In view of the environmental and social issues connected with dumpsites, the SWM Rules 2016, directs all local bodies to identify the legacy dumpsites and to scientifically remediate them in order to ensure a safe and healthy environment. Recognizing this necessity, KSWMP has initiated the remediation projects of legacy waste dumpsites in all the ULBs. As part of the project, in phase -1, the existing dumpsite of Vadakara, ward 20, Puthiyappa was proposed for remediation.

For arriving at a methodology for remediating the legacy waste in the dumpsites, as per the Project Implementation Manual, a feasibility study outlining the technical, economic, and socio-environmental factors has been carried out. As a result of the feasibility study that involved detailed field investigations & assessment, and market sounding, the method proposed for remediation of legacy waste dumpsite is biomining, which will ensure long-term sustainability and environmentally sound treatment, which is found technically feasible, economically viable, and socially acceptable. The details of various steps involved in the feasibility study are described in the following sections. `

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## 2. GENERAL DESCRIPTION ABOUT PROJECT

Vadakara municipality has an area of 21.34 sq.km with 47 wards. Solid waste generated from 18,549 households and 5442 institutions including commercial establishments is 35.60 TPD. The municipality intends to strengthen and enhance the existing treatment facilities of the biodegradable & non-biodegradable waste system at household, institutional and community level for effective management of the solid waste generated, and also remediation of existing legacy waste dumpsite.

The Puthiyappa dumpsite was used for dumping of solid waste from the year 1962 to year 2018. The dumping of the solid waste (biodegradable waste) was stopped due to the protest from local residents for addressing the issues of odor and leachate from the dumpsite, and they are in demand for remediating the legacy dumpsite and to utilize the remediated land for social cause.

Since the cessation of dumping activities in 2018, only sweeping waste from towns and streets is dumped at the facility on a daily basis. The legacy waste is spread over an area of 1.25 acres with an average height of 5 m, having a portion of the dumpsite which is 712 cu.m of waste being capped by 2020. The legacy waste at the site mainly consists of organic material, stones, plastic, and rags/clothes. The municipality intends to remediate the existing legacy waste dumpsite for the recovery of land and develop the same into a recreational park for the public use after assessed the suitability of the soil as per applicable standards. The details of the legacy waste dumpsite are provided below:

*Table 1 Dumpsite Details*

| Name of ULB | Vadakara |
|---|---|
| District | Kozhikode |
| Taluk | Vadakara |
| Location | Ward 20, Puthiyappa Vadakara |
| GPS Co-ordinate of the Site | Lat: 11° 35' 37.5612" N, Long: 75° 36' 20.9376" E |
| Total dumpsite area (in acres) | 1.52 |
| Legacy waste spread (in acres) | 1.25 |


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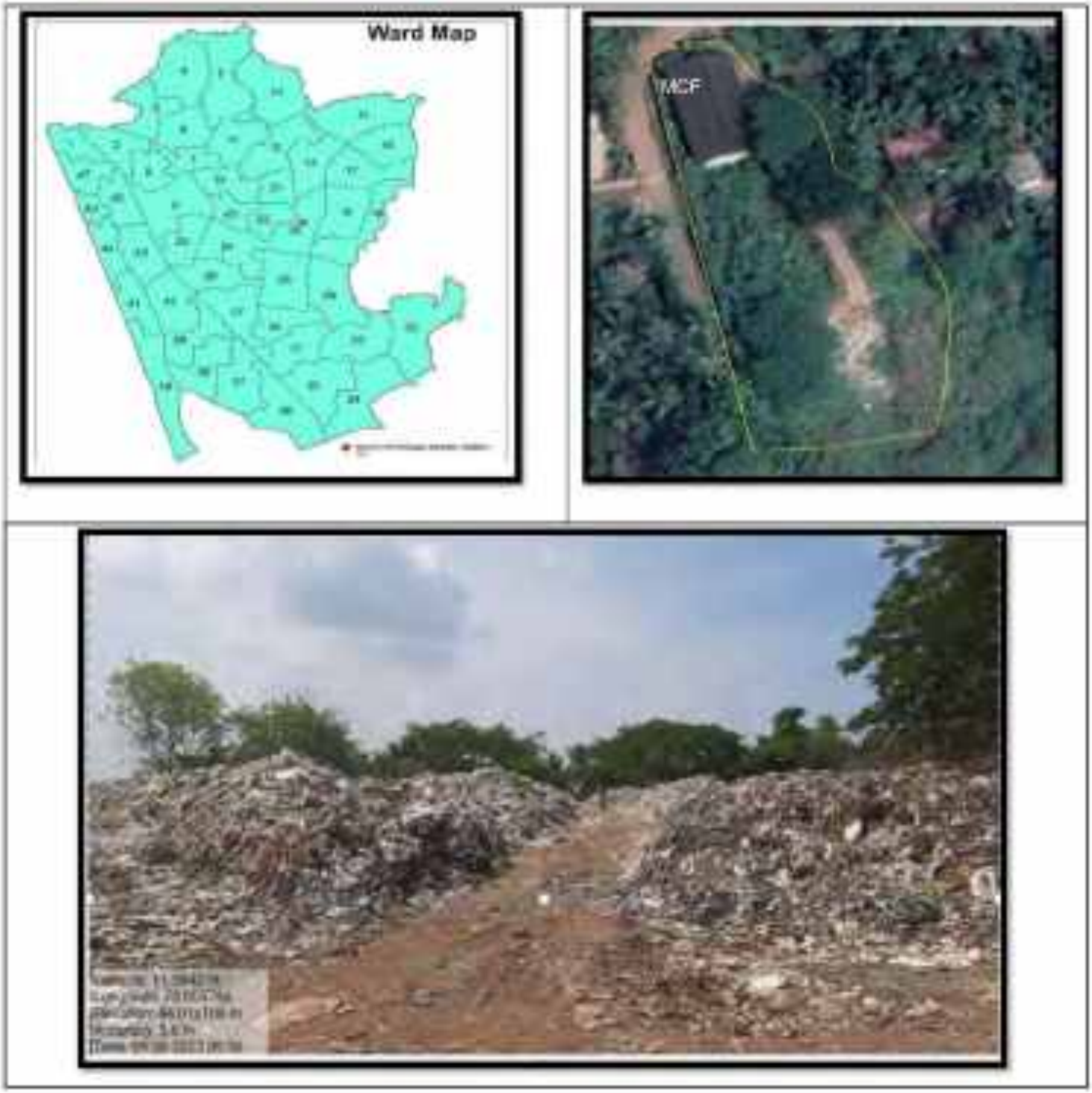



*Figure 1 Location of Dumpsite*


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## 3. LOCATION, DEMOGRAPHY, ACCESS, LAND-USE, WATER TABLE AND CLIMATE OF THE ULB

### 3.1 LOCATION

Vadakara municipality lies at 11.60°N, 75.58°E, located in Vadakara Taluk of Kozhikode District with an area of 21.34 km$^2$, comprising 47 (Nos) administrative wards. The dumpsite located in the ward 20, puthiyappa which is around 2.4 km away from the Coastal Regulation Zone. It is situated about 49 km to the north of Kozhikode City and approximately 44 km to the south of Kannur City. Vadakara is surrounded by Mahe on the North, Payyoli on the South, Villiappally on the East, and Arabian Sea on the West. Location map of Vadakara is given below.




*Figure 2 Location of Vadakara*

### 3.2 POPULATION, DENSITY AND LITERACY RATE

As of the 2011 Census of India, Vadakara had a population of 75, 295, with a decadal growth rate of 4.91 % with males constituting 35,531 (47%) of the population and females 39,531 (53%). The present population is 79771, considering the decadal growth rate of 4.91%. The density is around 3227 persons/sq.km. The sex ratio is 1119 females for 1000 males against the state average of 1084.

The literacy rate of Vadakara city is 94.88 %, which is higher than the state average of 94.00 %. In Vadakara, the male literacy rate is around 97.12 % while female literacy rate is 92.91%.

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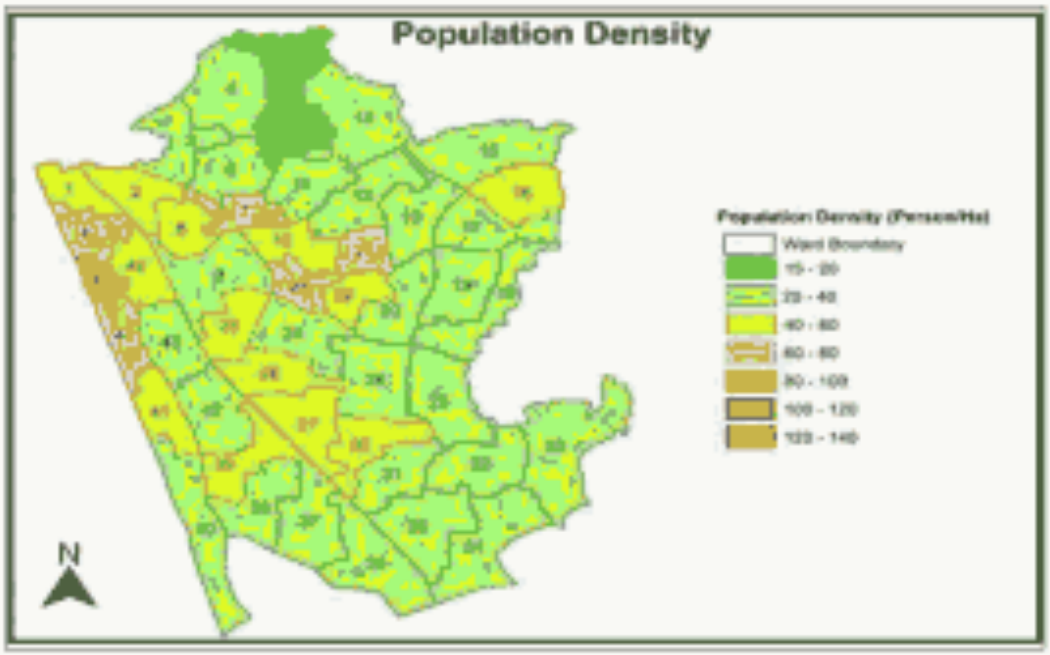



*Figure 3 Ward Wise Population Density (Person/ha)*

### 3.3 LAND USE

The Vadakara municipality has a total area of 21.34 Sq. km. The study area's land use has been assessed through satellite data interpretation and confirmed during on-site visits. The primary findings regarding the Vadakara Dumpsite from this analysis are as follows:

1. The predominant land use in the area is residential.
2. There is a nearby FCI Godown located approximately 20 meters away.
3. A veterinary hospital is situated at an approximate distance of 150 meters.

The land use indices of Vadakara municipality are shown in below figure.

Table 2 Land use indices

| Description | Area (in sq.km.) | Land Use % |
|---|---|---|
| Residential | 2.68 | 12.57 |
| Agricultural | 1.60 | 7.52 |
| Water bodies | 1.62 | 7.59 |
| Transportation | 1.02 | 4.76 |
| Commercial | 0.47 | 2.10 |
| Public and Semi Public | 0.15 | 0.78 |
| Tree Clad Area (Built up area with Thick Tree cover) | 13.02 | 61.01 |
| Private Vacant land | 0.78 | 3.67 |
| Total | 21.34 | 100 |

Source: Master Plan for Vadakara town 2031(draft)


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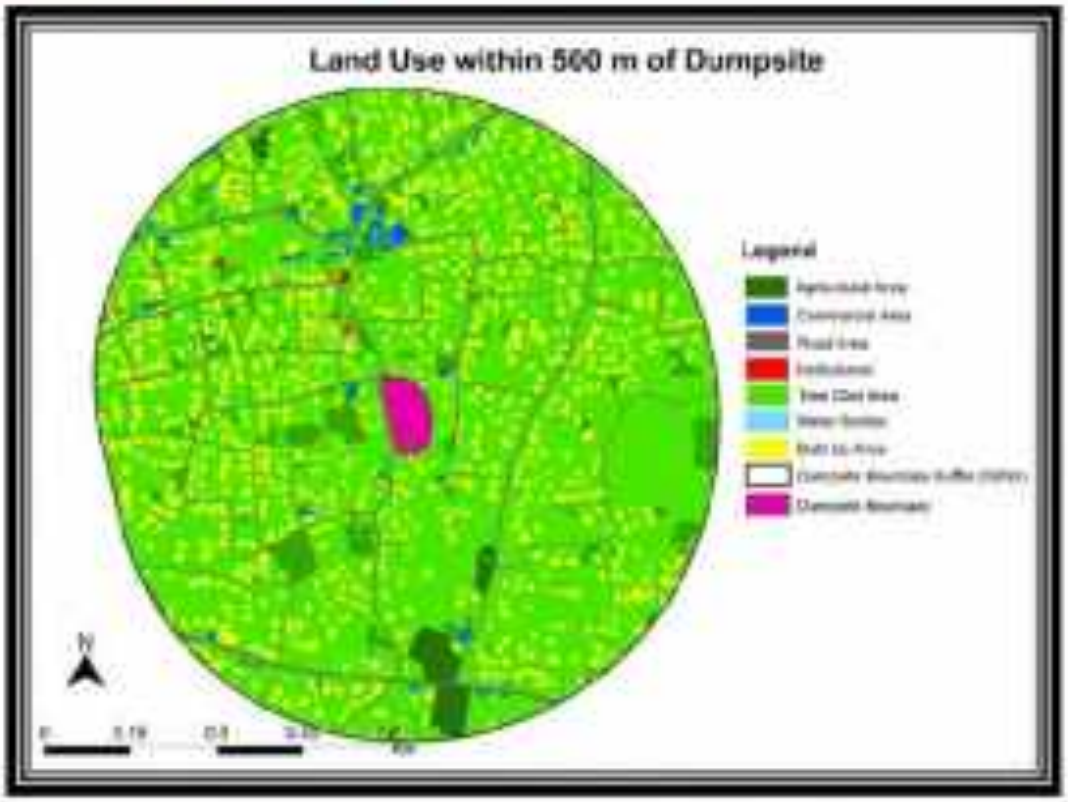



*Figure 4 Land Use Plan of Vadakara Dumpsite*

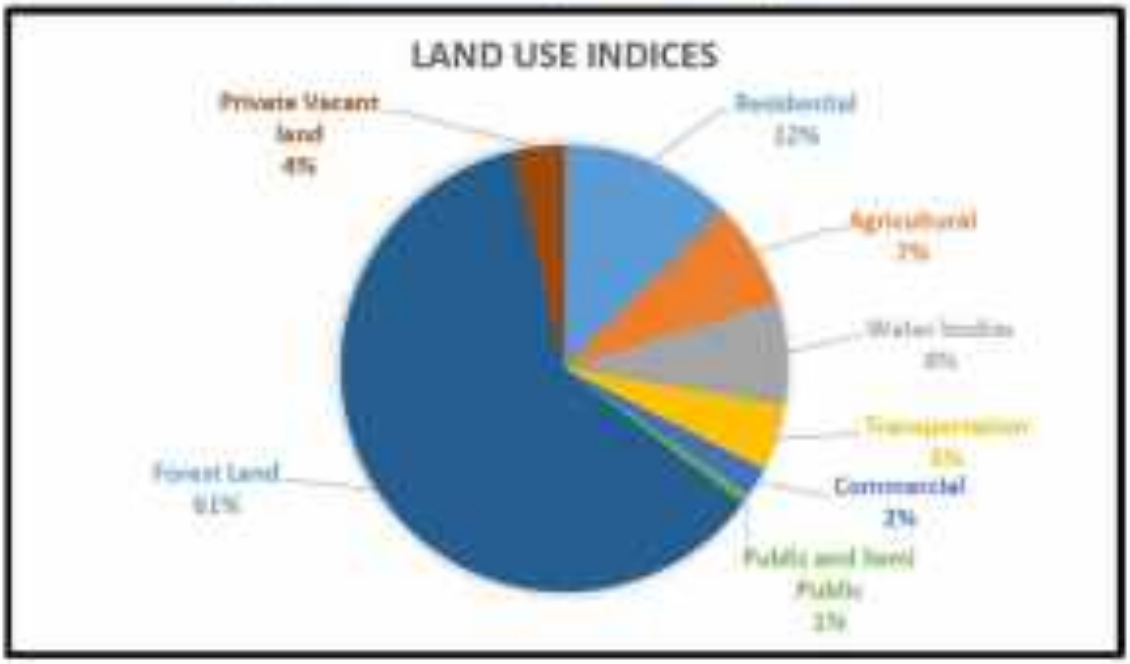
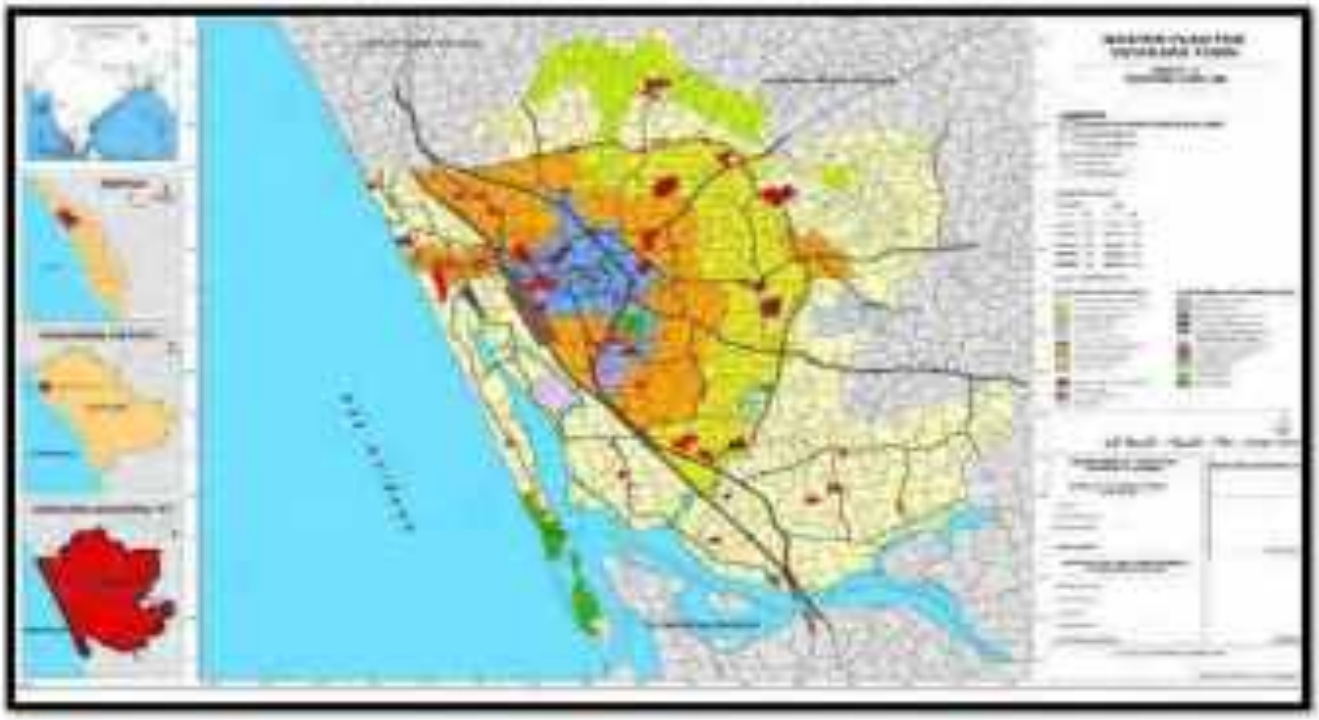



*Figure 5 Land Use Plan of Vadakara Town – Master Plan for Vadakara*


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Source - http://keralaplanning.kerala.gov.in



## 3.4 TRANSPORTATION CORRIDOR

*Table 3 Transportation corridor details*

| Mode | Details |
|---|---|
| Road | National Highway 66 passes through Vadakara town, connecting Vadakara to Kozhikode to the South (45 km) and to Kannur (44 km) and Mangalore (188 km) to the North. |
| Train | Vadakara Railway Station is one of India's model railway stations, and is connected to all major stations, and one of the top stations in North Kerala after Calicut and Kannur |
| Air | Kannur International Airport is the closest airport, approximately 48 km away. Calicut International Airport is approximately 60 km away. |


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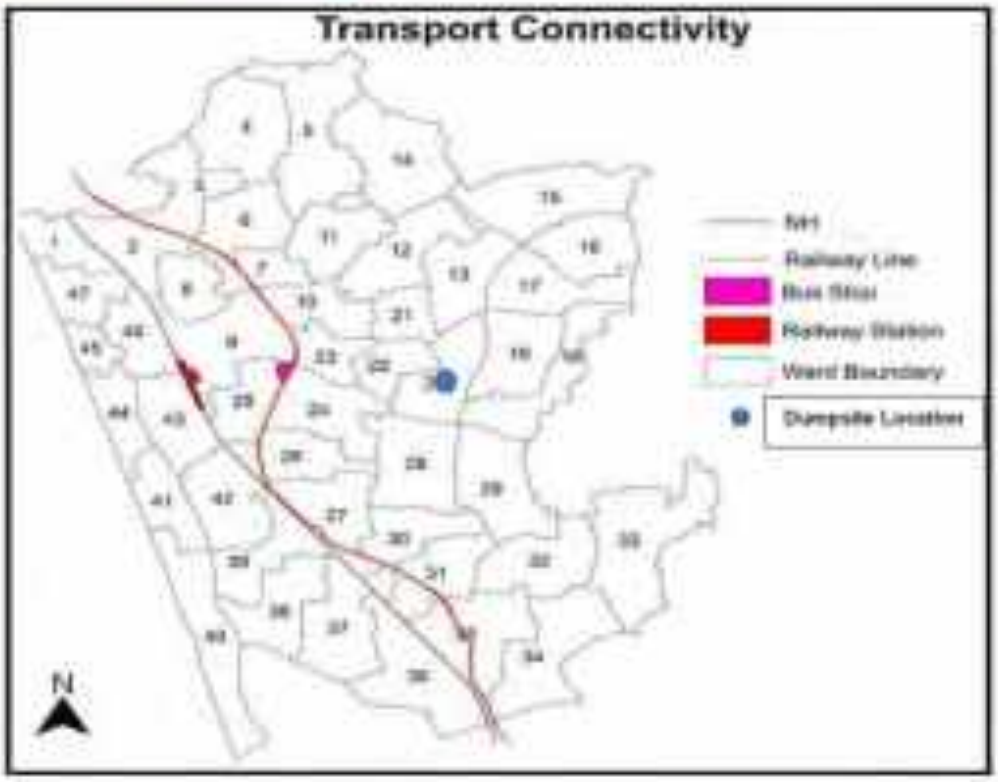



*Figure 6 Map for the Transportation Connectivity*

### 3.5 TOPOGRAPHY

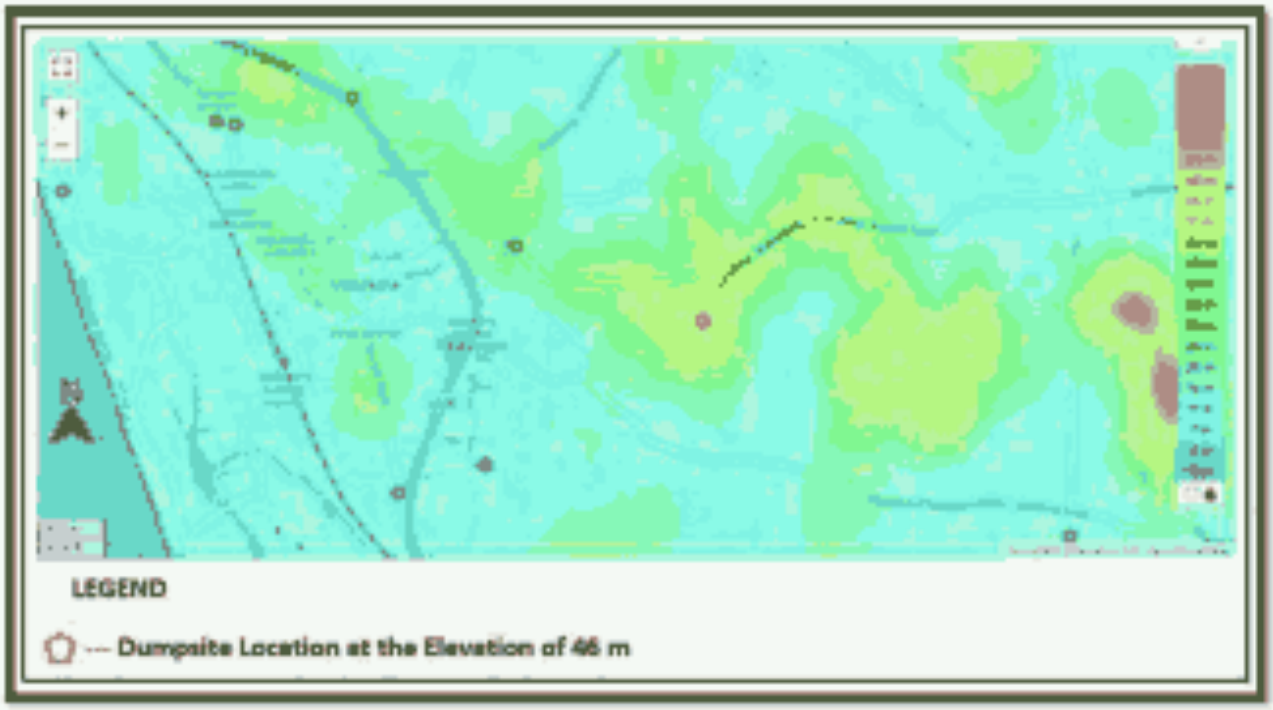
Based on altitude, the terrain is classified into three: low land, midland and highland.

*Table 4 Topography*

| Altitude | Details |
|---|---|
| Low land | The Land lying between 0 to 7.5m from MSL is treated as low land. The lowland is the coastal land of Vadakara. |
| Midland | Land lying between 7.5m to 75m from MSL is treated as midland. Majority of the land area in Vadakara is midland. |
| Highland | There is no high land region in Vadakara |

The average elevation of the Vadakara is 46 m and falls under the midland category which can be seen from the figure below.


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Source: en-in.topographic-map.com

*Figure 7 Topographic Map*

Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope. This steep slope on southeast direction possesses a potential risk of leachate runoff, which could result in the contamination of surface water on that side of the site.

## 3.6 CLIMATIC CONDITION

### 3.6.1 TEMPERATURE & RAINFALL

Vadakara falls in the tropical to sub- tropical climatic region. The maximum temperature varies between 32ºC and 37ºC and minimum temperature varies from 21ºC to 24ºC. The maximum monthly rainfall is 1031 mm and the annual rainfall is 3508 mm.

*Table 5 Temperature & Rainfall Data*

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average high °C | 31.7 | 32.8 | 32.9 | 33.2 | 32.7 | 29.6 | 28.3 | 28.8 | 29.5 | 30.4 | 31.1 | 31.5 | 31.0 |
| Average low °C | 21.9 | 23.8 | 24.6 | 25.8 | 25.7 | 23.9 | 23.4 | 23.6 | 23.7 | 23.8 | 23.3 | 22.1 | 23.7 |
| Average precipitation mm | 2 | 4 | 15 | 78 | 292 | 905 | 1,031 | 520 | 282 | 248 | 100 | 23 | 3,508 |

Source: Climate-Data.org


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According to the Rainfall Data, the most favorable working period spans from December to March due to the lower precipitation levels.

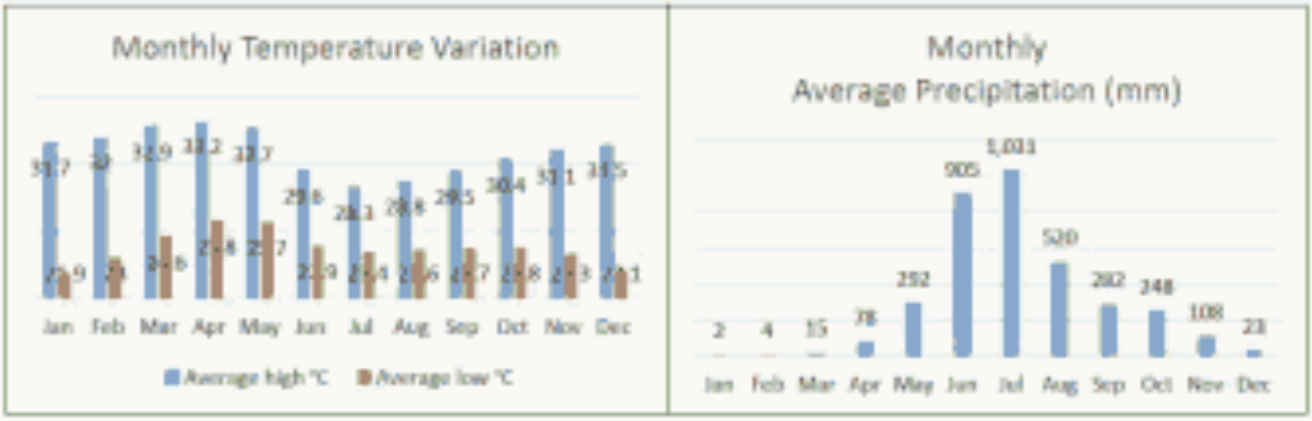



*Figure 8 Monthly Variation of Climate and Rainfall for Vadakara Town*

### 3.7 FLOOD ZONE

The details of the flood zone of Vadakara is provided in the table below. It may be noted that the site doesn't fall under flood zone and has a good elevation.

| DESCRIPTION | BASE YEAR | 1 in 10 YEAR (CC - RCP 8.5) | | 1 in 25 YEAR (CC - RCP 8.5) | | 1 in 50 YEAR (CC - RCP 8.5) | | 1 in 100 YEAR (CC - RCP 8.5) | |
|---|---|---|---|---|---|---|---|---|---|
| Vadakara | 2011 | Flood Inundation Area (Km2) | Max Flood Level (m) | Flood Inundation Area (Km2) | Max Flood Level (m) | Flood Inundation Area (Km2) | Max Flood Level (m) | Flood Inundation Area (Km2) | Max Flood Level (m) |
| | | 2.22 | 9.47 | 2.64 | 10.23 | 2.96 | 10.61 | 3.41 | 10.92 |

*Table 6 Flood zone details*

*Source: Kerala State Disaster Management Authority CC=Climate Change RCP=Representative Concentration Pathway*

### 3.8 EARTHQUAKE ZONE

The Bureau of Indian Standards (BIS) has grouped the country into four seismic zones viz. zones II, III, IV and V as detailed in the Map below. The Kerala state falls under Seismic Zone 3.

### 3.9 COASTAL REGULATION ZONE

As per the Coastal Regulation Zone (CRZ) notification 2011 and further amendment in CRZ notification 2019, the Vadakara legacy dumpsite does not fall under the CRZ zone. The dumpsite located in the ward 20, puthiyappa which is around 2.4 km away from the Coastal Regulation Zone

### 3.10 GROUND WATER LEVEL

The details of groundwater level during pre-monsoon and post-monsoon, and the average fluctuation is provided in the table below.


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*Table 7 Details of Ground Water level*

| Pre-monsoon (m) | Post-monsoon (m) | Avg. Fluctuation (m) |
|---|---|---|
| 16.03 | 10.93 | 5.1 |

*Source: Ground Water Information Booklet of Kozhikode District, Kerala State, CGWB*


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# 4. DETAILED DESCRIPTION OF THE DUMPSITE

## 4.1 PHYSICAL FEATURE OF THE SITE



The total area of the dumpsite is approximately 1.52 acres, out of which 1.25 acres are covered by legacy waste, with an average height of 5.00 m. The legacy dumpsite is located at Lat: 11° 35' 39.228'' N, Long: 75° 36' 20.5668'' in Puthiyappa (ward-20), Vadakara.

The site has boundary walls of stone masonry on all sides with a single gate entry. Piped water supply with a storage tank of 5000 litres is available in the dumpsite. Electrical power infrastructure viz., power lines & electrical transformer of 100 KVA – 11 KV/440V is adjoining the boundary of the dumpsite. Within the boundary, an MCF of 180 $m^2$ area is located for storage and primary segregation of Non-Biodegradable waste. The dumpsite is connected with an access road of 5.00 m width and 250.00 m long from Meppayil Road.

## 4.2 INFORMATION ON SITE MANAGEMENT

The Puthiyappa dumpsite was used for dumping of solid waste from the year 1962 to year 2018. Due to public protest, dumping activities were stopped from 2018, at present only street sweeping waste (dry leaves) is disposed of in the existing dumpsite on a daily basis. Up until July 2023, the disposal of waste from street sweeping was directed to a designated site. In accordance with the implementation of the Biomining Project, the disposal of street sweeping waste was subsequently discontinued.

## 4.3 SITE HISTORY INCLUDING PUBLIC PROTEST

The dumping of the solid waste (biodegradable waste) was stopped due to the protest from local residents for addressing the issues created by odor and leachate from dumpsite and local residents are now demanding to remediate the legacy dumpsite and to utilize the remediated land for social cause.

## 4.4 DIRECTIONS FROM AUTHORITIES LIKE NGT, PCB, ETC.

### 4.4.1 NGT DIRECTIONS & ORDERS

The National Green Tribunal (NGT) has set norms and guidelines (O.A. No. 606/2018) to address legacy waste accumulated at long-operating dumpsites, to mitigate environmental and health hazards. The norms focus on closure and remediation of dumpsites, waste segregation and treatment using appropriate technologies, conducting Environmental Impact Assessments (EIAs), implementing land use planning and zoning regulations, monitoring and compliance measures, and promoting public participation and awareness regarding legacy waste management. These

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guidelines aim to stabilize dumpsites, prevent further pollution, and involve communities in decision-making and risk education.

### 4.4.2 LOCAL SELF GOVERNMENT DEPARTMENT - GUIDELINES

The remediation of dumpsites is further directed by Honorable NGT in its order OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. Remediation of Legacy Waste Dumpsites through Bioremediation - G.O.(Rt)No.2629/2022/LSGD Dated, Thiruvananthapuram, 29-10- 2022

### 4.4.3 KSPCB - GUIDELINES FOR DUMPSITE REMEDIATION

The Kerala State Pollution Control Board (KSPCB) has established guidelines (PCB/HO/SEE2/Model City/Kozhikode corporation/2019 dated 09/09/2021) for dumpsite remediation to address the environmental and health impacts of waste disposal. The recommended steps include conducting a site assessment, developing a remediation plan based on risk assessment, selecting appropriate remediation technologies, implementing remediation activities under supervision, verifying the success of remediation, and ensuring long-term management and monitoring of the site. By following these guidelines, the KSPCB aims to mitigate the adverse effects of waste disposal, protect the environment, and safeguard public health.

### 4.4.4 CPCB GUIDELINES

Hon'ble NGT warned that due to incremental growth of Municipal Solid Waste (MSW), these MSW dumps are converting into virtual mountains. Hon'ble NGT further directed that every city/town should adhere to clause 'J' of Schedule–I of SWM Rules, 2016. Finally, Hon'ble NGT directed CPCB to propose Standard Operating Procedure (SOP) for implementation of Bio-mining and Bioremediation of legacy solid waste.

### 4.4.5 SWACHH BHARAT MISSION (SBM) ADVISORY

The advisory on dumpsite bioremediation addresses the challenges of legacy waste and promotes sustainable waste management practices and emphasizes the importance of dumpsite bioremediation as a sustainable solution for managing legacy waste. By adopting these guidelines, municipalities can address the environmental and health risks associated with dumpsites and promote a cleaner and healthier living environment for communities.

### 4.4.6 CENTRAL PUBLIC HEALTH AND ENVIRONMENTAL ENGINEERING ORGANIZATION (CPHEEO) GUIDELINES

The guidelines aim to provide a comprehensive approach to remediate dumpsites in a safe and environmentally sustainable manner. Key points from the guidelines include conducting site assessments, segregating waste, and implementing engineering and biological measures to control contamination, treating leachate to prevent groundwater contamination, and conducting post-remediation monitoring. These guidelines are crucial to ensure effective and environmentally sound dumpsite remediation that protects public health and the environment.

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# 5 SCOPE OF WORK

Preparation of feasibility report for the assessment of a technically feasible & financially viable solution for the remediation of legacy dumpsite located at Vadakara includes the following steps.

- Conducting detailed field investigations – 1. Geotechnical Investigation by M/s Matter Material testing & Research Laboratory (P) Ltd. and 2. Waste Analysis - Physical & Chemical, and Environmental Baseline Analysis by M/s Poluchem Laboratories.
- Assessment & Analysis of detailed investigation report submitted by the Laboratories.
- Waste quantification by conducting survey (total station/ drone survey) & assessment of composition of legacy waste based on the Physical & Chemical characteristics and Leachate.
- Quantification of by-products viz; Bio earth, RDF, Recyclables, Inert, etc., based on the Physical & Chemical characteristics and exploring the options for optimum utilization of the By-products.
- Market sounding/service provider's consultation to explore the available successful options of technologies/machineries.
- Optional Analysis – Types of remediation (land recovery – Biomining, Capping partially Biomining & Capping), Methods/Technologies (Stationary & Mobile- compact), Implementation mode, Forward linkages (Utilization/Management of By-products) and Environmental & Social categorization as per the Environmental Management Framework – Vol II Part A.
- Assessment of System Requirements – Machineries & Vehicles and auxiliary items with indicative specifications, Manpower & consumables etc.,
- Environmental Safeguards- Baseline assessment, impact & risk assessment, mitigations measures and Environmental Management & monitoring plan and its budget.
- Social Safeguards - Social Mapping, transect walk, Focus group discussion, Sensitive mapping.
- Preparation of Action Plan (Gender, Livelihood, RAP, Tribal etc.,), Social Management & monitoring plan.
- Project cost – Establishment and Operation & Maintenance cost, Disposal costs incl. transport, Environmental and social monitoring costs, Revenue from the project, Funding for project
- Project Implementation plan –contractual models and timelines.

## 5.1 OBJECTIVES:

- To remediate the legacy waste dumpsite of approximately 29,140 Tons by 31st March 2024.
- To reclaim the legacy waste dump area and to develop recreational park facilities, thereby eliminating the chances of dump fires, leachate generation, and foul odor.
- To reduce greenhouse gas emissions, soil pollution, and groundwater contamination.
- To increase nearby real estate/social value and benefit the citizens.

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# 6 COMPOSITION, CHARACTERISTICS OF LEGACY WASTE AND ITS IMPACTS

## 6.1 DETAILED INVESTIGATION STRATEGY

To understand the nature and composition of the legacy waste and the existing baseline environmental conditions, samples from waste, surface and groundwater, leachate, soil, air, and noise were collected as per the requirements given in the Project Implementation Manual, considering the state and national guidelines. Samples were collected as mentioned below;

- ✓ Bore hole upto a depth of 10 m and collection of 3 (nos) samples from the soil at interval of 1.5 m
- ✓ Waste analysis viz., leachate sample from 3 (nos) locations and physical analysis from 2 (nos) location, and chemical analysis from 1 (nos) location.
- ✓ Environmental baseline analysis surface water 1 (nos) location and ground water samples from 3 (nos) location (Well Water Samples -1 up gradient, 2 down gradient) and Air sampling from 2 (nos) locations and noise sampling from 1 (nos) location

## 6.2 DETAILED INVESTIGATIONS

The detailed investigations carried out for the legacy waste dumpsite is given in the table below:

*Table 8 Investigation details*

| S.No | Parameters | Sampling Nos. |
|---|---|---|
| 1 | Geotechnical Investigation | |
| A | Boreholes up to 10m depth (as per CPHEEO Manual) | 1 |
| B | Permeability test- (as per CPHEEO Manual) standard penetration test SPT and collection of undisturbed samples - Soil Investigation - Classification, gradation, Atterberg's limit, Bulk density, dry density, water content, cohesion, angle of internal friction, Proctor density, Optimum moisture content, coefficient of permeability, strength, compressibility (vertically-3 samples per borehole) | 1 |
| 2 | Waste & Environmental Analysis | |
| A | Leachate Analysis (TCLP usepa 1311) (SCHEDULE II of SWM rules, 2016), Suspended solids, Dissolved solids (inorganic),pH, Ammonical nitrogen (as N), Total Kjeldahl nitrogen (as N), BOD, COD, Arsenic (as As), Mercury, Lead, Cadmium, Copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compounds | 3 |
| B | Physical Analysis of waste (As per CPHEEO manual) including Density, Bulk Density, Moisture Content, Size of waste Constituents, Calorific Value | 2 |
| C | Chemical Analysis of waste/soil for heavy metals, pH, Nitrogen, Phosphorus and Potassium (N-P-K), total Carbon, C/N ratio, calorific value, Bio-chemical - biodegradable factor | 1 |
| D | Ground Water (Well Water Samples -1 up gradient, 2 down gradient) - (shallow and deep wells): pH, Colour, EC, Turbidity, SS, TDS, TOC, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, | 3 |


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| | | |
|---|---|---|
| | TKN, Total Alkalinity, Total hardness and Total Pesticides, Ecoli and Total Coliforms (IS 10500 – 2012) | |
| E | Surface Water (pH, Colour, EC, Turbidity, SS, TDS, TOC, DO, BOD, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, C/N, F, As and Mn, Cl, NO3, SO4, TKN, Total Alkalinity, Total hardness, Ecoli and Total Coliforms (IS 10500 – 2012) | 1 |
| F | Ambient Air Quality (Sulphur Dioxide (So2), Nitrogen Dioxide (No2), Particulate Matter 2.5, Particulate Matter 10, Ozone (O3), Lead (Pb), Carbon Monoxide (CO), Ammonia (NH3), Benzene (C6H6), Benzo pyrene (BaP), Arsenic (As), Nickel (Ni) for 24 hrs | 2 |
| G | Ambient Noise Level (Eq)(Rules) for 24 hours | 1 |
| **Note: Detailed Technical Investigations conducted as per PIM** | | |

### 6.3 METHODOLOGY OF SAMPLING

To assess the quantity & composition/characteristics of the legacy waste & also environmental baseline conditions in the vicinity of the dumpsite, a detailed sampling methodology including identification of sampling locations, distance from the sensitive components, quantity & number of samples, and location (Lat/Long) were considered. The following table shows the strategic location details of samples selected for the detailed investigation.

*Table 9 Details of sampling location*

| S.No | Description | Sampling location | Justification |
|---|---|---|---|
| 1 | Air sampling (2 Locations) | Within the dumpsite | As per the wind rose diagram, the direction and speed of the wind are determined and based on the existing wind-rose data the air sampling location fixed at two locations |
| | | Dumpsite entry point | |
| 2 | Noise (1 Location) | Within the dumpsite | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. |
| 3 | Surface water (1 Location) | Surface water near to the dumpsite (stream) | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope. This steep slope on southeast direction possesses a potential risk of leachate runoff, which could result in the contamination of surface water on that particular side of the site. So, the location of surface water is taken on the southeast direction |
| 4 | Ground water (3 Locations) | 3 wells identified near the dumpsite area | Considering the sites geographical features, it is situated in a predominantly flat terrain, except for one side characterized by a steep slope (SE). The infiltration of leachate which could result in the contamination of ground water |


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| | | | |
|---|---|---|---|
| | | | Based on the possible infiltration and slope direction, two ground water samples are collected in the east direction and one of the west direction. |
| 5 | Bore Hole (1 Location) | Within the dumpsite area | As per the site location, the noise levels are taken at the entry point which is abutting the access road resulting in huge noise impact due to movement of vehicles. |
| 6 | Legacy Waste | Within the dumpsite area | Not Applicable |

*Table 10 Direction and Distance of the sampling location*

| S.No: | Description | Direction | From Dumpsite (m) | From Boundary (m) |
|---|---|---|---|---|
| 1 | Surface Water | Southeast | 303 | 222 |
| 2 | Ground water-1 | West | 110 | 40 |
| 3 | Ground water-2 | Northeast | 106 | 33 |
| 4 | Ground water-3 | Southeast | 325 | 247 |
| **Note: Air and Noise Monitoring are monitored inside the dumpsite** | | | | |

*Table 11 Quantity of sampling & location*

| S. No | Items | Quantity of sample collected | Location |
|---|---|---|---|
| 1 | Solid Waste | 25 kg | Location -1: N- 11°35'38.062" E -75°36'20.735"<br>Location -2: N- 11°35'37.392" E -75°36'20.681" |
| 2 | Surface Water | 1.5 Litres | Location -1:N- 11°35'29.729" E -75°36'24.791" |
| 3 | Ground Water | 1.5 litres | Location -1: N- 11°35'39.614"E -75°36'18.171"<br>Location -2: N- 11°35'41.468"E -75°36'22.459"<br>Locations -3:N- 11°35'29.581"E -75°36'24.331" |
| 4 | Leachate | 1.5 litres | Location -1: N- 11°35'39.102"E -75°36'20.543"<br>Location -2: N- 11°35'37.504"E -75°36'20.874"<br>Location -3: N- 11°35'39.983"E -75°36'20.205" |
| 5 | Ambient Air Quality | 2 Nos | Location -1: N- 11°35'39.102"E -75°36'20.543"<br>Location -2: N- 11°35'37.504"E -75°36'20.874" |
| 6 | Ambient Noise Quality | 1 Nos | Location -1: N- 11°35'39.983"E -75°36'20.205" |


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*Figure 9 Sampling Locations – Borehole & legacy waste sample*

### 6.4 ANALYSIS AND INTERPRETATION OF EXPLORATORY DATA

As part of the feasibility study, Technical Support Consultants (IPE Global Ltd) has entrusted the geotechnical investigation & Environmental baseline assessment to M/s Matter Material Testing & Research Laboratory (P) Ltd and M/s Pollurhem Laboratories (P) Ltd respectively.

The initial site visit was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd on 16th May 2023 along with the experts of TSC and PIUs. Field Geotechnical investigation to collect the soil samples after drilling through the legacy waste was started on 17th May 2023 and was completed on 23rd May 2023. Positioning of Air samplers & Noise monitoring equipment, sampling of surface/groundwater, leachate, and legacy waste were done on 06th June 2023 by M/s Pollurhem Laboratories (P) Ltd. The lab analysis reports were submitted by the investigation agencies to TSC. The lab analysis reports are provided in Annexures – A & B

#### 6.4.1 GEOTECHNICAL EXPLORATORY DETAILS

For assessing the depth of legacy waste and contamination of the soil below the legacy waste, bore hole samples were collected using rotary drill. The exploratory data of the bore hole revealed a maximum depth of 6.70m of waste followed by 3.80m of soil. Lateritic rock was encountered below the soil stratum. The Geotechnical investigation was carried out by M/s Matter Material


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Testing & Research Laboratory (P) Ltd. The details of the exploratory data of the bore hole is provided below.

*Table 12 Exploratory Data of Bore Log*

| S. No | Borehole location | Total Depth of the Borehole (m) | Depth of Soil (m) | Depth of Legacy Waste (m) | Remarks |
|---|---|---|---|---|---|
| 1 | N- 11°35'38.862" E-75°36'20.735" | 10.5 | 3.8 | 6.7 | Lab Analysis Report provided in Annexure A |
| Note: Bore hole terminated at the depth of 3.8m below ground level due to Laterite rock | | | | | |

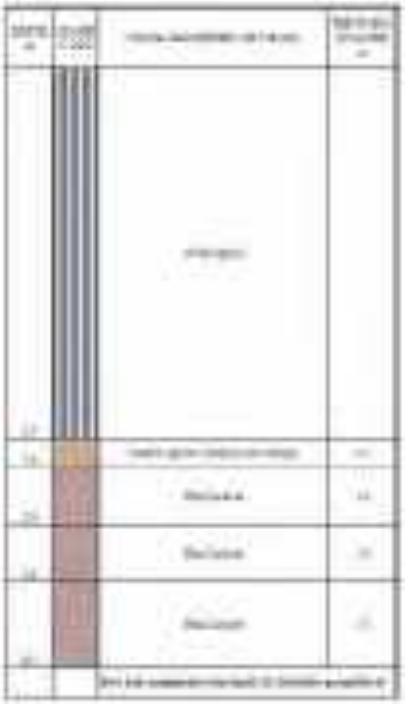





*Figure 10 Soil Profile & Geotechnical Investigation*

### 6.4.2 ESTIMATED TOTAL QUANTITY OF WASTE

The total quantity of waste is estimated based on the contour/topography survey profile of the waste over the ground level and exploratory data of the bore log (Geotechnical investigations). The details of the estimated total quantity of waste is provided below:

*Table 13 Quantity of waste below ground level*

| Level | Area of the Waste ($m^2$) | Depth of the Waste (m) | Volume of the Waste ($m^3$) | Density of Waste ($T/m^3$) | Total Quantity of Waste (T) |
|---|---|---|---|---|---|
| Below Ground | 5060 | 1.7 | 8602.00 | 0.7595 | 6533.22 |


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*Table 14 Quantity of waste above ground level*

| Level | Volume of Legacy Waste (m3) | Density of Waste (t/m³) | Total Quantity of Waste (T) | Remark |
|---|---|---|---|---|
| Above Ground | 29765* | 0.7595 | 22,606.52 | *As per the Contour Survey Report by ULB |

*Table 15 Estimated total quantity of waste*

| Estimated total quantity of waste | |
|---|---|
| Total Quantity of Legacy Waste (m³) | 38367.00 |
| Total Quantity of Legacy Waste (T) | 29139.74 |
| Total Quantity of Legacy Waste (T) Approximately | 29,140.00 |


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### 6.4.3 LEGACY WASTE CHARACTERIZATION

The characteristics of the legacy waste were assessed by collecting 2 samples of 25 kg from 2 (nos) locations within the dumpsite. The legacy waste samples were collected on 06th June 2023 by M/s Polluchem Laboratories (P) Ltd. The assessment of waste characteristics, was done based on the results of the analysis. The details of the characteristics viz., composition, physical & chemical characteristics, heavy metals, and estimated quantity of by-products are provided in the tables below:

| S. No | Items | Quantity of sample collected | Location |
|---|---|---|---|
| 1 | Solid Waste | 25 kg | Location -1: N- 11°35'38.862" E -75°36'20.735"<br>Location -2: N- 11°35'37.392" E -75°36'20.681" |

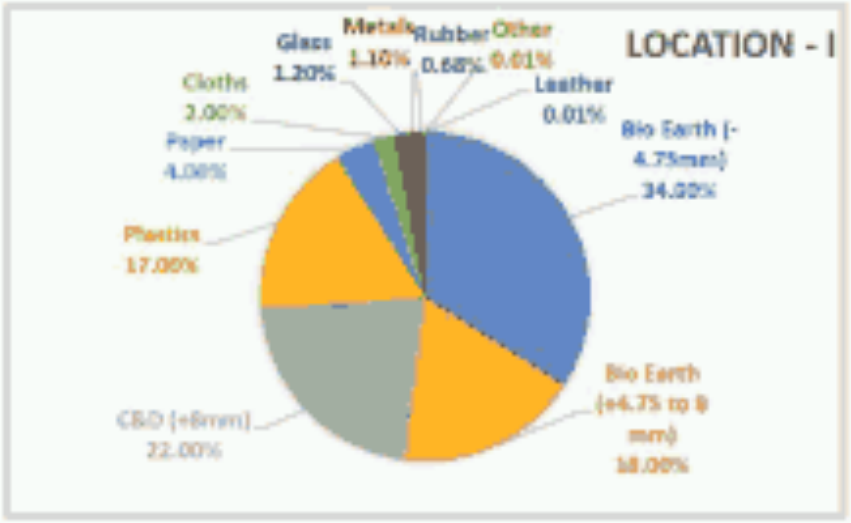
**Physical Composition:**

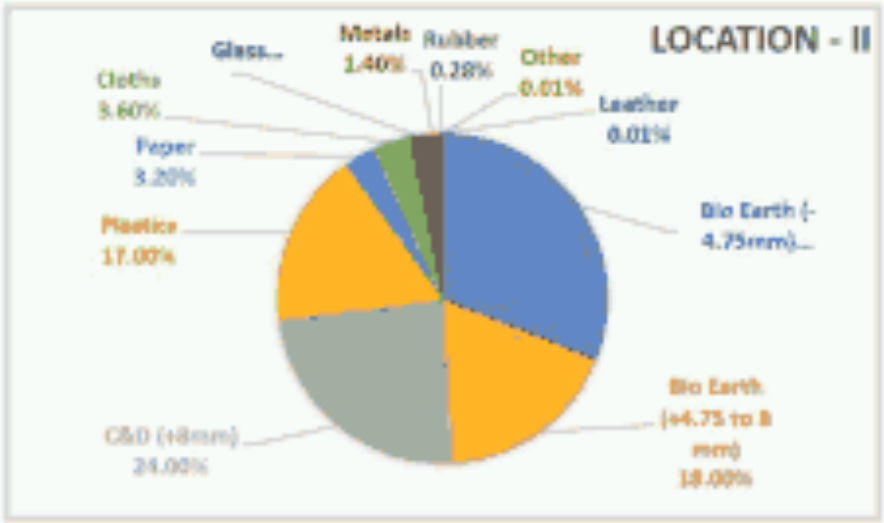
*Table 16 Physical Composition for Location- 1, 2 & Average*

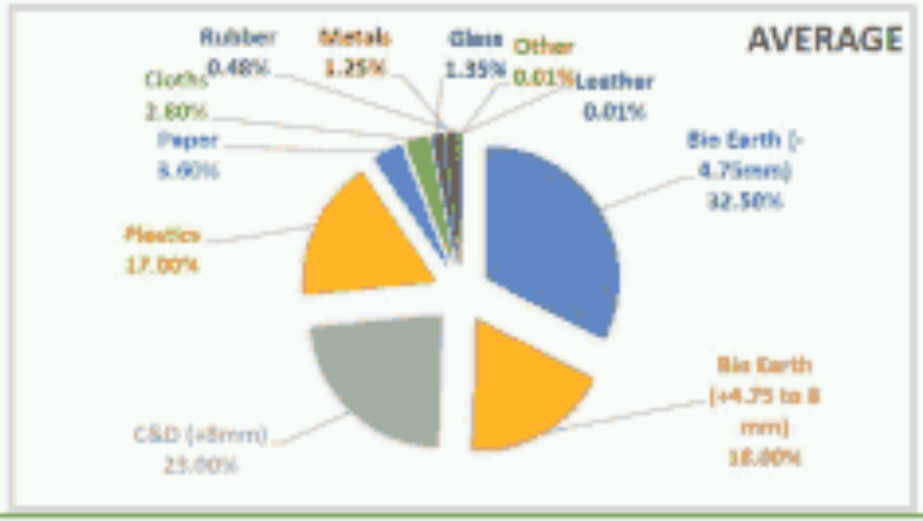
| Sl. No | Total Quantity of legacy waste (cu.m) | Parameters | Location - I | | Location – II | | Average | |
|---|---|---|---|---|---|---|---|---|
| | | | Avg. Percentage(%) | Quantity (cu.m) | Avg. Percentage (%) | Quantity (cu.m) | Avg. Percentage (%) | Quantity (cu.m) |
| 1 | 38367 | Bio Earth (-4.75mm) | 34 | 13044.78 | 31 | 11893.77 | 32.5 | 12469.275 |
| | | Bio Earth (+4.75 to 8 mm) | 18 | 6906.06 | 18 | 6906.06 | 18 | 6906.06 |
| 2 | | C&D (+8mm) | 22 | 8440.74 | 24 | 9208.08 | 23 | 8824.41 |
| 3 | | Plastics | 17 | 6522.39 | 17 | 6522.39 | 17 | 6522.39 |
| 4 | | Paper | 4 | 1534.68 | 3.2 | 1227.744 | 3.6 | 1381.212 |
| 5 | | Cloths | 2 | 767.34 | 3.6 | 1381.212 | 2.8 | 1074.276 |
| 6 | | Glass | 1.2 | 460.404 | 1.5 | 575.505 | 1.35 | 517.9545 |
| 7 | | Metals | 1.1 | 422.037 | 1.4 | 537.138 | 1.25 | 479.5875 |
| 8 | | Rubber | 0.68 | 260.8956 | 0.28 | 107.4276 | 0.48 | 184.3616 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 9 | | Other | 0.01 | 3.8367 | 0.01 | 3.8367 | 0.01 | 3.8367 |
| 10 | | Leather | 0.01 | 3.8367 | 0.01 | 3.8367 | 0.01 | 3.8367 |




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**Physical Analysis:**

*Table 17 Physical Analysis*

| S. No | Parameters | | Test Method | Unit | Location 1 | Location 2 | Avg. | Limit as per FCO |
|---|---|---|---|---|---|---|---|---|
| 1 | Moisture@105°C | | ASTM D 2216 | % | 9.71 | 8.14 | 8.925 | 15.0-25.0 |
| 2 | Bulk Density | | USEPA | kg/m³ | 774 | 784 | 779 | |
| 3 | Density | | USEPA | g/cm³ | 0.756 | 0.763 | 0.7595 | <1 |
| 4 | Calorific Value | | ASTM D 5865 | Kcal/kg | 2014 | 1987 | 2000.5 | -- |
| 5 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | Retained | Retained | Retained | |
| | | 75 | – | | | 0 | 1.6 | 0.8 | |
| | | 40 | – | | | 2.2 | 8.7 | 5.5 | |
| | | 20 | – | | | 6.5 | 9.8 | 8.2 | |
| | | 8 | – | | | 12.4 | 8.3 | 10.4 | |
| | | 4.75 | 4 | | | 7.53 | 4.05 | 5.8 | |
| | | 2.36 | 8 | | | 6.41 | 8.6 | 7.5 | |
| | | 1.18 | 16 | | | 16.47 | 12.4 | 14.4 | |
| | | 0.6 | 30 | | | 31.22 | 18.6 | 24.9 | |
| | | 0.3 | 50 | | | 12.71 | 19.53 | 16.1 | |
| | | 0.15 | 100 | | | 4.5 | 6.54 | 5.5 | |
| | | 0.09 | 170 | | | 0.06 | 1 | 0.5 | |
| | | 0.075 | 200 | | | 0 | 0.88 | 0.4 | |
| | | 0.045 | 325 | | | 0 | 0 | 0.0 | |
| Lat/Long: Location -1: N- 11°35'38.862"E -75°36'20.710" and Location -2: N- 11°35'37.392", E -75°36'20.681" | | | | | | | | |

**Chemical Analysis:**

*Table 18 Chemical Analysis*

| S.No | Parameters | Test Method | Unit | Location -1 |
|---|---|---|---|---|
| 1 | pH@25°C | USEPA | - | 8.09 |
| 2 | Biodegradable Factor | USEPA | % | 4.6 |
| 3 | Total carbon | USEPA 9060A | % | 5.1 |
| 4 | Phosphorus(P) | USEPA | % | 0.023 |


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| S. No | Parameters | Test Method | Unit | Location -1 |
|---|---|---|---|---|
| 5 | Nitrogen(N) | USEPA | % | 0.34 |
| 7 | Potassium(K) | USEPA | % | 0.076 |
| 8 | C/N Ratio | USEPA | .. | 15:01 |
| 9 | Calorific Value | ASTM D 5865 | Kcal/kg | 2000.5 |

**Heavy Metal Analysis:**

*Table 19 Heavy Metal Analysis*

| S. No | Parameters | Test Method | Unit | Location -1 | Limit as per Organic Compost (FCO 2009) |
|---|---|---|---|---|---|
| 1 | Iron (Fe) | USEPA 3050 | % | 2.31 | -- |
| 2 | Arsenic (As) | USEPA 3050 | mg/kg | <0.1 | 10 |
| 3 | Selenium (Se) | USEPA 3050 | mg/kg | <0.1 | -- |
| 4 | Nickel (Ni) | USEPA 3050 | mg/kg | 29.8 | 50 |
| 5 | Zinc (Zn) | USEPA 3050 | mg/kg | 144 | 1000 |
| 6 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 | 5 |
| 7 | Copper (Cu) | USEPA 3050 | mg/kg | 101.7 | 300 |
| 8 | Chromium (Cr) | USEPA 3050 | mg/kg | 29.2 | 50 |
| 9 | Lead (Pb) | USEPA 3050 | mg/kg | 31.06 | 100 |
| 10 | Mercury (Hg) | USEPA 3050 | mg/kg | <0.1 | .15 |
| 11 | Manganese (Mn) | USEPA 3050 | mg/kg | 81.8 | -- |

**By-Products:**

*Table 20 By-Products*

| By-Products | Bio Earth | C&D Waste | RDF | Recyclable |
|---|---|---|---|---|
| Percentage (%) | 50.5% | 23% | 23.9% | 2.6% |
| Quantity (cu.m) | 19375.34 | 8824.41 | 9169.71 | 997.54 |

### 6.4.4 ENVIRONMENTAL BASELINE

The environmental baseline was assessed from the analytical results of air, surface & groundwater, noise and leachate from the location as mentioned in the section 6.3. The samples were collected on 06th June 2023 by M/s Poluchem Laboratories (P) Ltd. The Environmental


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baseline was analyzed with reference to the lab analysis reports. The details of analysis & inferences are provided in the tables below:

**Surface Water Analysis:**

*Table 21 Surface water Analysis*

| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 – 1983RA2017 | 6.12 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 6 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 1.1 NTU | -- | -- |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 134 µS/cm | --- | -- |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 81 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1mg/l) | --- | -- |
| Total Hardness as CaCO3 | IS 3025 (P) 21 – 1983RA2014 | 38 mg/l | 200 mg/l | -- |
| Total Alkalinity as CaCO3 | IS 3025 (P) 23 – 1986RA2014 | 21.3 mg/l | -- | -- |
| Chloride as Cl- | IS 3025 (P) 32 – 1988RA2014 | 25.4 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as SO4 | IS 3025 (P) 24 – 1986RA2014 | 12.4 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 – 1989RA2014 | 4.2mg/l | 6 mg/l | 4 mg/l |
| BOD ( 3 days at 27° C) | IS 3025 (P) 44 - 1993RA2014 | 3.7 mg/l | 2 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 - 2006RA2017 | 10 mg/l | --- | -- |


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| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| TOC | APHA5310 | BDL(MDL-0.1mg/l) | – | – |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL-1mg/l) | – | – |
| Nitrate as NO3 | IS 3025 (P)34 – 1988RA2014 | 1.2 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 – 2008RA2014 | BDL(MDL-0.1mg/l) | 1.5 mg/l | 1.5 mg/l |
| Nickel as Ni | IS 3025(P) 54 – 2003RA2014 | BDL(MDL-0.01mg/l) | – | – |
| Cadmium as Cd | IS 3025(P) 41 – 1992RA2014 | BDL(MDL-0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47 – 1994RA2014 | BDL(MDL-0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42 – 1992RA2014 | BDL(MDL-0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59 – 2006RA2017 | BDL(MDL-0.01mg/l) | 0.5 mg/l | – |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL-0.001mg/l) | 0.001 mg/l | – |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL-0.01mg/l) | 15 mg/l | 15 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.18 mg/l | 0.3 mg/l | 0.5 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL-0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37 – 1988RA2014 | BDL(MDL-0.01mg/l) | 0.05 mg/l | 0.2 mg/l |
| Location | Inference | | | |
| 1 | The analysis reveals that all the parameters are within the acceptable limit except that it is slightly acidic, and the dissolved oxygen content is less than permissible limit of class A, just crossing the permissible limits of class C | | | |


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| Parameters | Test method | Result | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| | likewise, BoD is greater than the allowable limit, indicating the presence of organic matter. | | | |

**Note:** The sampling location and its respective distance from the dumpsite have been incorporated into Table 10. The stream is not use for any public use.


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**Ground Water Analysis:**

*Table 22 Groundwater Analysis*

| Parameter | Test Method | Location -1 | Location -2 | Location -3 | Acceptable Limit As per IS-10500-2012 |
|---|---|---|---|---|---|
| pH | IS 3025 (P) 11 – 1983RA2017 | 5.41 | 6.3 | 6.5 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 4 Hazen Unit | 4 Hazen Unit | 7 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 0.1 NTU | BDL(MDL-0.1 NTU) | 1.9 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 130 µS/cm | 140 µS/cm | 160 µS/cm | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 82 mg/l | 87 mg/l | 98 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL- 1 mg/l) | BDL(MDL- 1 mg/l) | 4 mg/l | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 10 mg/l | 12 mg/l | 36 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 9.95 mg/l | 7.96 mg/l | 25.87 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 21.68 mg/l | 23.65 mg/l | 29.56 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 2.68 mg/l | BDL(MDL-1 mg/l) | 3.87 mg/l | 200 mg/l |
| COD | IS 3025 (P) 58 – 2006RA2017 | 2 mg/l | 4.2 mg/l | 4 mg/l | — |
| TOC | APHA5310 | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | BDL(MDL-0.1mg/l) | — |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | ---- |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | BDL(MDL-1mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 – 2008RA2014 | 0.2 mg/l | 0.2 mg/l | 0.25 mg/l | 1.0 mg/l |


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| Parameter | Test Method | Location -1 | Location -2 | Location -3 | Acceptable Limit As per IS-10500-2012 |
|---|---|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54-2003RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41-1992RA2014 | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47-1994RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42-1992RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59-2006RA2017 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | BDL(MDL-0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 5.0 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.10 mg/l | 0.12 mg/l | 0.21 mg/l | 1.0 mg/l |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37-1988RA2014 | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | BDL(MDL-0.01mg/l) | 0.01 mg/l |
| Lat/Long: Location - 1 [N- 11°35'19.614", E -75°36'18.171"], Location -2 [N- 11°35'41.460", E -75°36'22.459"], Location -3 [N- 11°35'29.581", E -75°36'24.331"] | | | | | |

| Location | Inference |
|---|---|
| 1 | The analysis reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The PH of the sample is 5.4, which is in the acidic range, making the water not fit for any industrial purpose as it is more corrosive. |
| 2 | The analysis reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The pH of the sample analysis is 6.30 which is in a slightly acidic range, and may have influence in the industrial processes as it is corrosive. |
| 3 | The analysis reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The PH of the sample analysis is 6.5 which is also in a slightly acidic range. |

**Note :** The sampling location and its respective distance from the dumpsite have been incorporated into Table 10.


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**Ambient Air Quality:**

*Table 23 Ambient Air Quality*

| Parameters | Test Method | Location -1 | Location -2 | Limits as per NAAQS |
|---|---|---|---|---|
| Particulate Matter ($PM_{10}$) | IS 5182 Part 23 2006RA2012 | 86.5 µg/m³ | 89.6 µg/m³ | 100 µg/m³ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 34.2 µg/m³ | 39.7 µg/m³ | 60 µg/m³ |
| Sulphur Dioxide ($SO_2$) | IS 5182 Part 2 2001 RA 2017 | 12.3 µg/m³ | 17.6 µg/m³ | 80 µg/m³ |
| Nitrogen Dioxide ($NO_2$) | IS 5182 Part 06 2006 RA2017 | 19.4 µg/m³ | 22.3 µg/m³ | 80 µg/m³ |
| Carbon monoxide (CO) | SOP/PCL/COA/17 | <1 mg/m³ | <1 mg/m³ | 4 mg/m³ |
| Ammonia ($NH_3$) | CPCB | < 1 µg/m³ | < 1 µg/m³ | 400 µg/m³ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m³ | < 0.1 µg/m³ | 1 µg/m³ |
| Arsenic (As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m³ | <0.1 ng/m³ | 6 ng/m³ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m³ | <0.1 ng/m³ | 20 ng/m³ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m³ | < 1 µg/m³ | 100 µg/m³ |
| Benzene ($C_6H_6$) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m³ | < 0.1 µg/m³ | 5 µg/m³ |
| Benzo (a) pyrene (BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m³ | < 0.1 ng/m³ | 1 ng/m³ |
| Lat/Long: Location -1 [N- 11°15'39.102", E -75°36'20.541"], Location -2 [N- 11°15'37.584", E -75°36'20.874"] | | | | |

| Location | Inference |
|---|---|
| 1 | Within permissible limits |
| 2 | Within permissible limits |
| NOTE: The contractor is required to implement all necessary protective measures during the monitoring process to ensure that air quality levels are maintained within permissible limits. | |

**Note :** The sampling location and its respective distance from the dumpsite have been incorporated into Table 18.


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**Ambient Noise Level:**

*Table 24 Ambient Noise level*

| Date | Hourly Interval | Unit | Result | Limits in dB(A) Leq |
|---|---|---|---|---|
| 05.06.2023 | 15.00 Hrs | dB (A) | 50.3 | Commercial Area: Day time -65 dB(A) Leq<br>Night time -55 dB(A) Leq |
| | 16.00 Hrs | dB (A) | 51.7 | |
| | 17.00 Hrs | dB (A) | 50.2 | |
| | 18.00 Hrs | dB (A) | 50.7 | |
| | 19.00 Hrs | dB (A) | 49.2 | |
| | 20.00 Hrs | dB (A) | 49.4 | |
| | 21.00 Hrs | dB (A) | 48.1 | |
| | 22.00 Hrs | dB (A) | 45.9 | |
| | 23.00 Hrs | dB (A) | 45.7 | |
| 06.06.2023 | 00.00 Hrs | dB (A) | 45.2 | |
| | 01.00 Hrs | dB (A) | 46 | |
| | 02.00 Hrs | dB (A) | 48.6 | |
| | 03.00 Hrs | dB (A) | 45.2 | |
| | 04.00 Hrs | dB (A) | 49.6 | |
| | 05.00 Hrs | dB (A) | 49.7 | |
| | 06.00 Hrs | dB (A) | 48.1 | |
| | 07.00 Hrs | dB (A) | 45.9 | |
| | 08.00 Hrs | dB (A) | 50.2 | |
| | 09.00 Hrs | dB (A) | 53.4 | |
| | 10.00 Hrs | dB (A) | 58.5 | |
| | 11.00 Hrs | dB (A) | 52 | |
| | 12.00 Hrs | dB (A) | 55.5 | |
| | 13.00 Hrs | dB (A) | 49.9 | |
| | 14.00 Hrs | dB (A) | 48.7 | |
| Avg. Leq Day - 51.3 dB (A) | | | | |
| Avg. Leq Night 47.4 dB (A) | | | | |

| Location | Inference |
|---|---|
| 1 | The analysis reveals that noise levels are within the acceptable limits |


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**Leachate Analysis:**

*Table 25 Leachate Analysis*

| Parameters | Test Method | L1 | L2 | L3 | Limits as per SWM Rules 2016 |
|---|---|---|---|---|---|
| pH | IS 3025 (P) 11-1983 RA2017 | 5.64 | 5.87 | 5.64 | 5.5 to 9.0 |
| Total Dissolved Solids (Inorganic) | IS 3025 (P) 16-1984 RA2017 | 941 mg/l | 847 mg/l | 812 mg/l | 2100 mg/l |
| Total Suspended Solids | IS 3025 (P) 15-1984 RA2017 | 87 mg/l | 56 mg/l | 48 mg/l | 100 mg/l |
| Chloride as Cl | IS 3025 (P) 32-1988 RA2014 | 274 mg/l | 187 mg/l | 154 mg/l | 1000 mg/l |
| COD | IS 3025 (P) 58-2006 RA2017 | 196 mg/l | 140 mg/l | 160 mg/l | 250 mg/l |
| BOD( 3 days at 27 deg.Cel) | IS 3025 (P) 44-1988 RA2014 | 74.6 mg/l | 62.3 mg/l | 54.3 mg/l | 30 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34-1988 RA2014 | 19.7 mg/l | 16.3 mg/l | 16.3 mg/l | 100 mg/l |
| Ammonical Nitrogen as N | IS 3025 (P) 34-1988 RA2014 | 9.8 mg/l | 7.4 mg/l | 8.9 mg/l | 50 mg/l |
| Phenolic Compound as C6H5OH | IS 3025 (P) 43-1992RA2014 | 0.12 mg/l | 0.10 mg/l | 0.15 mg/l | 1 mg/l |
| Fluoride asF | IS 3025 (P) 60-2008RA2014 | 0.5 mg/l | 0.4 mg/l | 0.8 mg/l | 2 mg/l |
| Cyanide as CN | IS 3025 (P) 27-1986 RA2014 | BDL(MDL-0.01 mg/l) | BDL(MDL-0.01 mg/l) | BDL(MDL-0.01 mg/l) | 0.2 mg/l |
| Nickel as Ni | IS 3025 (P) 54-2003 RA2014 | BDL(MDL-0.01 mg/l) | BDL(MDL-0.01 mg/l) | BDL(MDL-0.01 mg/l) | 3 mg/l |
| Cadmium as Cd | IS 3025 (P) 41-1992 RA2014 | BDL(MDL-0.001 mg/l) | BDL(MDL-0.001 mg/l) | BDL(MDL-0.001 mg/l) | 2 mg/l |
| Lead as Pb | IS 3025 (P) 47-1994 RA2014 | BDL(MDL-0.01 mg/l) | BDL(MDL-0.01 mg/l) | BDL(MDL-0.01 mg/l) | 0.1 mg/l |


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| Parameters | Test Method | L1 | L2 | L3 | Limits as per SWM Rules 2016 |
|---|---|---|---|---|---|
| Copper as Cu | IS 3025 (P) 42-1992 RA2014 | 0.15 mg/l | BDL(MDL-0.01 mg/l) | BDL(MDL-0.01 mg/l) | 3 mg/l |
| Mercury as Hg | IS 3025 (P) 48-1994 RA2014 | BDL(MDL-0.001 mg/l) | BDL(MDL-0.001 mg/l) | BDL(MDL-0.001 mg/l) | 0.01 mg/l |
| Zinc as ZN | IS 3025 (P) 49-1994 RA2014 | 1.3 mg/l | 1.4 mg/l | BDL(MDL-0.01 mg/l) | 5 mg/l |
| Total Arsenic as As | IS 3025 (P) 37-1988 RA2014 | BDL(MDL-0.01 mg/l) | BDL(MDL-0.01 mg/l) | BDL(MDL-0.01 mg/l) | 0.2 mg/l |
| Lat/Long:<br>L-1: N-11 °35'29.581", E-75°36'24.331"<br>L-2: N-11 °35'39.260" E-75°36'23.380"<br>L-3 N-11 °35'34.263" E-75°36'21.410" | | | | | |

| Location | Inference |
|---|---|
| 1 | The analysis reveals that all the parameters fall within the acceptable limit except BoD, which is slightly higher than the allowable limit, indicating that the leachate is containing organic matter. |
| 2 | Similar to the first location with a slightly higher content of BOD |
| 3 | Similar to the first location with a slightly higher content of BOD |

### 6.5 RISK ASSESSMENT

**Surface Water:** Dumpsites can release pollutants into nearby surface water bodies through leachate, which is generated when rainwater or other liquids come into contact with the waste. Leachate can contain various contaminants such as heavy metals, organic compounds, and pathogens. Proper containment and management of leachate are essential to prevent water pollution.

The analysis of surface water reveals that all the parameters are within the acceptable limit, except it is slightly acidic and the dissolved oxygen content is less than prescribed limit, so also the BoD is greater than the allowable limit. Indicating that the water is contains organic load.


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*Table 26 Risk Assessment- surface water*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite – BoD higher than the acceptable limits |
| **Pathway** | Water / Run off |
| **Receptor** | Humans, Animals, Aquatic life and flora & fauna |
| **Risk** | High BoD indicates the water is highly polluted and it is harmful to ecosystems as fish and other aquatic life may suffocate in oxygen-depleted waters. Also, it will contain more pathogens and make the water unfit for human and animals. |

**Groundwater:** Pollutants from dumpsites can infiltrate into the underlying groundwater, if waste disposal practices have caused contamination of the soil. Once pollutants enter the groundwater, they can spread over a wide area, affecting drinking water sources and ecosystems. Remediation techniques often focus on preventing or minimizing further groundwater contamination.

The analysis of ground water samples at three different locations reveals that except pH, all other parameters are within the limit as per IS 10500:2012. The pH of the sample analysis is 5.40 @ G-1, 6.30 @ G-2 and 6.50 @ G-3 location which is in acidic range and harmful to health also make the water not fit for any industrial purpose as it is more corrosive.

*Table 27 Risk Assessment - Ground water*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Leachate from Dumpsite – pH is acidic in nature |
| **Pathway** | Water, Soil |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | **Possible risks to Human health**<br>• diarrhoea<br>• Nausea and Vomiting<br>• Abdominal Pain<br>• Weakness<br>• Shortness of Breath<br>**Possible risks to Animals**<br>Animals when intake waters with pH acidic in nature it affect the health of the animals.<br>**Possible risks to flora**<br>It can decrease the availability of plant nutrients, such as phosphorus and molybdenum, and increases the availability of some elements to toxic levels, particularly aluminium and manganese. |


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**Air:** Dumpsites may emit pollutants into the air through processes such as open burning of waste or the release of gases from decomposing organic materials. Airborne pollutants can include particulate matter, volatile organic compounds (VOCs), dioxins, and other hazardous substances. These pollutants can have adverse effects on air quality and human health. Measures to control and mitigate air pollution during dumpsite remediation include covering waste, implementing proper waste management practices viz., dust containment screens etc.

*Table 28 Risk Assessment - air*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Within the limits |
| **Pathway** | Air |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | No anticipated Risks |

**Soil:** Dumpsites can contaminate the surrounding soil with a wide range of pollutants. Hazardous chemicals, heavy metals, and organic compounds can leach from the waste and accumulate in the soil, potentially posing risks to plants, animals, and humans.

*Table 29 Risk Assessment - soil*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Heavy metals etc. |
| **Pathway** | Soil |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | **Possible risks to Human health**<br>Soils if contain substances such as heavy metals, which may be toxic to humans, can pass those substances on to humans through crop uptake, leading to unsafe foods.<br>**Possible risks to Animals**<br>When farm animals consume the plants grown from contaminated soil it affects the health of animals in later stage.<br>**Possible risks to flora**<br>Soil pollution may alter plant metabolism and reduce crop yields and cause trees and plants that may absorb soil contaminants to pass them up the food chain. |

**Bioaccumulation in Biota:** Pollutants from dumpsites can enter the food chain and bioaccumulate in plants and animals. Contaminated soil or water can be taken up by plants, and these plants may then be consumed by animals. As pollutants move up the food chain, their concentrations can increase, leading to potential health risks for humans and wildlife. Remediation efforts include restoring the ecological balance and minimizing the exposure of organisms to contaminated environments.


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*Table 30 Risk Assessment - Bioaccumulation in Biota*

| Risk Assessment | |
|---|---|
| **Source** | Legacy Waste Dumpsite |
| **Pollutant** | Leachate and gas emission from Dumpsite |
| **Pathway** | Air, water and soil |
| **Receptor** | Humans, Animals and flora & fauna |
| **Risk** | **Possible risks to Human health, Animals and flora & fauna**<br>Accumulation of contaminants in plants and animals indirectly through food chain affects human health. |


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# 7 EVALUATION OF REMEDIATION TECHNIQUES

Although the term "legacy waste" has not been defined in any official government document in India, it typically refers to aged municipal solid waste in landfills or dumpsites. There is no information on how old waste must be in order to qualify to be called legacy waste. These legacy dumpsites are creating various irreversible environmental/health/livelihood hazards. The major sources of pollution are:

- ✓ Puddles of leachate flowing through the adjacent area and reaching the water table long-term issues of greenhouse gas emissions
- ✓ Surface water and groundwater pollution due to erosion and seepage
- ✓ Dumpsite fires
- ✓ Due to the faster urban development and increased waste generation per capita and mismanagement of generated waste.

The dumpsites have emerged as pollution hubs, especially those situated in human settlements, as cities have grown over the decades. It has, therefore, become a necessity for the city authorities to remediate the existing dumpsites in an environmentally sound and economically viable manner.

**Remediation of legacy waste dumpsite**

Remediation is a scientific process in which contaminants are removed or neutralized scientifically so that pollution to the environment can be controlled or reduced and eventually reclaiming the land for public use. The remediation of dumpsites leads to the following advantages:

1. Uplift of the environment- reduction in greenhouse gas emissions, soil pollution, ground water contamination, significant reduction in air pollution of the entire area and elimination of dump fires and leachate generation.
2. Enhancement of social aspects - Elimination of foul odour to benefit the citizen living nearby, decline in vector borne diseases arising out of the dumpsite and increase in nearby real state value and rental values.
3. Land - Dumpsite land becomes available for public use or for setting up SWM facility on the reclaimed land.
4. Utilization of bio products/aggregates - the aggregates generated from the process like refuse-derived fuel can be reused, recycled, or repurposed, thus exerting less pressure on the economy to use virgin natural resources like fossil fuels.

For assessment of site-specific remediation type/methodology of legacy waste dumpsite, the following activities shall be carried out:

- ✓ A total station survey for assessment of volumetric quantity of legacy waste above the ground level.
- ✓ Detailed investigations 1. Geotechnical Investigation and 2. Waste Analysis - Chemical, Environmental baseline Analysis.
- ✓ History of the site, Physical features of site, as –is/current situation and compositional analysis of waste.
- ✓ Baseline study of heavy metals in surface;


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- ✓ water, rainfall, soil type, surface hydrology, topography, wind direction etc. shall be studied before and after bioremediation.
- ✓ Periodic study should also be carried out after completion of bioremediation to check for any adverse effects in the surrounding area.

The details of the remediation techniques for the remediation of the legacy waste dumpsite remediation are as follows

## 7.1 BIO-MINING – RECLAMATION/RECOVERY OF LAND

Bio- mining is the scientific technique to extract materials of economic interest from legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) and followed by sustainable management through recycling, co-processing, road construction etc.

*Table 31 Phases of Bio-mining*

| Phases of Bio-mining | |
|---|---|
| Phase 1 Stabilization | The legacy waste is formed into equal-sized windrows, and which are turned frequently, bio-culture is added and de-odourizer (an odour-controlling agent) sprayed. This phase removes stench, reduces moisture and eliminates pathogens. |
| Phase 2: Sorting & Segregation | In this phase, stabilized legacy waste is sorted/segregated into bio earth, recyclables, refused derived fuel (RDF) and C&D through series of various sizes of Trommels/circular rotatory sieves and manpower. |
| Phase 3 Disposal & Utilization | In this phase, the non-combustible fractions such as soil and stones are disposed of for further processing into finer aggregates or for earth filling. The combustible fractions are called refuse-derived fuel (RDF) are sent for co-processing in cement industries. |

| | |
|---|---|
| Salient Aspects | Land recovery, increase in value of land and available for public use/habitation with immediate effect.<br>Ensures long-term sustainability and environmentally sound treatment of legacy waste and present lucrative revenue-generating opportunities.<br>Bio products/aggregates generated from the process can be used as alternative construction material, fuel and recyclables.<br>Compliance to SWM Rules and NGT orders.<br>Improvement in aesthetics and quality of life & health. |
| Applicability | The ownership is well defined.<br>Working space is available in the dumpsite.<br>Linkage for utilization by-products is available |

## 7.2 CAPPING WITHOUT LAND RECOVERY


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Capping is a scientific process of profiling legacy waste and covering with barrier layers consisting of soil, high density polyethylene (HDPE) liner, gas collection system surface drainage system, and a vegetative cover to minimize the percolation of rainwater into the legacy waste.

| | |
|---|---|
| Salient Aspects | The capped area becomes a green space and can be developed into parks/recreational areas.<br>Capped area will be equipped with environmental monitoring systems for post-closure maintenance to monitor pollution levels in groundwater and surface-water sources and air (especially methane emissions) at least 15 years.<br>Capped area needs to be inspected periodically for settlement due to physical, chemical and biological transformation, leachate generation, erosion and naturally occurring invasion by deep-rooted vegetation. Recurring expenditure will be incurred for regular maintenance.<br>On July 17, 2019, the National Green Tribunal passed an order directing that capping of legacy waste would lead to huge environmental and health consequences. The tribunal suggested bio-mining as environmentally safe and the most preferable approaches to dumpsite remediation.<br>SWM rules do not permit habitation over it for at least 15 years because of the danger posed by toxic gases release by the waste. |
| Applicability | Capping could be a solution for legacy waste where bio-mining is not possible because of steep terrain, inaccessible ravines and narrow valleys.<br>Lack of linkage for utilization/ disposal of segregated components<br>Lack of working space & resources |

## 7.3 CAPPING WITH PARTIAL LAND RECOVERY

Capping with partial land recovery is process of combination of capping and bio-mining, legacy waste through bio-remediation i.e. exposure of all the legacy waste (formation of windrows) to air along with use of composting bio-cultures, to stabilize of the waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.). The useful fractions derived from this process can linked to relevant buyers and the inert material will be capped to prevent further degradation of the environment.

| | |
|---|---|
| Salient Aspects | The capped area becomes a green space and can be developed into parks/recreational areas and partial land recovered can be available for public use/habitation with immediate effect.<br>Ensures short -term sustainability and environmentally sound treatment of legacy waste.<br>Salient Aspects are of Capping and Bio-mining are applicable for the respective capped area and recovered area |
| Applicability | Legacy waste dumpsite area partial of steep terrain, inaccessible ravines and narrow valleys.<br>Lack of linkage for disposal of inert<br>Recovery land for public use is not a priority |

## 7.4 SELECTION OF REMEDIATION OPTION


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Selection of the applicable method/type or technique is based on the factors like., salient aspects & applicability of remediation types viz., Capping without land recovery, Bio-mining – reclamation/recovery of land & capping with partial land recovery and also available resources viz., manpower, machineries, money and physical site conditions including quantity & characteristics of legacy waste, baseline environment, social issues & demands, compliances to regulatory (KSPCB/NGT) requirements, need for land recovery and forward linkages/utilization of processed aggregates/by-products.

Based on the detailed assessment of the selection parameters, Bio-mining – reclamation/recovery of land is the method/type or technique, which shall ensure long-term sustainability and environmentally sound treatment of legacy waste and land recovery/remediation legacy waste dumpsite. It may be noted that the bio-earth and C&D material which will be recovered by remediation is proposed to be used for development of the reclaimed legacy waste dumpsite as recreational park/facility (for site development work/ profiling). The bio-earth and C&D material recovered will be subjected to bi-weekly sampling and conform to the parameters mentioned in Schedule II of SWM Rules 2016 before using the material. Considering the same, there won't be any leachate generation using this material. There won't be any capping done and hence the question of erosion etc. doesn't arise.

**Salient parameters for opting the Bio-mining – reclamation/recovery of land.**

1. Based on the assessment from the chemical analysis report from the M/s. Polluchem, all the heavy metals are within the permissible limits as prescribed by the regulatory authorities Soil is free of contamination viz., heavy metals, chemical and other toxic substances.
2. Land recovery, increase in value of land and available for public use/setting of SWM facility with immediate effect. An area of 1.25 acres will be reclaimed through bio-mining
3. Adequate downstream linkages for the management/disposal waste viz., Bio-earth and C&D waste will be utilized for development of the reclaimed legacy dumpsite as recreational park/facility, recyclables will be sold to the authorized recyclers & will be collected from the project site and RDF will be sent to Cement industries for co-processing viz., as supplement to the conventional fuel.
4. By products/aggregates generated from the process can be used as alternative construction material (after processing), fuel and recyclables.
5. The Solid Waste Management Rules, 2016 and several National Green Tribunal (NGT) directives have mandated that urban local bodies opt for bio-mining over capping.

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# 8 TECHNICAL DESCRIPTION OF THE SELECTED OPTION

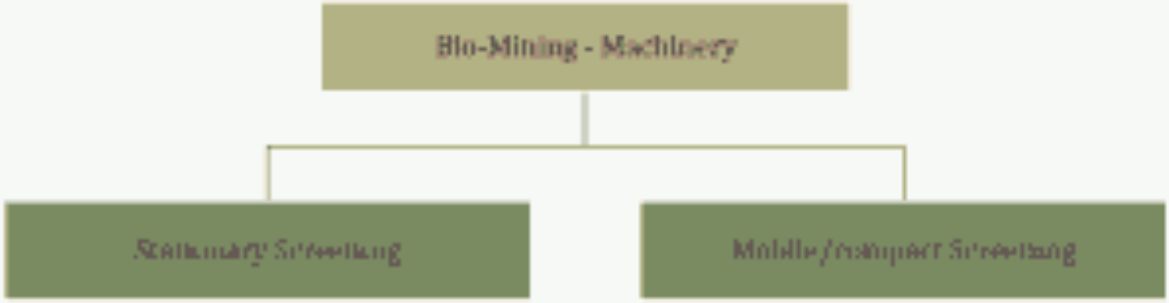
## 8.1 METHODOLOGY

The legacy waste dumpsite reclamation through bio-mining with recovery of land involves Phase 1: stabilization, Phase 2: sorting & segregation and Phase 3: disposal & utilization

The type of machinery, capacity and type of screens to stabilize of the legacy waste followed by screening/sorting of the stabilized waste to recover all valuable resources viz., bio-earth/organic fines, bricks, stones, plastics, rubber, glass, metals, clothes, rags etc.) will depend on the physical site conditions including quantity & characteristics of legacy waste and utilization of the aggregates/by-products/recovered material.

The type machinery available for the bio mining are as follows:

1. Stationary screening machinery and
2. Mobile/compact machinery.




### 8.1.1 STATIONARY SCREENING MACHINERY

A Stationary trommel is a specialized piece of equipment used in legacy waste bioremediation processes to separate and classify solid waste materials. It is designed to efficiently screen and sort different components of the waste based on size and other characteristics. Technical description of a Stationary Trommel used in legacy waste bioremediation are as follows:

- ✓ Structure: The Stationary trommel consists of a frame made of steel or other durable materials. It is designed to withstand the harsh conditions of waste treatment facilities. The frame supports a cylindrical drum that is inclined at an angle for optimal material flow.
- ✓ Drum: The drum is the main component of the Stationary Trommel and is typically made of perforated metal or mesh. It is cylindrical in shape and rotates on its axis using a motorized drive system. The drum's 3- 5 mtr diameter and 10 mtr length can vary depending on the specific requirements of the waste treatment process.
- ✓ Motor and Drive System: The Stationary Trommel is equipped with a motor and drive system that powers the rotation of the drum. The motor is typically electrically powered and is connected to the drum through a gearbox or direct drive mechanism. The rotational speed of the drum can be adjusted to optimize the screening process.
- ✓ Inlet and Outlet: The Stationary Trommel has an inlet where the legacy waste is fed into the drum for processing. The waste material enters the drum at one end, typically assisted by a conveyor or loader. The screened waste material is discharged from the opposite end of the drum through an outlet.


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- ✓ Screening Mechanism: As the drum rotates, the legacy waste inside it is subjected to a combination of tumbling and rolling actions. The perforated drum allows smaller-sized particles and materials to pass through, while larger items such as bulky waste, debris, and contaminants are retained inside the drum. The drum's perforation size can be customized to achieve the desired separation efficiency.
- ✓ Waste Sorting: The Stationary Trommel facilitates the separation of different components within the legacy waste. It effectively segregates organic waste, inert materials, recyclables, and other categories based on their size and physical properties. This sorting process prepares the waste for further treatment or disposal.

Source: DCC Infra., Gurugram Site



*Figure 11 Stationary Trommel Machine*

Salient Features of Stationary Screening Machinery:

- Land requirement high for setting of machinery and processing area.
- Erection, Installation and Commissioning is time consuming
- Cost Intensive – CAPEX & OPEX high
- Electrical Power Intensive and Consumption is high
- Breakdown of the Machinery is high, onsite technicians should be available.
- Manpower – skilled & unskilled Intensive
- Suitable for quantity more than 2,00,000 ton of legacy waste.
- Less suitability for reuse of the machinery/screenings for more than one site/location.

### 8.1.2 MOBILE/COMPACT SCREENING MACHINERY

The Mobile Trommel is a technical apparatus utilized in legacy waste bioremediation processes. Its primary function is to separate and sort various types of waste materials, such as solid waste and organic matter, for effective bioremediation.

**Structure:** The trommel consists of a cylindrical drum, typically made of heavy-duty metal, which is inclined at a slight angle. The drum is supported by a framework and set in motion by a motor

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or engine, causing it to rotate slowly. The rotation of the drum allows the waste materials to be fed into the trommel at one end, while simultaneously moving the materials along its length. Large screening area (9.5 sq m). Helps in good quality segregation & high productivity.

**Screening Mechanism:** The Mobile Trommel incorporates various mechanical features to facilitate waste separation. As the waste enters the drum, it encounters a series of screens or perforations arranged along the length of the drum. These screens have different mesh sizes, which allow for the separation of different-sized particles. The smaller particles, such as sand or fine soil, pass through the screens and fall through openings at the bottom of the trommel, while larger materials, such as plastics or larger debris, are retained and carried along by the rotation of the drum.

**Separation System:** Additionally, the Mobile Trommel may be equipped with paddles or lifters mounted inside the drum. These paddles help to agitate and tumble the waste materials, assisting in the separation process by ensuring proper contact between the waste and the screens. They also help to break up clumps or aggregates, aiding in the release of trapped organic matter. Four different screen inclination angles for operations between 20°-35° are available for selection provides flexibility.

**Treatment Process:** In the context of legacy waste bioremediation, the Mobile Trommel plays a crucial role in preparing the waste for subsequent treatment steps. By separating the waste into different fractions based on particle size, it allows for targeted bioremediation processes. For example, the fine fraction may be subjected to aerobic or anaerobic composting, while the larger fraction can undergo mechanical or physical treatments.

**Transport:** Quick and easy folding of conveyor helps in quick setup time.

**Discharge height:** Wider conveyor and higher discharge heights help in making bigger stockpile and eliminates the frequent loader usages.



*Source: Kleemann Mobile Screens (Piranna, Ahamadabad Site)*

***Figure 12 Compact Screening Machinery***

**Salient Features of Mobile/Compact Screening Machinery:**

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- Full Mobility: Plants are fully mobile like excavator. Plants can be moved across the most difficult of surfaces and terrain and can accommodate the most inaccessible locations.
- Quick Set up time: Track-Mobile plants can normally be set-up within 1 hour, as it normally does not require additional conveyors, feed hopper to link separate machines, thus increasing machine utilization.
- Versatility: Track-Mobile plants can be operated independently or in combination of two or three stage screening depending upon user requirements.
- No Civil works required: Plants do not require any civil works, can be erected & shifted quickly. Thus offer quicker return on investment.
- Manpower requirement is less.

## 8.2 SELECTION OF MACHINERIES

Selection of machineries for screening of the stabilized legacy waste is based on the parameters viz., salient features of the screening machineries, remediation type (Bio-mining – reclamation/recovery of land) and also compliances to regulatory (KSPCB/NGT) requirements (legacy waste dumpsite remediation by 31st March 2024), physical site conditions including quantity & characteristics of legacy waste and sorting/segregation of stabilized legacy waste into aggregates/by- products as per the requirements of the utilization/forward linkage.

Based on the detailed assessment of the selection parameters listed above, the site conditions, legacy waste characteristics, statutory requirements etc, mobile / compact screening shall be the optimum screening machinery for the Vadakara Dumpsite. The 29140 tons legacy waste can be remediated within the stipulated time by NGT i.e. 31st March 2024

**Salient parameters for opting the Mobile/Compact screeners.**

1. Sorting/segregation of the stabilized legacy waste of 38367 m³/ 29140 Tons within the stipulated timeline of 31st March 2024.
2. The remediation process will be guided by National, State Regulations & EIA/EMP in line with KSWMP ESMF.
3. Salient Features of Mobile/Compact Screening Machinery – details are in the section 8.1.2

## 8.3 SYSTEM REQUIREMENTS

### 8.3.1 CAPACITY SIZING OF MOBILE COMPACT SCREENER

The capacity of the Mobile compact screener is assessed as **100 TPH** considering the physical site conditions including quantity & characteristics of legacy waste and stipulated timeline for 100 % land reclamation by **31st March 2024.** The details of plant capacity sizing are provided in the table below:

*Table 32 Capacity sizing of Mobile Compact Screener*

| Description | Quantity |
|---|---|
| Quantity of waste (Tons) | 29140 |


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| | |
|---|---|
| Mobilization and site preparation (days) | 60 |
| Weekends & Holidays | 20 |
| Rainy Days | 20 |
| Break downs (Days) | 15 |
| No of days (Nov 2023 - Mar 2024) | 150 |
| Effective processing days | 35 |
| Processing per day (Tons) | 756 |
| Capacity of the Plant - Considering working 8 hrs/day | 94 |
| Proposed Capacity of plant TPH | 100 |

### 8.3.2 MACHINERIES & VEHICLES

Detailed assessment of quantity (nos) of machinery, vehicles, auxiliary items required for effective processing of the legacy waste are provided in the Annexure – E. The summary of machineries and vehicles requirements are provided in the table below:

*Table 33 Machineries & Vehicles*

| S. No. | Description | Quantity(Nos) | Remarks |
|---|---|---|---|
| 1 | Mobile Trommel @ 100TPH | 1 | Detailed Specifications are provided at Annexure – E |
| 2 | Baling Machine @ 50TPH | 1 | |
| 3 | Ballistic Separator @ 30TPH | 1 | |
| 4 | Magnetic Separator | 1 | |
| 5 | Front End Loader @ Bucket Capacity 1Cum | 2 | |
| 6 | Chain Mounted Excavator @ Bucket Capacity 1.1 Cum | 2 | |
| 7 | Weighing bridge - 40 Ton | 1 | |
| 8 | Tipper @ 8Cum | 5 | |
| 9 | Tractor - Trolley shift of Materials | 1 | |
| 10 | Tractor -Trolley Water Tanker | 1 | |
| 12 | Mechanical Sprayer | 2 | |
| 13 | Office - Portable cabin (1 Nos) | 1 | |
| 14 | GPS (1 Nos) & Tracking System (1 Nos) | 1 | |
| 15 | CCTV System (Cameras 5 Nos) | 5 | |
| 16 | Fire Safety System - Fire Extinguisher ABC type 4 Kg/cm2 | 10 | |

Note: Considering the size of the site, it is required that the contractor liaisons with the Fire Department and deploys a fire tender at the site during the period of the contract works to manage any fire incident as part of Fire Safety Plan.


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## 8.4 OPERATIONS AND MAINTENANCE

### 8.4.1 MANPOWER:

Detailed assessment manpower required for effective processing of the legacy waste are provided in the Annexure – L The summary of manpower required are provided in the table below:

*Table 34 Manpower details*

| S. No | Manpower | Nos |
|---|---|---|
| 1 | Site In-charge/Head | 1 |
| 2 | Environmental, Social and Health & Safety (ESHS) Officer | 1 |
| 3 | Security (3 X 8 Hrs) | 3 |
| 4 | Operations Supervisor & Accountant | 2 |
| 5 | Machine Operator, Mechanic & Electrician | 2 |
| 6 | Labors for stone removal | 2 |
| 7 | Labors for spraying Bio culture | 2 |
| 8 | Labors near Screening machinery | 4 |
| 9 | Labors at Baling facility | 2 |
| 10 | Drivers for tipper trucks, excavators, backhoe loaders and tractors | 11 |

### 8.4.2 ELECTRICAL POWER:

*Table 35 Electrical Power details*

| Machineries | Required Electrical Load (KW) | Working Hr. | Total Units (KW-Hr) |
|---|---|---|---|
| Baling Machine | 5 | 4 | 20 |
| Ballistic Separator | 15 | 6 | 90 |
| Magnetic Separator | 5 | 6 | 30 |
| Weigh bridge | 5 | 6 | 30 |
| Total | 30 | | 170 |


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### 8.4.3 FUEL/DIESEL FOR VEHICLES:

*Table 36 Fuel/Diesel for Vehicles*

| Description | Liters per Day |
|---|---|
| Fuel - Diesel Mobile Trommel (12 liters/hour) | 96 |

### 8.4.4 WATER REQUIREMENTS:

*Table 37 Water Requirements*

| Description | Liters per Day |
|---|---|
| Water -250 Liters per Ton | 250 |
| (Source – Municipality water Supply) | |


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# 9 SCOPE OF DISPOSAL INCLUDING LOCATION OF DISPOSAL FOR RDF, BIO SOILS, C & D WASTE, AND OTHERS AS PER LOCAL DEMANDS

## 9.1 UTILIZATION OF BY PRODUCTS

The details of the utilization of aggregates/by-products screened out by processing of the stabilized legacy waste are provided in the table below

*Table 38 Utilization RDF, bio soils, C & D waste*

| S.No | Component | Quantity (Cu.m) | Utilization/Linkage/Usage |
|---|---|---|---|
| 1 | Bio earth and C&D Waste | 28200 | The bio earth and C&D and quantity 28200 cu.m waste will be utilized for development of the reclaimed legacy waste dumpsite as recreational park/facility after ensuring that it is free of contamination and meets the required standards. |
| 2 | RDF | 9169.71 | RDF will be sent to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel. Currently the indicative nearest location for the RDF disposal is at Dalmia Cements, Trichy which has the necessary infrastructure for co-processing of RDF. |
| 3 | Recyclables & others | 997.54 | Recyclables will be sold to CKCL/recyclers authorized by KSPCB/CPCB. |
| Note: The contractors engaged in biomining will be responsible for ensuring this disposal of Bio Earth, RDF, recyclables, and others. | | | |


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## 10 ESTIMATED PROJECT COST

The details of the estimated cost for bio-mining - recovery of land by remediating legacy waste dumpsite is provided in the table below:

*Table 39 Estimate for Dumpsite remediaion considering Forward Linkage*

| Estimate for Dumpsite remediaion considering Forward Linkage | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Activity** | **Details** | **Rate/ m3** | **Cost Index @ 1.35 * A** | **COP @ 1.15 * C** | **% weightage consideration** | **Round off (INR)** | **Quantity (m3)** | **Amount (Rs)** |
| | | | **A** | **B** | **D** | | | | |
| 1 | Remediation/ Biomining | Rate adopted from Calculation from Suchitwa Mission (DSR 2018 including baling) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 2 | Transportation of RDF | The average distance to cement factories works out to be 400 km. [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 3 | Disposal of recyclable | Considering that the recyclable will be sold at rate of [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 4 | Disposal of Inert | Considering the disposal cost of [redacted] (market rate) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 5 | Disposal of Compost / Soil enricher | Considering the disposal cost of [redacted] (market rate) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| | | | | | | | [redacted] | | [redacted] |
| | **Environmental & Social Safeguard estimated amount for the implementation and monitoring** | | | | | | | | [redacted] |
| | **Grand Total** | | | | | | | | [redacted] |
| **NOTE** | | | | | | | | | |

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| | |
|---|---|
| 1 | [redacted] |
| 2 | [redacted] |
| 3 | [redacted] |
| 4 | The estimate is based on the information available. The actual cost may vary from site to site based on results of dumpsite investigations report and contractors forward linkages |

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### 10.1 REVENUE FROM THE PROJECT

The anticipated sources of revenue from the processing of the legacy waste dumpsite viz., by sale Bio earth & C&D waste, organic compost, RDF and recyclables. But due to the following reasons mentioned below no revenue from the project is considered

- Bio earth & C&D waste will be utilized within the remediated dumpsite as filler material for development of recreational park.
- RDF is utilized as fuel (co – processing) in the cement industries, presently most cement industries are only accepting the RDF at no cost whereas transportation cost is required to be borne by the contractor sending the RDF to the cement factory/ WtE facility.
- The uncertainty of quantity and quality of the recyclables from legacy dumpsite due to burnt or crushed or disintegrated, rusted and additional money is required for cleaning of the recyclables for saleable.

### 10.2 FUNDING FOR PROJECT

The estimated cost of [redacted] - for the project Dumpsite Remediation which equals to [redacted] **per m³**. The sources and funding pattern is given below.

*Table 40 Funding for the project*

| Item | External (70%) | State Govt.(30%) | Total cost |
|---|---|---|---|
| | Rs. | Rs. | Rs. |
| Bioremediation | [redacted] | [redacted] | [redacted] |


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# 11 PROJECT IMPLEMENTATION PLAN

## 11.1 PROPOSED OPERATIONAL PLAN

The bioremediation of Vadakara dumpsite will be done with the land recovery and will be executed through an outsourcing model. The proposed operational plan is provided at the Annexure - I

## 11.2 TIMELINE

In compliance with the National Green Tribunal (NGT) orders, it is mandatory to remediate all dumpsites in Kerala by March 2024. To ensure timely completion and compliance with the deadline, timeline for the implementation of project is provided below.

| S No | Description | Time frame |
|---|---|---|
| 1 | Start date | 01/12/2023 |
| 2 | End date | 31/03/2024 |



## 11.3 CONTRACT MODEL

**Execution Method:**

- Item Rate Contract and disposal/Management of by-products/aggregates with land recovery and redevelopment of the site with inert/ soil earthfill. The work shall be carried out in compliance with SWM Rules 2016 and CPCB Guidelines for the disposal of legacy waste 2019.

**Working Model:**

- 100% work to outsourced to selected private contractor
- TSC will assess the quantity of waste and the ULB will hand over the land for setting up the plant to the Contractor.
- Cost of Electricity connection to be provided by ULB for the plant.
- Electricity charges for the usage of the plant to be paid by contractor
- Contractor is responsible for disposal of RDF, recyclables, and aggregates


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## 12 BENEFITS OF THE PROJECT

Remediation of legacy waste dumpsite in the Vadakara leads to the following anticipated benefits:

- **Reclamation of Land**: An area of 1.25 acres will be reclaimed and will be developed into a recreational park for public use. A contamination assessment is to be carried out before any public use project is taken up at the location.
- **Environmental Protection**: The primary benefit of dumpsite remediation is the protection and restoration of the environment. By cleaning up contaminated sites, the project helps prevent the release of pollutants into the soil, groundwater, and air, thereby safeguarding ecosystems and biodiversity. The project shall arrest GHG emissions from the legacy dumpsite.
- **Health Improvement**: Remediation projects reduce these risks, leading to improved public health outcomes and a reduction in waterborne and airborne diseases.
- **Enhanced Water Quality**: Remediation activities prevent further contamination of surface and ground water resources and contribute to the restoration of water quality, benefiting both aquatic ecosystems and local communities' access to the safe drinking water.
- **Aesthetic and Social Benefits**: Remediation of legacy waste dumpsite can significantly improve the aesthetics of the surrounding areas. Reclaimed sites are more visually appealing, enhancing the overall quality of life for nearby residents. Uncontrolled waste dumping will be stopped.
- **Operational & Life cycle Aspects**

  Further dumping of untreated waste will be stopped completely. The project will extract utilizable components from the legacy waste through bio-mining process.
- **Employment**

  During remediation & post- remediation period, requirement of un-skilled labor will be fulfilled by s local sourcing.

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# 13 CONCLUSION

- The activities of the bio-mining will be commenced from Dec 2023 to Mar 2024. An area of 1.25 acres will be reclaimed and will be developed into a recreational park for public use after contamination assessment.
- Through the process of bio mining the dumpsite, complete land reclamation and recovery, while prioritizing environmental safeguards. This means that the land will be reclaimed and put to use.
- Considering site conditions and quantum, screening of the 38367 $m^3$ of legacy waste, mobile / compact screening machinery will be preferred.
- Favorable site conditions for bio-mining:
    1. Optimum width of the road is available for movement of the vehicles.
    2. Electrical power infrastructure viz., power lines & electrical transformer is available adjacent to the boundary of the dumpsite.
    3. Piped water supply and a storage of water tank 5000 liters are available at the dumpsite.
    4. At the dumpsite plot, a vacant land parcel of approx. 0.20 acres is available for the installation of auxiliary infrastructures, supporting conditions movement of processing machinery and vehicles.
- The project activity requires to obtained "Site Authorization, Consent to Establish and Consent to Operate" from KSPCB
- By-products utilization/forward linkages/Usage
    1. The bio earth & C&D quantity of 19375.34 $m^3$ & 8824.41 $m^3$ respectively is proposed to be utilized after testing for the contamination for development of the reclaimed land as recreational park/facility. The contractor shall level/profile the site in consultation with the PIU/TSC/DPMU.
    2. Refused derived fuel (RDF) of 9169.71 $m^3$ will be to cement factories for co-processing i.e., for utilizing as alternative fuel, supplementing the conventional fuel in the processes. The indicative location of cement plant is Dalmia Cements, Trichy.
    3. Recyclables of 997.54 $m^3$ will be sold to CKCL /Private recyclers authorized by KSPCB/CPCB
- The implementation/execution of the project activities shall be conforming to SWM Rules 2016, NGT orders, KSPCB norms, CPCB guidelines and KSWMP ESMF and other regulatory rules & norms.
- Environmental & Social safeguards:
    1. The project attracts E2 Environmental category based on the Environmental Screening and Exclusions mentioned in the Environmental and Social Framework Guidelines.
    2. Site specific Environmental Assessment and Environmental Management Plan has been developed.
    3. The project attracts moderate risk social category based on the social mapping & transect walk to understand the settlements/habitations/establishments etc., and consultation with the people living around the proposed project site to assess the problems faced by the legacy waste dumpsite and impact during the execution of the project.
- Total cost of the project is [redacted] /- (INR [redacted]). The cost per $m^3$ for processing and disposal of the legacy waste is [redacted] /- per $m^3$.

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ANNEXURES

*Table 41 List of Annexures*

| Annexures | Description |
|---|---|
| Annexure A | GEOTECHNICAL TEST REPORT |
| Annexure B | ENVIRONMENTAL TEST REPORT |
| Annexure C | PHOTOGRAPHS -SAMPLING |
| Annexure D | VOLUMETRIC ANALYSIS |
| Annexure E | SITE PLAN |
| Annexure F | SURVEY CONTOUR PLAN |
| Annexure G | REQUIREMENT OF VEHICLE & MACHINERY |
| Annexure H | SPECIFICATION OF MACHINERIES & VEHICLES |
| Annexure I | PROPOSED OPERATIONAL PLAN |
| Annexure J | LSGD GUIDELINES FOR REMEDIATION OF LEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION |


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## Annexure-A

# GEOTECHNICAL TEST REPORT

MatterLab
Where Quality Matters

Report Number: **ML/GT/2233/221/23**

# GEOTECHNICAL EXAMINATION OF DUMPSITE UNDER PACKAGE D OF KSWMP AT PUTHIYAPPU, VADAKARA, KOZHIKODE DISTRICT

| | | |
|---|---|---|
| Client (For MatterLab) | : | Project Manager, IPE Global Ltd. |
| Address | : | 2nd Floor, 16/3878-3879, Kavanatt Building, Kanayanoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact Person | : | - |
| Project No | : | GT-216 |
| Project Name | : | Geotechnical examination of dumpsite under package D of KSWMP at Puthiyappu, Vadakara, Kozhikode District. |
| Owner | : | KSWMP |
| Project Location | : | Puthiyappu, Vadakara |
| Tel / Fax No | : | - |



## REVISION DETAILS

| Revision | Date | Details | Prepared by | Sign |
|---|---|---|---|---|
| 0 | 19-06-2023 | 1st Submission | Dr. Gautham Adapa | |
| | | | | |
| | | | | |

| | Name | Designation | Sign & Stamp |
|---|---|---|---|
| Checked by: | Anjima C S | Geotechnical Engineer, MatterLab | |
| Approved by: | Freddy Soman | General Manager, MatterLab | |

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2 SCOPE OF WORK ..... 4

3 GEOTECHNICAL INVESTIGATIONS ..... 4

4 DUMP WASTE SAMPLING FROM SITE ..... 4

5 LABORATORY ANALYSIS ..... 7

6 SUMMARY ..... 8

## LIST OF ANNEXURES

Appendix I : Borelogs

Appendix II : Laboratory Test Results

# 1 INTRODUCTION

IPE Global Ltd. Which provides technical support consultancy services to the Urban local bodies in different municipalities for the Kerala State Waste Management Project (KSWMP) has entrusted the geotechnical investigative works as part of their DPR study for the remediation of dumpsite in Puthiyappu, Vadakara, Kozhikode district to M/s Matter Material Testing & Research Laboratory (P) Ltd. A single borehole was bored using a rotary drill. The initial site visit was done on 16th May 2023. During the site visit it was observed that the dumpsite is situated on the top a lateritic hill. The ground observed at the site was hard laterite and upon enquiry it was learned that two open wells which were located on a specific side of the hill were to closed because of leachate getting seeped in to the wells. The field geotechnical investigation to collect the soil samples of the ground after drilling through the legacy waste was started on 17th May 2023 and was completed on 23rd May 2023. Standard Penetration test (SPT) was conducted within the borehole as required. Soil samples and rock samples were collected and relevant laboratory tests were carried out on it. This report presents results of the geotechnical investigation of the ground encountered after drilling through the waste at the dumpsite.




**Figure 1** : Location of the borehole drilled at the dumpsite

## 2 SCOPE OF WORK

The scope of this work comprises of:

- Preliminary site visit by the geotechnical team to access the site conditions and selecting an appropriate point for geotechnical investigation.
- Drilling of a single borehole at the proposed borehole location as per the direction of the Client.
- Collection of soil and rock samples and performing necessary laboratory tests on the collected samples to obtain the desired parameters of the ground profile.
- Preparation of report with laboratory test results.

## 3 OBSERVATIONS FROM SITE

Matterlab has deputed a team from our geotechnical department during the third week of May 2023, in order to collect the information regarding the site prior to mobilising the equipment for drilling, along with an environmental engineer (Mr. Gopi) related to IPE Global.

The location of the dumpsite is situated on an elevated hill formation. The geological formation around the site as per our observations was hard laterite. It was also noted that the surrounding area of the dumpsite is habituated and open wells are situated all around the dumpsite. Upon enquiring the locals, it was revealed that 2 open wells in a specific direction to the dumpsite were effected and had to be closed due to the seepage of leachate.

## 4 GEOTECHNICAL INVESTIGATIONS

### 4.1 Rotary drilling

Rotary drilling technique was adopted for advancing and clearing out through legacy waste and soil between sample intervals. Standard penetration test (SPT) is conducted at every 1.50m interval after drilling was done through waste in the landfill.

### 4.2 Drilling equipment

Mechanical rigs of rotary drilling machine were used for the purpose. The rigs are well suited for the required work. The rigs are new and well-maintained.

Soil Boring: The boring was advanced by rotating drill string connected by series of drill rods. The boring diameter of 150mm was formed using a drag bit (Soil Cutter) in soil. The drag bit cuts the subsoil at the bottom of the borehole and the soil fragments were removed by drilling

mud (bentonite) which is under circulation. Bentonite slurry is used for stabilizing the borehole.

Bentonite slurry deposits as a thin film on the wall of the borehole during circulation and stability of borehole is derived from its thixotropic property and the hydro static head of the suspension. Bentonite having liquid limit greater than 400% is used for preparing bentonite slurry.

### 4.3 Observation during drilling

**Sampling**

The samples collected from the SPT sampler are treated as disturbed samples. Immediately after collection of sample from the sampler, the sample was transferred to a double walled polythene bag. A sample label is attached and the bag is tied tightly with thread to avoid any loss of moisture.

**Standard Penetration Test (SPT)**

These tests were conducted in the boreholes at regular intervals or the change of strata; it was carried out by standard sampler (a split-spoon sampler) of standard design and dimension (50 mm OD and 35 mm ID, with minimum length of 450 mm). The sampler was driven by a 63.5 kg drive weight (monkey) as per guidelines laid in IS: 2131. As per the IS code of practice for this test, the monkey was allowed to fall on the top of the drill rod from a height of 750 mm several times until the sample penetrates about 150 mm into the soil as a seating drive. The number of blows required to drive the spoon from 150 mm to 450 mm i.e., beyond the seating drive, were recorded and this number of blows is called 'N' value or Standard Penetration Test (SPT) value of the sub-soil at that particular depth. Where the test has been carried out on completion of a test, the split spoon sampler was brought out of the borehole and opened the same. The collected soil sample from the split spoon sampler was preserved in air tight polythene packets for classification purpose. The samples were labeled properly with the project name, borehole and the depth of sampling.

**Extraction of Cores:**

The core samples were extracted from the core barrels in a manner to prevent disturbances to the core. All the pieces of cores were sequentially numbered from top to bottom. Arrows indicating the lower end of the piece are marked on each core. Rock classification in terms of

weathering and state of fractures and strength is carried out in the following manner. Tabulations given in below explain it briefly.

**Table 1: Rock Classification**

| Terms | Description | Grade |
|---|---|---|
| Fresh | No visible sign of rock material weathering; perhaps slight discoloration on Minor discontinuity surfaces. | I |
| Slightly Weathered | Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discoloured by weathering. | II |
| Moderately Weathered | Less than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as core stones. | III |
| Highly Weathered | More than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as core stones | IV |
| Disintegrated Rock | All rock material is decomposed and / or disintegrated to soil. The original mass structure is still largely intact. | V |
| Residual Soil | All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported. | VI |

-As per IS 4464-1985 (Reaffirmed 2004)

It should be understood that all grades of weathering may not be seen in a given rock mass and that in some cases a particular grade may be present to a very small extent. Distribution of the various weathering grades of rock material in the rock mass may be related to the porosity of the rock material and the presence of open discontinuities of all types in the rock mass.

**Preparation of Bore Logs:**

On completion of each borehole, the soil samples were examined and logged. The final log is prepared on the basis of visual examination of soil samples and laboratory testing data. The following are observed and recorded in the bore log:

The commencement and completion date, location of borehole, elevation of top and bottom of boring, ground water table, boundaries of each soil layer that encountered, classification and description of the deposit, blow count values obtained from SPT tests, collection of soil samples etc.

The borelog is attached as **Appendix-I.**

## 5 LABORATORY ANALYSIS

The laboratory tests were conducted as per the relevant Standard Codes. A summary of laboratory tests carried out is shown below in **Table 2** and the complete results of laboratory testing are presented in **Appendix II**.



(a) (b) (c) (d)

**Figure 3 :** Laboratory tests performed at MatterLab.

**Table 2: Details of various laboratory tests and relevant codes followed**

| Sl No. | Type of sample | Description | Relevant Codes |
|---|---|---|---|
| 1 | Rock | Point Load Test | ISRM suggested Method |
| 2 | | Water Absorption | IS: 1124 - 1974 |
| 3 | | Apparent Specific gravity | IS: 1124 - 1974 |
| 4 | | Dry density | ISRM suggested Method |
| 5 | | Mohrs' Hardness | Using Mohrs' scale |

## 6 SUMMARY

The geotechnical examination on the soil samples collected after boring through the waste at the dumpsite at Puthiyappu, Vadakara, Kozhikode was carried out by M/s Matter Material Testing & Research Laboratory (P) Ltd. As per the work instructions of the client, a single borehole was bored using a rotary drill. The maximum depth of investigation was 10.5m (6.7m in waste and 3.8m in the original ground).

The ground encountered after drilling through the waste was a Lateritic rock. Cutting had to be done to cut through the rock with a core recovery of 6% and an RQD of NIL. The rock samples collected during the site investigation were transported to the lab. The tests mentioned in the above table were performed on the samples in the laboratory following the respective codes to obtain the necessary parameters. The laboratory results on hard lateritic samples obtained from cutting are appended in **Appendix II**.

# APPENDIX-I

# BORELOGS

Matter Material Testing Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur,
Kozhikode, Kerala

# FIELD BORELOG

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT** | **: Geotechnical Investigation at Dumpsite in Puthiyappu,Vatakara** | **SHEET NO.** | **: 1 of 1`** | **START DATE** | **: 17/05/2023** |
| **CLIENT** | **: Program Manager IPE Global Ltd .** | **BORE DIAMETER (mm)** | **: 150** | **END DATE** | **: 23/05/2023** |
| **Proposed Structure :** | **Dump site** | **BORING TYPE** | **: Rotary** | **REDUCED LEVEL (m)** | **: -** |
| **LOCATION** | **: Puthiyappu,Vatakara** | **TERMINATION DEPTH (m)** | **: 10.5** | **EASTING (m)** | **: 75.60587** |
| **BOREHOLE NO.** | **: BH-01** | **WATER LEVEL** | **:** | **NORTHING (m)** | **: 11.593838** |

| DEPTH m | GRAPHIC LOG | VISUAL DESCRIPTION OF STRATA | THICKNESS OF LAYER m | SAMPLE DEPTH | SAMPLE TYPE | BLOW COUNT/15CM | | | SPT N VAL | DEPTH V/S N VALUE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | N1 | N2 | N3 | | | |
| 6.7 | | Waste deposit | | | | | | | | | |
| 7.0 | | Lateritic gravels (Original soil starting) | 0.3 | 7.0 | SPT-1 | 28 | >50 | > | >5 | | Balance-32cm |
| 8.0 | | Hard Laterite | 1.0 | | RC-1 | | | | | | CR 8% RQD NIL |
| 9.0 | | Hard Laterite | 1.0 | | RC-2 | | | | | | CR 6 % RQD NIL |
| 10.5 | | Hard Laterite | 1.5 | | RC-3 | | | | | | CR 5 % RQD NIL |
| | | **Bore hole terminated at the depth of 3.8m below ground level** | | | | | | | | | |

Abbreviations
DS- Disturbed Sample, UDS- Undisturbed Sample, SPT- Standard Penetration Test
CR- Core Recovery, RQD- Rock Quality Designation

Sd/-
Site Supervisor

# APPENDIX-II

# LABORATORY TEST RESULTS

# SUMMARY OF LABORATORY TEST RESULTS

**Report Number : ML23/R-01958 Report Date:17/06/2023**

**Project : Geotechnical Investigation at Dumpsite in Puthiyappu,Vatakara**

**Borehole ID : BH-01**

| N value | MatterLab ref. | Depth (m) | Type of sample (DS/UDS/RC) | Soil description | IS Classification | Rock cores | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Core recovery (%) | RQD (%) | Point load (MPa) | Water Absorption (%) | Apparent Specific gravity | Dry density (kg/m$^3$) | Mohrs Hardness |
| | ML23/W-01958/S1 | 8m - 9m | RC | Lateritic Rock | | 6 | NIL | 0.5 | 10.4 | 2.42 | 2410 | 3.5 |
| | ML23/W-01958/S2 | 9m - 10m | RC | Lateritic Rock | | 5 | NIL | 0.4 | 9.6 | 2.4 | 2390 | 3.5 |

MatterLab
Where Quality Matters

Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvennur Nada (PO)
Thiruvennur, Kozhikode, Kerala, 673029

# POINT LOAD INDEX OF ROCK TEST REPORT

Report No: ML23/R-01958/1
Issue No : 1
Report Date:17/06/2023

| | |
|---|---|
| Client: | Program Manager IPE Global Ltd |
| Address: | 2nd Floor, 15/3878-3879,Kavarattil Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Puthiyappu, Vatakara |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Puthiyappu, Vatakara |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 05/06/2023 | Client sample Ref.:* | BH 01, Depth: 8m - 9m |
| Work Order ID: | ML23/W-01958 | Source*: | BH 01, Depth: 8m - 9m |
| Sample ID: | ML23/W-01958/B1 | Sampled By*: | Geotechnical Division |
| Sampling Location: | - | Sampling Method: | IS: 2131 - 1981 |
| Sample Cert. No: | - | Date Tested : | 13/06/2023 - 14/06/2023 |
| Tested By: | GK | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Sample Description: | Laterite Core |

**Test Results** — Test Method: ISRM Suggested Method

| Specimen No | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Sampling Date | | 20/03/2023 | | | |
| Moisture Condition @ Test | | As Received | | | |
| Moisture Content | (%) | 1.97 | 2.07 | 3.13 | 2.15 |
| Test type | | Axial | | | |
| Direction of Loading to Plane of Weakness | | Perpendicular | | | |
| Specimen Diameter | (mm) | 54.1 | 53.8 | 54.7 | 53.7 |
| Specimen Thickness | (mm) | 28.1 | 26.4 | 20.2 | 30.3 |
| Failure Load | (kN) | 0.938 | 1.046 | 0.850 | 1.121 |
| Equivalent Core Dia | ($mm^2$) | 2004 | 1909 | 1408 | 2073 |
| Point Load Index, $I_s$ | (MPa) | 0.47 | 0.55 | 0.60 | 0.54 |
| Corrected Point Load Index, $I_{s(50)}$ | (MPa) | 0.45 | 0.54 | 0.59 | 0.52 |
| Mean Point Load Index, $I_{s(50)}$ | (MPa) | 0.5 | | | |

For and on behalf of MatterLab

**Comments**
*Information provided by client
Test conducted on available bore hole sample

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These results relate only to the samples tested.



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MatterLab
Where Quality Matters

Matter Material Testing & Research Laboratory (P) Ltd.
Mini Bypass Road, Thiruvannur Nada (PO)
Thiruvannur, Kozhikode, Kerala, 673029

# POINT LOAD INDEX OF ROCK TEST REPORT

Report No: ML23R-019858
Issue No : 1
Report Date:17/06/2023

| | |
|---|---|
| Client: | Program Manager IPE Global Ltd |
| Address: | 2nd Floor, 1903/3878-3879,Kavanatt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Puthiyappu, Vatakara |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Puthiyappu, Vatakara |
| Tel / Email: | - |

| Sample Details | | | |
|---|---|---|---|
| Received Date: | 09/06/2023 | Client sample Ref.:* | BH 01, Depth 9m - 10.5m |
| Work Order ID: | ML23WW-01958 | Source*: | BH 01, Depth 0m - 10.5m |
| Sample ID: | ML23WW-01958/02 | Sampled By*: | Geotechnical Division |
| Sampling Location: | - | Sampling Method: | IS: 2131 - 1981 |
| Sample Cert. No: | - | Date Tested : | 13/06/2023 - 14/06/2023 |
| Tested By: | GK | Test Method Variation: | None |
| Test Location: | MatterLab, Kozhikode | Sample Description: | Laterite Core |

| Test Results | | Test Method: ISRM Suggested Method | |
|---|---|---|---|
| Specimen No | | 1 | 2 |
| Sampling Date | | 20/05/2023 | |
| Moisture Condition @ Test | | As Received | |
| Moisture Content | (%) | 1.4 | 1.88 |
| Test type | | Axial | Irregular |
| Direction of Loading to Plane of Weakness | | Perpendicular | |
| Specimen Diameter | (mm) | 50.0 | 48.0 |
| Specimen Thickness | (mm) | 30.7 | 33.8 |
| Failure Load | (kN) | 0.78 | 0.79 |
| Equivalent Core Dia | ($mm^2$) | 1976 | 2090 |
| Point Load Index , $I_s$ | (MPa) | 0.39 | 0.38 |
| Corrected Point Load Index, $I_{s(50)}$ | (MPa) | 0.37 | 0.35 |
| Mean Point Load Index, $I_{s(50)}$ | (MPa) | 0.4 | |

SREELESH T.V

For and on behalf of MatterLab

| Comments |
|---|
| *Information provided by client |
| Test conducted on available bore hole sample. |

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Thiruvannur, Kozhikode, Kerala, 673029

# Water Absorption of Rock - Test Report

Report No: ML23W-01958/2
Issue No: 1
Report Date:12/09/2023

| | |
|---|---|
| Client: | Program Manager IPE Global Ltd. |
| Address: | 2nd Floor, 19/3678-3679,Kaveratt Building, Kanayannoor Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Puthiyappu, Vatakara |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Puthiyappu, Vatakara |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*: | Laterite Core, BH 01, Depth 8m - 9m |
| Work Order ID: | ML23W-01958 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-01958/01 | Source*: | BH 01, Depth 8m - 9m |
| Date Sampled: | 05/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | - | Date Tested : | 12/08/2023 - 14/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 8m - 9m |
| Tested By: | GK | Client Sample Desc.*: | Laterite Core, BH 01, Depth 8m - 9m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS: 1124 - 1974 | Water Absorption,% | 10.4 | - |

For and on behalf of Matter Lab

**Comments**

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Thiruvannur, Kozhikode, Kerala, 673029

# Water Absorption of Rock - Test Report

Report No: ML23R-018564
Issue No : 1
Report Date: 13/06/2023

| | |
|---|---|
| Client: | Program Manager IPE Global Ltd. |
| Address: | 2nd Floor, 1613/B-3B/B Kavanatt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Puthiyappu, Velakara |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Puthiyappu, Velakara |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 08/06/2023 | Client Sample Ref.*: | Laterite Core, BH 01, Depth 9m - 10.5m |
| Work Order ID: | ML23W-01868 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-01868/02 | Source*: | BH 01, Depth 9m - 10.5m |
| Date Sampled: | 20/03/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Stored@: | - |
| Sample Location*: | - | Date Tested : | 13/06/2023 - 14/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 9m - 10.5m |
| Tested By: | GK | Client Sample Desc.*: | Laterite Core, BH 01, Depth 9m - 10.5m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS: 1124 - 1974 | Water Absorption,% | 9.9 | - |

PREETHI T.V
Chemical Laboratory

For and on behalf of Matter Lab

## Comments

*Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673029

# Specific gravity of Rock - Test Report

Report No: ML23/[illegible]
Issue No : 1
Report Date:17/06/2023

| | |
|---|---|
| Client: | Program Manager IPE Global Ltd. |
| Address: | 2nd Floor, 18/3878-3879,Kavanatt Building, Kaniyanoor Village, Kanhirad, Ernakulam, Kerala - 628008 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical investigation at Dumpsite in Puthiyappa, Vatakara |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Puthiyappu, Vatakara |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 05/06/2023 | Client Sample Ref.*: | Laterite Core, BH 01, Depth 8m - 9m |
| Work Order ID: | ML23/W-01958 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01958/01 | Source*: | BH 01, Depth 8m - 9m |
| Date Sampled: | 20/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | - | Date Tested : | 13/06/2023 - 16/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 8m - 9m |
| Tested By: | GK | Client Sample Desc.*: | Laterite Core, BH 01, Depth 8m - 9m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS: 1124 - 1974 | Apparent Specific gravity | 2.42 | - |

NEELESH T.V
Head-Civil Laboratory

For and on behalf of Matter Lab

**Comments**

*Information provided by client

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Thiruvannur, Kozhikode, Kerala, 673029

# Specific gravity of Rock - Test Report

Report No: ML23/R-016686
Issue No : 1
Report Date: 17/06/2023

| | |
|---|---|
| Client: | Program Manager IPE Global Ltd. |
| Address: | 2nd Floor, 1853/B-3875,Kavanatt Building, Kaniyannur Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Puthiyappu, Vatakara |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Puthiyappu, Vatakara |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 08/06/2023 | Client Sample Ref.*: | Laterite Core, BH 01, Depth 9m - 10.50m |
| Work Order ID: | ML23/WI-01958 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/WI-01958/02 | Source*: | BH 01, Depth 9m - 10.50m |
| Date Sampled: | 20/03/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size/kg: | - |
| Sample Location*: | - | Date Tested : | 15/06/2023 - 16/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 9m - 10.50m |
| Tested By: | GK | Client Sample Desc.*: | Laterite Core, BH 01, Depth 9m - 10.50m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| IS: 1124 - 1974 | Apparent Specific gravity | 2.40 | - |

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# Density of Rock - Test Report

Report No: ML23/R-01958/T
Issue No : 1
Report Date: 17/08/2023

| | |
|---|---|
| Client: | Program Manager IPE Global Ltd. |
| Address: | 2nd Floor, 18/3878-3879,Kevinat Building, Kaneyannor Village, Kaloor-ad, Ernakulam, Kerala - 628330 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Puthiyappu, Vatakara |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Puthiyappu, Vatakara |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 09/08/2023 | Client Sample Ref.*: | Laterite Core, BH 01, Depth 8m - 9m |
| Work Order ID: | ML23/W-01958 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01958/01 | Source*: | BH 01, Depth 8m - 9m |
| Date Sampled: | 20/03/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | - | Date Tested : | 13/08/2023 - 16/08/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 8m - 9m |
| Tested By: | GK | Client Sample Desc.*: | Laterite Core, BH 01, Depth 8m - 9m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Dry Density, kg/m³ | 2410 | - |

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# Density of Rock - Test Report

Report No: ML23R-01858
Issue No : 1
Report Date:17/06/2023

| | |
|---|---|
| Client: | Program Manager IPE Global Ltd. |
| Address: | 2nd Floor, 1B/3875-3876,Karvaratt Building, Kanakyannoor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Puthiyappu, Vatakara |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Puthiyappu, Vatakara |
| Tel / Email: | - |

## Sample Details

| | | | |
|---|---|---|---|
| Received Date: | 08/06/2023 | Client Sample Ref.*: | Laterite Core, BH 01, Depth 9m - 10.50m |
| Work Order ID: | ML23W-01858 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-01858/02 | Source*: | BH 01, Depth 9m - 10.50m |
| Date Sampled: | 20/05/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*: | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | - | Date Tested : | 13/06/2023 - 16/06/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 9m - 10.50m |
| Tested By: | GK | Client Sample Desc.*: | Laterite Core, BH 01, Depth 9m - 10.50m |
| Test Location: | MatterLab - Kozhikode | | |

## Test Results

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| ISRM Suggested Method | Dry Density, kg/m³ | 2390 | - |

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## Comments

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Thiruvannur, Kozhikode, Kerala, 673029

# SCRATCH HARDNESS OF SURFACE ACCORDING TO MOHS'SCALE OF ROCK TEST REPORT

Report No: ML23/W-01955/R
Issue No: 1
Report Date:17/09/2023

| | |
|---|---|
| Client: | Program Manager IPE Global Ltd |
| Address: | 2nd Floor, 18/3978-3870,Kavanatt Building, Kanayannor Village, Kakkanad, Ernakulam, Kerala - 682030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Puthiyappa, Vatakara |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Puthiyappa, Vatakara |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 08/09/2023 | Client Sample Ref.*): | Laterite Core, BH 01, Depth 8m - 9m |
| Work Order ID: | ML23/W-01955 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23/W-01955/01 | Source*): | BH 01, Depth 8m - 9m |
| Date Sampled: | 29/08/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*): | - | Date Tested : | 14/09/2023 |
| Sample Cert. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 8m - 9m |
| Tested By: | GK | Client Sample Desc.*): | Laterite Core, BH 01, Depth 8m - 9m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| Using Mohs' Scale | Mohs' Hardness | 3.5 | - |

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**Comments**
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# SCRATCH HARDNESS OF SURFACE ACCORDING TO MOHS'SCALE OF ROCK TEST REPORT

Report No: ML23W-[illegible]
Issue No.: 1
Report Date:17/09/2023

| | |
|---|---|
| Client: | Program Manager IPE Global Ltd. |
| Address: | 2nd Floor, 1603B/3B-3B79 Kaveratt Building, Kanayannur Village, Kakkanad, Ernakulam, Kerala - 628030 |
| Contact: | - |
| Project No: | - |
| Project Name: | Geotechnical Investigation at Dumpsite in Puthiyappu, Vatakara |
| Consultant: | - |
| Owner: | KSWMP |
| Contractor: | - |
| Project Location: | Puthiyappu, Vatakara |
| Tel / Email: | - |

**Sample Details**

| | | | |
|---|---|---|---|
| Received Date: | 08/09/2023 | Client Sample Ref.*): | Laterite Core, BH 01, Depth 9m - 10.5m |
| Work Order ID: | ML23W-01958 | Sample Submitted By: | Geotechnical Division |
| Sample ID: | ML23W-01958/02 | Source*): | BH 01, Depth 9m - 10.5m |
| Date Sampled: | 20/03/2023 | Sampled By: | Geotechnical Division |
| Sampling Method*): | IS: 2131 - 1981 | Sample Size(kg): | - |
| Sample Location*: | - | Date Tested : | 14/09/2023 |
| Sample Cont. No: | - | Test Method Variation: | None |
| Lot No / Lot Size: | - | Lab Sample Desc.: | Laterite Core, BH 01, Depth 9m - 10.5m |
| Tested By: | OK | Client Sample Desc.*): | Laterite Core, BH 01, Depth 9m - 10.5m |
| Test Location: | MatterLab - Kozhikode | | |

**Test Results**

| Test Method | Test/Parameters | Result | Specification |
|---|---|---|---|
| Using Mohs' Scale | Mohs' Hardness | 3.5 | - |

For and on behalf of Matter Lab

**Comments**

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Annexure-B

# ENVIRONMENTAL TEST REPORT

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PALLATH BUILDING, N. KALAMASSERY P. O., ERNAKULAM - 683104

Phone: 0484-2544050, 9281582022, 9747400091, 9747400099, www.poluchem.com, poluchem@gmail.com


**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/SD/4814/2023 (ULR NO:TC639922000004814F) |
|---|---|---|
| M/s.Program Manager IPE Global Ltd Kavassam Building Kakkanad Ernakulam (TSC Package D, KSWMP) | Date of issue: | 17/06/2023 |
| | Date of monitoring | 01/06/2023 |
| | Monitoring Location | Vadakara-Pathayappu<br>GPS Reading : N- 11°35'39.983"<br>E -75°36'20.205" |
| | Sample Description | Ambient Sound Level |

| HOURLY INTERVAL | | RESULT | HOURLY INTERVAL | RESULT |
|---|---|---|---|---|
| 01.06.2023 | 15.00 Hrs | 50.3 dB (A) | 08.00 Hrs | 50.2 dB (A) |
| 16.00 Hrs | | 51.7 dB (A) | 09.00 Hrs | 53.4dB (A) |
| 17.00 Hrs | | 50.2 dB (A) | 10.00 Hrs | 58.5 dB (A) |
| 18.00 Hrs | | 50.7 dB (A) | 11.00 Hrs | 52.0 dB (A) |
| 19.00 Hrs | | 49.2 dB (A) | 12.00 Hrs | 55.5 dB (A) |
| 20.00 Hrs | | 49.4 dB (A) | 13.00 Hrs | 49.9 dB (A) |
| 21.00 Hrs | | 48.1dB (A) | 14.00 Hrs | 48.7 dB (A) |
| 22.00 Hrs | | 45.9dB (A) | | |
| 23.00 Hrs | | 45.7 dB (A) | | |
| 06.06.2023 | 00.00 Hrs | 45.2 dB (A) | | |
| 01.00 Hrs | | 46.0 dB (A) | | |
| 02.00 Hrs | | 48.6 dB (A) | | |
| 03.00 Hrs | | 45.2 dB (A) | | |
| 04.00 Hrs | | 49.6 dB (A) | | |
| 05.00 Hrs | | 48.7 dB (A) | | |
| 06.00 Hrs | | 48.1 dB (A) | LeqDay | 51.3 dB (A) |
| 07.00 Hrs | | 45.9 dB (A) | LeqNight | 47.4 dB (A) |

Limits: Industrial Area Day Time-75dB(A),Night Time- 70dB(A),Commercial area Day Time-65 dB(A),Night Time55dB(A)
Residential area Day Time -55 dB(A),Night Time -45dB(A),Silence zone day time-50dB(A),Night time-40dB(A)
Day Time from 06.00 am to 10.00 pm & Night Time from 10.00 pm to 06.00 am

*End of the Report*

For Poluchem Laboratories (P) Ltd.

Authorised Signatory

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

# POLUCHEM LABORATORIES (P) LTD.

CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

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Phone: 0484-2544033, 8281883222, 9747400685, 9747400686 www.poluchem.com, poluchem@gmail.com

## TEST REPORT



Ref.No: PL/RT/GW/1426/2023

Date of Issue: 12/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kayamatt Building Kakkanad
Ernakulam
(TSC Package 3, KSWMP )

Sample drawn by :Poluchem Laboratory Sample Collector

Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014

Sample Description : Ground water-2

Sample Location : Vadakara-Puthiyappu
Gps Reading : N- 11°35'41.468"
E -75°36'22.459"

Sample code : F/1420/2023

Date of Sample Collected : 06/06/2023

Date of receipt of sample : 07/06/2023

Date of analysis started : 07/06/2023

Date of completion of analysis : 12/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 6.30 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | BDL(MDL-0.1 NTU) | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 140 µS/cm | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 87 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL- 1 mg/l) | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 32 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 7.96 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 23.63 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | BDL(MDL-1 mg/l) | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.12 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL- 1mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.2 mg/l | 1.0 mg/l |

BDL – Below Detection Level, MDL– Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

*End of the report*

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CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

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Phone: 0484-2544000, 8281982322, 9747400085, 9747400086, www.poluchem.com, poluchem@gmail.com




Continuation of Test Certificate No: 1420/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 110 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorized Signatory

Microbiologist

Poluchem Laboratories (P) Ltd

*End of the report*

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ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


## TEST REPORT



Ref.No: PL/RT/GW/4819/2023 Date of Issue: 12/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by :Poluchem Laboratory Sample Collector

Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014

Sample Description : Ground water-2

Sample Location : Vadakara-Puthiyappu
Gps Reading : N- 11 °35'41.468"
E -75°36'22.459"

Sample code : P/4819/2023

Date of Sample Collected : 06/06/2023

Date of receipt of sample : 07/06/2023

Date of analysis started : 07/06/2023

Date of completion of analysis : 12/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 4.2 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | ---- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level, MDL- Minimum Detection Level

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Continuation of Test Certificate No: 481/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chlorpyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory
SREEJA R
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/1421/2023**
(U.R.NO:WA0029010000421F)

**Date of Issue: 12/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kaveratt Building Kakkanad
Ernakulam
(TSC Package D: KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : Vadakara-Puthiyappa
Gps Reading : N- 11 °35'29.581"
E -75°36'24.331"

Sample code : E/1421/2023
Date of Sample Collected : 06/06/2023
Date of receipt of sample : 07/06/2023
Date of analysis started : 07/06/2023
Date of completion of analysis : 12/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 – 1983RA2017 | 6.50 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 – 1983RA2017 | 7 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 1.9 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 160 µS/cm | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 98 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 4 mg/l | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 36 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 25.87 mg/l | 200 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 29.56 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 3.87 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.21 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL- 1mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.25 mg/l | 1.0 mg/l |

BDL - Below Detection Level MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RAJEEV
Technical Manager

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/GW/4820/2023** **Date of Issue: 12/06/2023**

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanait Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by :Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-3
Sample Location : Vadakara-Puthiyappu
Gps Reading : N- 11°35'29.581"
E -75°36'24.331"

Sample code : P/4820/2023
Date of Sample Collected : 06/06/2023
Date of receipt of sample : 07/06/2023
Date of analysis started : 07/06/2023
Date of completion of analysis : 12/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 4 mg/l | --- |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | --- |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | ---- |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

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Continuation of Test Certificate No: 480/2023

RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chlorpyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory
SREEJA RAJ SIGH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

*End of the report*

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## TEST REPORT



**ReCNo: PL/RE/GW/1419/2023** — **Date of Issue: 12/06/2023**

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Karunam,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Vadakara-Puthiyappu
Gps Reading : N- 11 °35'39.614"
E -75°36'18.171"

Sample code : P/1419/2023
Date of Sample Collected : 06/06/2023
Date of receipt of sample : 07/06/2023
Date of analysis started : 07/06/2023
Date of completion of analysis : 12/06/2023

| Parameters tested | Test method | Results | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.41 | 6.5 – 8.5 |
| Color | IS 3025 (P) 04 –1983RA2017 | 4 Hazen Unit | 5 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 0.1 NTU | 1 NTU |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 130 µS/cm | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 82 mg/l | 500 mg/l |
| Total Suspended Solids | IS 3025 (P) 17 – 1984RA2017 | BDL(MDL- 1 mg/l) | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 10 mg/l | 200 mg/l |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 9.95 mg/l | 200 mg/l |
| Chloride as $Cl^-$ | IS 3025 (P) 32 – 1988RA2014 | 21.68 mg/l | 250 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 2.68 mg/l | 200 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.10 mg/l | 1.0 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | BDL(MDL- 1mg/l) | 45 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.2 mg/l | 1.0 mg/l |

BDL:- Below Detection Level MDL – Minimum Detection Level

For Poluchem Laboratories(P) Ltd

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

*End of the report*

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Continuation of Test Certificate No: 1419/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | LIMIT AS PER IS 10500:2012 |
|---|---|---|---|---|
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 80 | Shall not be detectable in any 100 ml sample |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | Shall not be detectable in any 100 ml sample |

For Poluchem Laboratories (P) Ltd

Authorised Signatory.
Microbiologist
Poluchem Laboratories (P) Ltd

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## TEST REPORT



Ref.No: PL/RT/GW/4818/2023

Date of Issue: 12/06/2023

Name & address of customer : M/s.Program Manager
IPE Global Ltd
Kuvanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Ground water-1
Sample Location : Vadakara-Puthiyappu
Gps Reading : N- 11 °35'39.614"
E -75°36'18.171"

Sample code : F/4818/2023
Date of Sample Collected : 06/06/2023
Date of receipt of sample : 07/06/2023
Date of analysis started : 07/06/2023
Date of completion of analysis : 12/06/2023

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| Nickel as Ni | IS 3025(P) 54– 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.02 mg/l |
| Cadmium as Cd | IS 3025(P) 41– 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.003 mg/l |
| Lead as Pb | IS 3025(P) 47– 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |
| Copper as Cu | IS 3025(P) 42– 1992RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Manganese as Mn | IS 3025(P) 59– 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.1 mg/l |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 5.0 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 2 mg/l | — |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | — |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | — |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37– 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.01 mg/l |

BDL- Below Detection Level
MDL- Minimum Detection Level

Contd..

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Continuation of Test Certificate No: 05182023

## RESULT OF PESTICIDE ANALYSIS

| Parameters tested | Test method | Result | Acceptable Limit As per IS – 10500 - 2012 |
|---|---|---|---|
| 2,4-D | USEPA 525.2 | Not Detected | 30 µg /l |
| Alachor | | Not Detected | 20 µg /l |
| Aldrin and Dieldrin | | Not Detected | 0.03 µg /l |
| Alpha-HCH | | Not Detected | 0.01 µg /l |
| Endosulfan(Sum of Alpha,beta,Isomers and sulphate) | | Not Detected | 0.4 µg /l |
| Atrazine | | Not Detected | 2.0 µg /l |
| Beta -HCH | | Not Detected | 0.04 µg /l |
| Butachlor | | Not Detected | 125 µg /l |
| Chloropyrifos | | Not Detected | 30 µg /l |
| Delta HCH | | Not Detected | 0.04 µg /l |
| Ethion | | Not Detected | 3.0 µg /l |
| Isoproturon | | Not Detected | 9.0 µg /l |
| Lindane(Gamma HCH) | | Not Detected | 2.0 µg /l |
| Monocrotophos | | Not Detected | 1.0 µg /l |
| Malathion(Sum of malathion and malaoxon) | | Not Detected | 190 µg /l |
| Methyl Parathion(Sum of methyl parathion and methyl paraoxon) | | Not Detected | 0.3 µg /l |
| DDT(o p and p p-isomers of DDT,DDE and DDD) | | Not Detected | 1.0 µg /l |
| Phorate(Sum of Phorate,Phorate sulfoxide &Phorate Sulphone) | | Not Detected | 2.0 µg /l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory
DINESH KUMAR
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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## TEST REPORT



**Ref.No: PL/RT/SW/1422/2023** **Date of Issue: 12/06/2023**

(ULR NO:TC030923000000001422F)

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector

Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014

Sample Description : Surface Water-Down Stream
-Vadakara-Puthiyappo

Sample Location : Gps Reading : N- 11°35'29.729"
E -75°36'24.791"

Sample code : P/1422/2023

Date of Sample Collected :06/06/2023

Date of receipt of sample :07/06/2023

Date of analysis started :07/06/2023

Date of completion of analysis :12/06/2023

| Parameters tested | Test method | Results | Limit as per IS-2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| pH | IS 3025 (P) 11 –1983RA2017 | 6.12 | 6.5 – 8.5 | 6.0-9.0 |
| Color | IS 3025 (P) 04—1983RA2017 | 6 Hazen Unit | 10 Hazen Unit | 10 Hazen Unit |
| Turbidity | IS 3025 (P) 10 – 1984RA2017 | 1.1 NTU | — | — |
| Electrical Conductivity | IS 3025 (P) 14 – 1984RA2013 | 134 µS/cm | — | — |
| Total Dissolved Solids | IS 3025 (P) 16 – 1984RA2017 | 81 mg/l | 500 mg/l | 1500 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | BDL(MDL-1mg/l) | — | — |
| Total Hardness as $CaCO_3$ | IS 3025 (P) 21 – 1983RA2014 | 38 mg/l | 200 mg/l | — |
| Total Alkalinity as $CaCO_3$ | IS 3025 (P) 23 – 1986RA2014 | 21.3 mg/l | — | — |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 25.4 mg/l | 250 mg/l | 600 mg/l |
| Sulphate as $SO_4$ | IS 3025 (P) 24 – 1986RA2014 | 12.4 mg/l | 400 mg/l | 400 mg/l |
| Dissolved Oxygen | IS 3025 (P) 38 - 1989RA2014 | 6.2mg/l | 6 mg/l | 4 mg/l |
| Iron as Fe | IS 3025 (P) 53 – 2003RA2014 | 0.08 mg/l | 0.3 mg/l | 0.5 mg/l |
| Nitrate as $NO_3$ | IS 3025 (P)34 – 1988RA2014 | 1.2 mg/l | 20 mg/l | 50 mg/l |
| Fluoride as F | IS 3025 (P) 60 - 2008RA2014 | BDL(MDL- 0.1mg/l) | 1.5 mg/l | 1.5 mg/l |

BDL- Below Detection Level MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory

SREEJA RAMESH
QUALITY MANAGER

*End of the report*

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# POLUCHEM LABORATORIES (P) LTD.

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

PALLATH BUILDING, N. KALAMASSERY P. O., ERNAKULAM - 683104

Phone: 0484-2544030, 8201382322, 9747455085, 9747400089, www.poluchem.com, poluchem@gmail.com




Continuation of Test Certificate No: 1422/2023

## RESULT OF MICROBIOLOGY ANALYSIS

| PARAMETERS TESTED | UNIT | TEST METHOD | RESULTS | Limit as per IS 2296 | |
|---|---|---|---|---|---|
| | | | | Class A | Class C |
| Coliforms | MPN/100ml | IS 1622: 1981 RA2009 | 110 | 50 | 5000 |
| E coli | Present or Absent/100ml | IS 1622: 1981 RA 2009 | Absent | --- | --- |

Class A-Drinking water source without conventional treatment but after disinfection
Class C- Drinking water source after conventional treatment and disinfection

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
INDUJA M.
Microbiologist
Poluchem Laboratories (P) Ltd

*End of the report*

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# POLUCHEM LABORATORIES PVT LTD

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## TEST REPORT



Ref.No: PL/RT/SW/4815/2023

Date of Issue: 12/06/2023

Name & address of customer :M/s. Program Manager
IPE Global Ltd
Kavanatt,Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by :Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample Description : Surface Water-Down Stream
-Vadakara-Puthiyappu

Sample Location : Gps Reading : N- 11 °35'29.729"
E -75°36'24.791"

Sample code : F/4815/2023
Date of Sample Collected :06/06/2023
Date of receipt of sample :07/06/2023
Date of analysis started :07/06/2023
Date of completion of analysis :12/06/2023

| Parameters tested | Test method | Result | Limit as per IS 2296 | |
|---|---|---|---|---|
| | | | Class A | Class C |
| Nickel as Ni | IS 3025(P) 54- 2003RA2014 | BDL(MDL- 0.01mg/l) | – | – |
| Cadmium as Cd | IS 3025(P) 41- 1992RA2014 | BDL(MDL- 0.001mg/l) | 0.01 mg/l | 0.01 mg/l |
| Lead as Pb | IS 3025(P) 47- 1994RA2014 | BDL(MDL- 0.01mg/l) | 0.1 mg/l | 0.1 mg/l |
| Copper as Cu | IS 3025(P) 42- 1992RA2014 | BDL(MDL- 0.01mg/l) | 1.5 mg/l | 1.5 mg/l |
| Manganese as Mn | IS 3025(P) 59- 2006RA2017 | BDL(MDL- 0.01mg/l) | 0.5 mg/l | — |
| Mercury as Hg | IS 3025(P) 48 – 1994RA2014 | BDL(MDL- 0.001mg/l) | 0.001 mg/l | — |
| Zinc as Zn | IS 3025(P) 49 – 1994RA2014 | BDL(MDL- 0.01mg/l) | 15 mg/l | 15 mg/l |
| B.O.D ( 3 days at 27° C ) | IS 3025 (P) 44 -1993RA2014 | 3.7 mg/l | 3 mg/l | 3 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 10 mg/l | — | — |
| TOC | APHA5310 | BDL(MDL- 0.1mg/l) | – | – |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988 RA2014 | BDL(MDL- 1mg/l) | — | — |
| Total Chromium as Cr | IS 3025 (P)52 – 2003RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.05 mg/l |
| Total Arsenic as As | IS 3025(P) 37- 1988RA2014 | BDL(MDL- 0.01mg/l) | 0.05 mg/l | 0.2 mg/l |

For Poluchem Laboratories (P) Ltd

Authorized Signatory.
BREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

*End of the report*

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## TEST REPORT



**Ref.No: PL/RT/5847/2023** **Date of Issue: 24/06/2023**

Name & address of customer : M/s. Phugmen Manager
IPE Global Ltd
Kavanatt, Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Leachate
Sample Location : Vadakara-Puthiyappu
Gps Reading : N-11 °35 '28.581"
E -75°36'24.331"

Sample code : F/5847/2023
Date of sample collected : 14/06/2023
Date of receipt of sample : 16/06/2023
Date of analysis started : 16/06/2023
Date of completion of analysis : 24/06/2023

| Parameters tested | Test method | Results |
|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.64 |
| Total Dissolved Solids(Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 941 mg/l |
| Total Suspended Solids | IS 3025 (P) 17 – 1984RA2017 | 87 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 274 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 196 mg/l |
| B O D (3 days at 27° C) | IS 3025 (P) 44 – 1993RA 2014 | 74.6 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 19.7 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 9.8 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 0.12 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.5 mg/l |
| Cyanide as CN | IS 3025 (P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54- 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | 0.15 mg/l |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 1.3 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories(P) Ltd

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT. LTD.

*End of the report*

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# POLUCHEM LABORATORIES (P) LTD.

CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

PALLATH BUILDING, N. KALAMASSERY P. O., ERNAKULAM - 683104

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMR/RT/134/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd.<br>Kovenant,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 17/06/2023 |
| | Date of monitoring | 05/06/2023 |
| | Date of sample received | 07/06/2023 |
| | Date of analysis Started | 07/06/2023 |
| | Sample Code | G/E/134/2023 |
| | Sample description | Ambient air -Vattakuzhi Puthiyappu |
| | Sample Location | Gps Reading : N- 11°35'37.504"<br>E -75°36'20.874" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | I S 5182 Part 23 2006RA2012 | 89.6 $\mu g/m^3$ | 100 $\mu g/m^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 39.7 $\mu g/m^3$ | 60 $\mu g/m^3$ |
| Sulphur Dioxide ( $SO_2$) | I S 5182 Part 2 2001 RA 2017 | 17.6 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 22.3 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | <1 $mg/m^3$ | 4 $mg/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/4813/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanat,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP) | Date of issue | 17/06/2023 |
| | Date of monitoring | 05/06/2023 |
| | Date of sample received | 07/06/2023 |
| | Date of analysis Started | 07/06/2023 |
| | Sample Code | C/T/4813/2023 |
| | Sample description | Ambient air -Vadakara-Puthiyappu |
| | Sample Location | Gps Reading : N- 11°35'37.504"<br>E -75°36'20.874" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 $\mu g/m^3$ | 400 $\mu g/m^3$ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 $\mu g/m^3$ | 1 $\mu g/m^3$ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 6 $ng/m^3$ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 $ng/m^3$ | 20 $ng/m^3$ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 $\mu g/m^3$ | 180 $\mu g/m^3$ |
| Benzene ($C_6H_6$) | IS 5182 Part 11 2006 RA2014 | < 0.1 $\mu g/m^3$ | 5 $\mu g/m^3$ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 $ng/m^3$ | 1 $ng/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/133/2023 (ULR NO:TC489220900000113F) |
|---|---|---|
| M/s.Program Manager IPE Global Ltd Kanamat Building Kakkanad Ernakulam (TSC Package D, KSWMP ) | Date of issue | 17/06/2023 |
| | Date of monitoring | 05/06/2023 |
| | Date of sample received | 07/06/2023 |
| | Date of analysis Started | 07/06/2023 |
| | Sample Code | G/P/133/2023 |
| | Sample description | Ambient air -Vadakara Pathiyappu |
| | Sample Location | Gps Reading : N- 11°35'39.182" E -75°36'20.543" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Particulate Matter ($PM_{10}$) | IS 5182 Part 23 2006RA2012 | 86.5 $\mu g/m^3$ | 100 $\mu g/m^3$ |
| Particulate Matter ($PM_{2.5}$) | CPCB | 34.2$\mu g/m^3$ | 60 $\mu g/m^3$ |
| Sulphur Dioxide ( $SO_2$) | IS 5182 Part 2 2001 RA 2017 | 12.3 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Nitrogen Dioxide ( $NO_2$) | IS 5182 Part 06 2006 RA2017 | 19.4 $\mu g/m^3$ | 80 $\mu g/m^3$ |
| Carbon monoxide ( CO) | SOP/PCL/COA/17 | <1 $mg/m^3$ | 4 $mg/m^3$ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

| | |
|---|---|
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BREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

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## TEST REPORT



| Client Name & Address | Certificate No | PL/AMB/RT/4812/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanan,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue | 17/06/2023 |
| | Date of monitoring | 05/06/2023 |
| | Date of sample received | 07/06/2023 |
| | Date of analysis Started | 07/06/2023 |
| | Sample Code | G/F/4812/2023 |
| | Sample description | Ambient air -Vaikkara-Puthiyappu |
| | Sample Location | Gps Reading : N- 11°35'39.182"<br>E -75°36'20.543" |

| Parameters | Test Method | Result | Limits as per NAAQS |
|---|---|---|---|
| Ammonia ( $NH_3$) | CPCB | < 1 µg/m³ | 400 µg/m³ |
| Lead (Pb) | IS 5182 Part 22 2004RA2017 | < 0.1 µg/m³ | 1 µg/m³ |
| Arsenic ( As) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m³ | 6 ng/m³ |
| Nickel (Ni) | IS 5182 Part 22 2004 RA2017 | <0.1 ng/m³ | 20 ng/m³ |
| Ozone ($O_3$) | IS 5182 Part 09 1974 RA2017 | < 1 µg/m³ | 180 µg/m³ |
| Benzene ($C_6H_6$) | IS 5182 Part 11 2006 RA2014 | < 0.1 µg/m³ | 5 µg/m³ |
| Benzo (a) pyrene ( BaP) | IS 5182 Part 12 2004 RA2014 | < 0.1 ng/m³ | 1 ng/m³ |

Note: NAAQS-National Ambient Air Quality Standards

*End of the Report*

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AUTHORIZED SIGNATORY

SREEJA RAMESH
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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/4816/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kuvasan,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP) | Date of issue: | 12/06/2023 |
| | Date of monitoring | 06/06/2023 |
| | Date of sample received: | 07/06/2023 |
| | Date of analysis | 07/06/2023 |
| | Sample Description | Waste Analysis -Vadakara-Puthiyappu |
| | Sample Location | Gps Reading : N- 11 °35'38.862"<br>E -75°36'20.735" |

**CHEMICAL PARAMETERS**

| SL NO | Parameters tested | Test Method | Unit | Result |
|---|---|---|---|---|
| 01 | pH@25°C | USEPA | - | 8.09 |
| 02 | Biodegradable Factor | USEPA | % | 4.6 |
| 03 | Total carbon | USEPA 9060A | % | 5.1 |
| 04 | Phosphorus(P) | USEPA | % | 0.023 |
| 05 | Nitrogen(N) | USEPA | % | 0.34 |
| 07 | Potassium(K) | USEPA | % | 0.076 |
| 08 | C/N Ratio | USEPA | - | 15:1 |
| 09 | Calorific Value | ASTM D 5865 | K.cal/kg | 2100 |

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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/4816/2023 |
|---|---|---|
| M/s. IPE Global Ltd<br>Kaveram,Building Kakkanad<br>Ernakulam<br>(TSC Package D-KSWMP ) | Date of issue: | 12/06/2023 |
| | Date of monitoring | 06/06/2023 |
| | Date of sample received | 07/06/2023 |
| | Date of analysis | 07/06/2023 |
| | Sample Description | Waste Analysis -Vadakara-Puthiyapm |
| | Sample Location | Gps Reading : N- 11°35'38.862"<br>E -75°36'20.735" |

**TOXICITY ANALYSIS- HEAVY METALS**

| Sl. NO | Parameters tested | Test Method | Unit | Result | Limit as per Municipal waste (Management & Handling) Rules 1999 |
|---|---|---|---|---|---|
| 10 | Iron (Fe) | USEPA 3050 | % | 2.31 | -- |
| 11 | Arsenic(As) | USEPA 3050 | mg/kg | <0.1 | 20 |
| 12 | Selenium(Se) | USEPA 3050 | mg/kg | <0.1 | -- |
| 13 | Nickel(Ni) | USEPA 3050 | mg/kg | 29.8 | 100 |
| 14 | Zinc (Zn) | USEPA 3050 | mg/kg | 144 | 2500 |
| 15 | Cadmium (Cd) | USEPA 3050 | mg/kg | <0.1 | 20 |
| 16 | Copper (Cu) | USEPA 3050 | mg/kg | 101.7 | 500 |
| 17 | Chromium(Cr) | USEPA 3050 | mg/kg | 29.2 | 300 |
| 18 | Lead(Pb) | USEPA 3050 | mg/kg | 31.08 | 500 |
| 19 | Mercury(Hg) | USEPA 3050 | mg/kg | <0.1 | 10 |
| 20 | Manganese(Mn) | USEPA 3050 | mg/kg | 81.8 | -- |

* End of the Report*

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For and on behalf of
POLUCHEM LABORATORIES (P) LTD.

AUTHORIZED SIGNATORY

SREEJA RAMESH
QUALITY MANAGER

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## TEST REPORT



**RefNo: PL/RT/5856/2023** **Date of Issue: 24/06/2023**

Name & address of customer : M/S. Program Manager
IPE Global Ltd
Kanmanr, Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Leachate
Sample Location : Vadakara-Puthiyappa
Gps Reading : N-11°35'39.260"
E-75°36'23.280"

Sample code : P/5856/2023
Date of sample collected : 14/06/2023
Date of receipt of sample : 16/06/2023
Date of analysis started : 16/06/2023
Date of completion of analysis : 24/06/2023

| Parameters tested | Test method | Results |
|---|---|---|
| pH | IS 3025 (P) 11 – 1983RA2017 | 8.87 |
| Total Dissolved Solids(Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 847 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 56 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 187 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 140 mg/l |
| B O D (3 days at 27° C) | IS 3025 (P) 44 – 1993RA 2014 | 62.3 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 16.3 mg/l |
| Ammoniacal Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 7.4 mg/l |
| Phenolic Compound as $C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 0.10 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.4 mg/l |
| Cyanide as CN | IS 3025 (P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54– 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41– 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47– 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025 (P) 42– 1992RA2014 | BDL(MDL- 0.01 mg/l) |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | 1.4 mg/l |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd.

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER

*End of the report*

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## TEST REPORT



Ref.No: PL/KT/5857/2023 Date of Issue: 24/06/2023

Name & address of customer : M/s. Program Manager
IPE Global Ltd
Kavassut, Building Kakkanad
Ernakulam
(TSC Package D, KSWMP )

Sample drawn by : Poluchem Laboratory Sample Collector
Sampling Method : IS 3025 Part 1 1987- Reaffirmed 2014
Sample description : Leachate
Sample Location : Vadakara-Puthiyappu
Gps Reading : N-11°35'34.263"
E-75°36'21.410"

Sample code : P/5857/2023
Date of sample collected : 14/06/2023
Date of receipt of sample : 16/06/2023
Date of analysis started : 16/06/2023
Date of completion of analysis : 24/06/2023

| Parameters tested | Test method | Results |
|---|---|---|
| pH | IS 3025 (P) 11 –1983RA2017 | 5.64 |
| Total Dissolved Solids(Inorganic) | IS 3025 (P) 16 – 1984RA2017 | 812 mg/l |
| Total Suspended Solids | IS 3025 (P) 15 – 1984RA2017 | 48 mg/l |
| Chloride as Cl | IS 3025 (P) 32 – 1988RA2014 | 154 mg/l |
| C O D | IS 3025 (P) 58 -2006RA2017 | 160 mg/l |
| B O D (3 days at 27° C) | IS 3025 (P) 44 – 1993RA 2014 | 54.3 mg/l |
| Total Kjeldhal Nitrogen as N | IS 3025 (P) 34 – 1988RA2014 | 16.3 mg/l |
| Ammonical Nitrogen as N | IS 3025 (P) 34 – 1988RA 2014 | 8.9 mg/l |
| Phenolic Compound as$C_6H_5OH$ | IS 3025 (P) 43-1992RA2014 | 0.15 mg/l |
| Fluoride as F | IS 3025 (P) 60 -2008RA2014 | 0.8 mg/l |
| Cyanide as CN | IS 3025 (P) 27-1986RA2014 | BDL(MDL- 0.01 mg/l) |
| Nickel as Ni | IS 3025 (P) 54 – 2003RA2014 | BDL(MDL- 0.01 mg/l) |
| Cadmium as Cd | IS 3025 (P) 41 – 1992RA2014 | BDL(MDL- 0.001 mg/l) |
| Lead as Pb | IS 3025 (P) 47 – 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Copper as Cu | IS 3025 (P) 42 – 1992RA2014 | BDL(MDL- 0.01 mg/l) |
| Mercury as Hg | IS 3025 (P) 48 – 1994RA2014 | BDL(MDL- 0.001 mg/l) |
| Zinc as Zn | IS 3025 (P) 49 – 1994RA2014 | BDL(MDL- 0.01 mg/l) |
| Total Arsenic as As | IS 3025 (P) 37– 1988RA2014 | BDL(MDL- 0.01 mg/l) |

BDL- Below Detection Level, MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd

Authorized Signatory.

SREEJA RANEESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

*End of the report*

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# POLUCHEM LABORATORIES PVT LTD

**CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY**

PALLATH BUILDING, NORTH KALAMASSERY, ERNAKULAM - 683104

Phone : 0484-2544030, 8281882322, 9747400685 www.poluchem.com, poluchem@gmail.com

ACCREDITED BY KSPCB AS "A" GRADE LABORATORY


**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/5631/2023 |
|---|---|---|
| M/s.Program Manager<br>3PE Global Ltd<br>Kavanat,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 17/06/2023 |
| | Date of sample collection | 05/06/2023 |
| | Date of sample received: | 07/06/2023 |
| | Date of analysis | 07/06/2023 |
| | Sample Received From | Vadakara Puthiyappu |
| | Sample description | Waste Segregation |
| | Sample Location | Gps Reading :N- N- 11°35'27.392"<br>E -75°36'20.681" |

| PHYSICAL COMPOSITION | | | | |
|---|---|---|---|---|
| SL NO | Parameters | | Result | |
| | | | Weight | Percentage |
| 01 | BioEarth | (-4.75mm) | 7.75 | 31 |
| | | (+4.75 to 8 mm) | 4.5 | 18 |
| 02 | C&D | C&D (+8mm) | 6 | 24 |
| 03 | Plastics | Plastics | 4.25 | 17 |
| 04 | Paper | Paper/MLP/SUP | 0.8 | 3.2 |
| 05 | Cloths | Cloths/ Bags | 0.9 | 3.6 |
| 06 | Glass | Glass | 0.38 | 1.5 |
| 07 | Metals | Metals | 0.35 | 1.4 |
| 08 | Rubber | Rubber | 0.07 | 0.28 |
| 09 | E-Waste | E-waste | 0.0025 | 0.01 |
| 10 | Leather | Leather | 0.0025 | 0.01 |
| Total Weight Of sample -25 Kg | | | | |

* End of the Report*

| | |
|---|---|
| The results are related only to the sample collected for analysis. This certificate shall not be reproduced except in full and without the written permission with authorized signatory | For and on behalf of<br>POLUCHEM LABORATORIES (P) LTD.<br><br>AUTHORIZED SIGNATORY |

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD.

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/5629/2023 |
|---|---|---|
| M/s.Program Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP) | Date of issue: | 17/06/2023 |
| | Date of sample collection | 05/06/2023 |
| | Date of sample received: | 07/06/2023 |
| | Date of analysis | 07/06/2023 |
| | Sample Received From | Vadakara-Puthuyappu |
| | Sample description | Waste Segregation |
| | Sample Location | Gps Reading : N- 11°15'38.862"<br>E-75°36'20.735" |

| PHYSICAL COMPOSITION | | | | |
|---|---|---|---|---|
| SL NO | Parameters | | Result | |
| | | | Weight | Percentage |
| 01 | BioEarth | (-4.75mm) | 8.75 | 35 |
| | | (+4.75 to 8 mm) | 4 | 16 |
| 02 | C&D | C&D (+8mm) | 5.25 | 21 |
| 03 | Plastics | Plastics | 4.5 | 18 |
| 04 | Paper | Paper/MLP/SUP | 0.85 | 4 |
| 05 | Cloths | Cloths/ Rags | 0.75 | 3.0 |
| 06 | Glass | Glass | 0.325 | 1.3 |
| 07 | Metals | Metals | 0.35 | 1.4 |
| 08 | Rubber | Rubber | 0.07 | 0.28 |
| 09 | E-Waste | E-waste | 0.0025 | 0.01 |
| 10 | Leather | Leather | 0.0025 | 0.01 |
| Total Weight Of sample -25 Kg | | | | |

* End of the Report*

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SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES PVT LTD

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**TEST REPORT** 

| Client Name & Address | Certificate No: | PL/RT/4817/2023 |
|---|---|---|
| M/s.Pregran Manager<br>IPE Global Ltd<br>Kavanatt,Building Kakkanad<br>Ernakulam<br>(TSC Package D, KSWMP ) | Date of issue: | 12/06/2023 |
| | Date of monitoring | 06/06/2023 |
| | Date of sample received: | 07/06/2023 |
| | Date of analysis | 07/06/2023 |
| | Sample Description | Waste Analysis - Vadakara-Puthiyappu |
| | Sample Location | Gps Reading : N- 11°35'37.392"<br>E -75°36'20.681" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 8.14 |
| 02 | Bulk Density | | | USEPA | kg/m³ | 784 |
| 03 | Density | | | USEPA | g/cm³ | 0.763 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 1987 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 75 | -- | | | 1.6 |
| | | 40 | -- | | | 8.7 |
| | | 20 | -- | | | 9.8 |
| | | 8 | -- | | | 8.3 |
| | | 4.75 | 4 | | | 4.05 |
| | | 2.36 | 8 | | | 8.6 |
| | | 1.18 | 16 | | | 12.4 |
| | | 0.6 | 30 | | | 18.6 |
| | | 0.3 | 50 | | | 19.53 |
| | | 0.15 | 100 | | | 6.54 |
| | | 0.09 | 170 | | | 1.0 |
| | | 0.075 | 200 | | | 0.88 |
| | | 0.045 | 325 | | | 0 |

* End of the Report*

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SREEJA RAMESH
QUALITY MANAGER

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## TEST REPORT



| Client Name & Address | Certificate No: | PL/RT/4816/2023 |
|---|---|---|
| M/s Program Manager<br>IPE Global Ltd<br>Kavanat,Building Kakkanad<br>Ernakulam<br>( TSC Package D, KSWMP ) | Date of issue: | 12/06/2023 |
| | Date of monitoring | 06/06/2023 |
| | Date of sample received: | 07/06/2023 |
| | Date of analysis | 07/06/2023 |
| | Sample Description | Waste Analysis - Vadakara-Puthiyappa |
| | Sample Location | Gps Reading : N- 11°35'38.862"<br>E -75°36'20.735" |

**PHYSICAL PARAMETERS**

| SL NO | Parameters tested | | | Test Method | Unit | Result |
|---|---|---|---|---|---|---|
| 01 | Moisture@105°C | | | ASTM D 2216 | % | 9.71 |
| 02 | Bulk Density | | | USEPA | kg/m³ | 774 |
| 03 | Density | | | USEPA | g/cm³ | 0.756 |
| 04 | Calorific Value | | | ASTM D 5865 | K.cal/kg | 2014 |
| 05 | Size of waste Constituent | Sieve Size(mm) | ASTM No | ASTM | % | % Retained |
| | | 75 | -- | | | 0 |
| | | 40 | -- | | | 2.2 |
| | | 20 | -- | | | 6.5 |
| | | 8 | -- | | | 12.4 |
| | | 4.75 | 4 | | | 7.53 |
| | | 2.36 | 8 | | | 6.41 |
| | | 1.18 | 16 | | | 16.47 |
| | | 0.6 | 30 | | | 31.22 |
| | | 0.3 | 50 | | | 12.71 |
| | | 0.15 | 100 | | | 4.50 |
| | | 0.09 | 170 | | | 0.06 |
| | | 0.075 | 200 | | | 0 |
| | | 0.045 | 325 | | | 0 |

* End of the Report*

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POLUCHEM LABORATORIES (P) LTD

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QUALITY MANAGER

Annexure-C

# PHOTOGRAPHS –SAMPLING



*Figure 13 Geotechnical Survey*



*Figure 14 Ground Water Sampling*

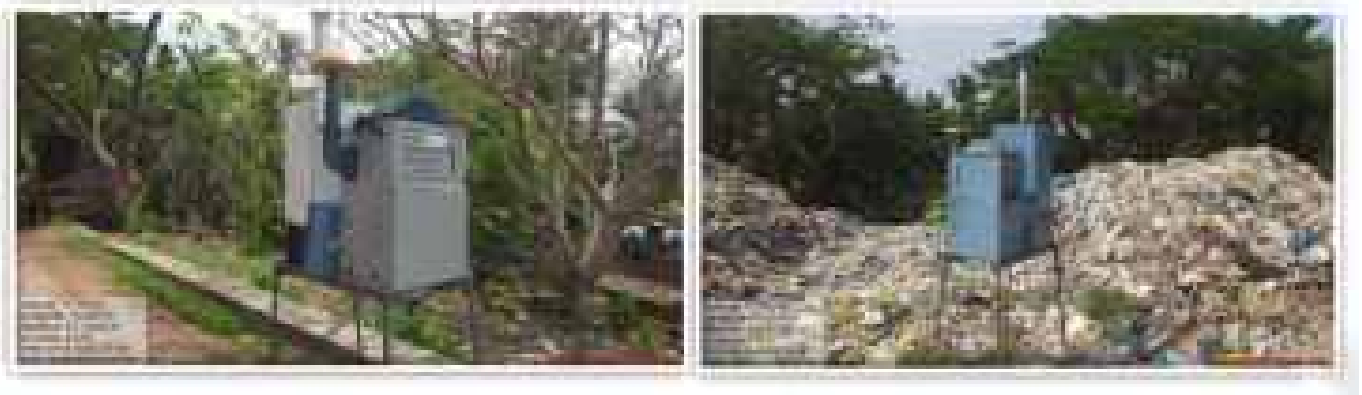


*Figure 15 Ambient Air Sampling*



*Figure 16 Surface Water Sampling*



*Figure 17 Ambient Noise Sampling*

Annexure-D

# VOLUMETRIC ANALYSIS

| VOLUME REPORT | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sl. No. | Section From | Previous Section | Difference | Filling Volume | | | |
| | | | | Area | Previous | Average | Volume |
| | | | | Sq. Mtr | Area | Sq. Mtr | Cubic Meters |
| 1 | 972.924 | - | 0.000 | 0.001 | 0.000 | 0.001 | 0.000 |
| 2 | 975.000 | 972.924 | 2.076 | 112.107 | 0.001 | 56.054 | 116.368 |
| 3 | 980.000 | 975.000 | 5.000 | 276.085 | 112.107 | 194.096 | 970.480 |
| 4 | 985.000 | 980.000 | 5.000 | 344.801 | 276.085 | 310.443 | 1552.215 |
| 5 | 990.000 | 985.000 | 5.000 | 384.952 | 344.801 | 364.877 | 1824.383 |
| 6 | 995.000 | 990.000 | 5.000 | 416.960 | 384.952 | 400.956 | 2004.780 |
| 7 | 1000.000 | 995.000 | 5.000 | 428.008 | 416.960 | 422.484 | 2112.420 |
| 8 | 1005.000 | 1000.000 | 5.000 | 446.970 | 428.008 | 437.489 | 2187.445 |
| 9 | 1010.000 | 1005.000 | 5.000 | 457.296 | 446.970 | 452.133 | 2260.665 |
| 10 | 1015.000 | 1010.000 | 5.000 | 469.169 | 457.296 | 463.233 | 2316.163 |
| 11 | 1020.000 | 1015.000 | 5.000 | 442.954 | 469.169 | 456.062 | 2280.308 |
| 12 | 1025.000 | 1020.000 | 5.000 | 421.425 | 442.954 | 432.190 | 2160.948 |
| 13 | 1030.000 | 1025.000 | 5.000 | 371.742 | 421.425 | 396.584 | 1982.918 |
| 14 | 1035.000 | 1030.000 | 5.000 | 329.297 | 371.742 | 350.520 | 1752.598 |
| 15 | 1040.000 | 1035.000 | 5.000 | 295.981 | 329.297 | 312.639 | 1563.195 |
| 16 | 1045.000 | 1040.000 | 5.000 | 262.786 | 295.981 | 279.384 | 1396.918 |
| 17 | 1050.000 | 1045.000 | 5.000 | 218.449 | 262.786 | 240.618 | 1203.089 |
| 18 | 1055.000 | 1050.000 | 5.000 | 150.815 | 218.449 | 184.632 | 923.160 |
| 19 | 1060.000 | 1055.000 | 5.000 | 51.244 | 150.815 | 101.030 | 505.148 |
| 20 | 1065.000 | 1060.000 | 5.000 | 23.894 | 51.244 | 37.569 | 187.845 |
| 21 | 1070.000 | 1065.000 | 5.000 | 23.499 | 23.894 | 23.697 | 118.483 |
| 22 | 1075.000 | 1070.000 | 5.000 | 26.220 | 23.499 | 24.860 | 124.298 |
| 23 | 1080.000 | 1075.000 | 5.000 | 28.270 | 26.220 | 27.245 | 136.225 |
| 24 | 1085.000 | 1080.000 | 5.000 | 4.179 | 28.270 | 16.225 | 81.123 |
| 25 | 1086.753 | 1085.000 | 1.753 | 0.000 | 4.179 | 2.090 | 3.663 |
| | | | | | | | 29764.831 |

Annexure-E

# SITE PLAN



*Figure 18 Site Management Plan*

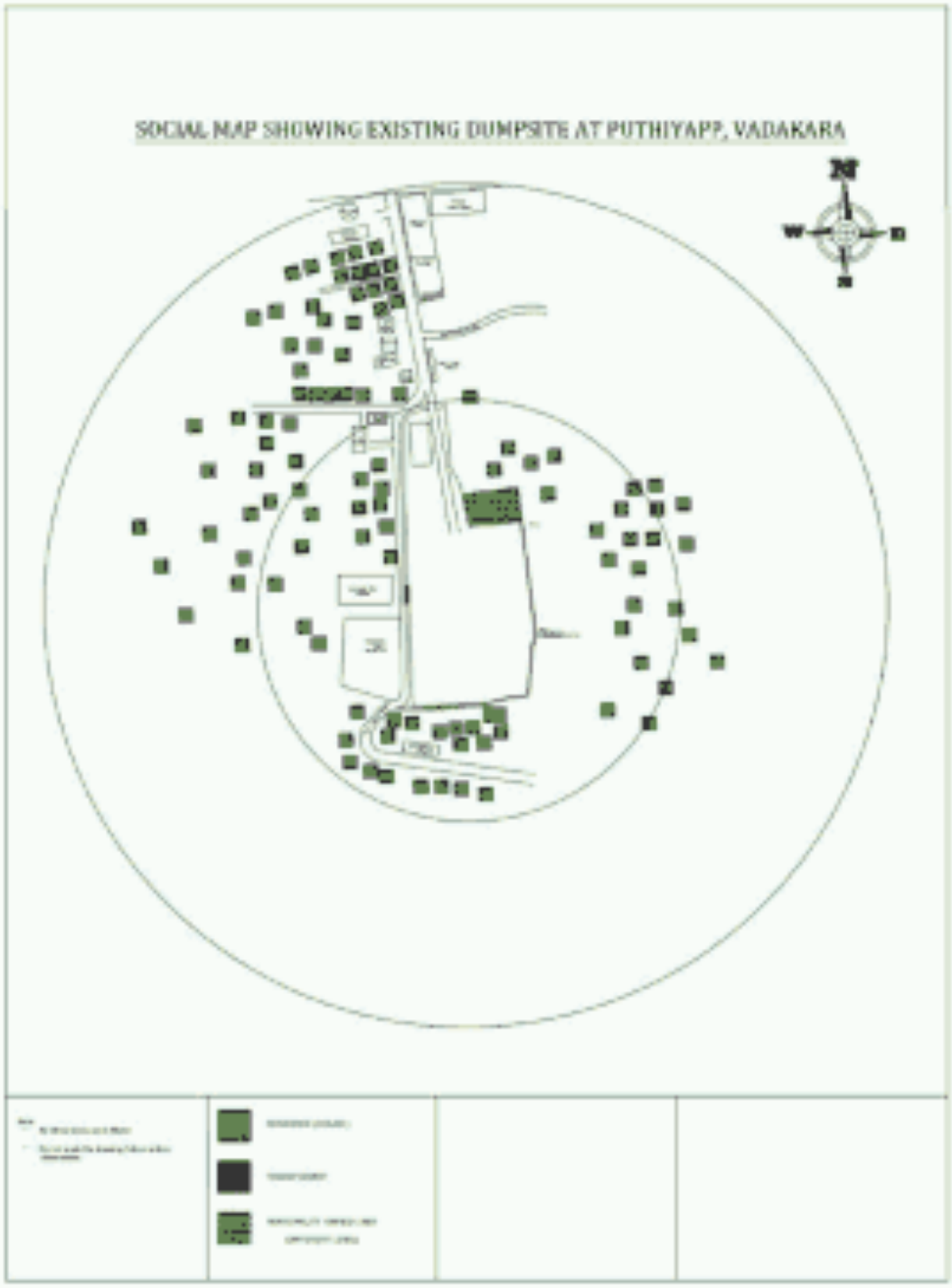



*Figure 19 Social Map - Vadakara*

Annexure-F

# SURVEY CONTOUR PLAN




*Figure 20 Contour Survey Map*

Annexure-G

# REQUIREMENT OF VEHICLE & MACHINERY

*Table 42 Details Analysis*

| S.No | Machinery & Vehicles | Qty | Units |
|---|---|---|---|
| 1 | Excavation Process | | |
| | Design capacity | 800 | TPD |
| | Required Material to be Excavated per hour | 100 | TPH |
| | Capacity of front-end loader with backhoe per hour | 40 | TPH |
| | No of front-end loader with backhoe required | 3 | Nos |
| 2 | Vehicles Needed for Site movement | | |
| | Tipper capacity per Trip | 5 | Tons |
| | No of trips Per hour | 3 | |
| | No of tippers required | 5 | |
| 3 | No of Tipper required for transporting Byproducts of Biomining ( Earth,RDF, Inerts & Recyclables) | 6 | |
| 3 | Windrow formation and turning | | |
| | Front end loader required for formation of Windrow from the material dropped by the tipper trucks and for turning of waste | 2 | Nos |
| 4 | Feeding to sieving and baling operations | | |
| | Quantity of waste to be fed to sieving machines | 800 | TPD |
| | Quantity of RDF material to be fed to baling machine | 96 | TPD |
| | Capacity of front-end loader to feed in a day to feeders (20 TPH X 10 hours) | 200 | TPD |
| | No of front-end loaders required for feeding sieving and baling machines | 2 | Nos |
| 5 | Water Tanker | 1 | Nos |
| 6 | Tractor | 1 | Nos |
| 7 | Backhoe Loader | 2 | Nos |

Annexure-H

# SPECIFICATION OF MACHINERIES & VEHICLES

*Table 43 Machineries Details*

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| 1 | Mobile Trommel | 1 | Model – Ekomann Scalper MSS 802 |
| | | | Crawler Chassis – Chassis 833D |
| | | | Drive – KYB MAG 05 NP, Speed 0.9/1 km/h |
| | | | Fuel Tank holding Capacity – 330 litres |
| | | | Feed Capacity (up to approx.) – 500 t/h |
| | | | Screen Size (W*L) – 1,550 *4,880 mm |
| | | | Machine Weight – 30,000 - 36,000 Kg |
| | | | Drive Output – 99 kW at 1800 rpm |
| | | | Screen Slope – 15.4 - 20 Degree |
| | | | Screen Slpoe Conveyor – 12.5 Degree |
| | | | Fine-grain Conveyor Belt Width – 1200 mm |
| | | | Hopper Discharge Capacity – 9.1 cum |
| | | | Screen Pure Size – Less than 900 * 7760 mm |
| | | | Between 900*7760 mm and 1550*4880 mm |
| | | | Greater Than 1550*4880 mm |
| | | | Warranty – 12 months, however max. 2,000 operation hours from setting into operation, however 15 months after the reported date of readiness for shipment resp. |
| 2 | Baling Machine | 1 | Model – FLT-BMPO 25MT |
| | | | Capacity – 25 Tonnes |
| | | | Cylinder – Single Cylinder (140mm*80mm@3000psi) |
| | | | Oil Tank Capacity – 250 Litreres Lifetime Oil |

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| | | | Bale Size – 600*600*600 - 900mm |
| | | | Bale Weight – 50-75 Kg |
| | | | Cycle Time – 15-20mm per Bale |
| | | | Power – 7.5 HP |
| | | | Production Capacity – 1000-1500 Kg/Hr Shift |
| | | | Feed Type – PET, HDPE, MLP, PAPER, CLOTHS, BAGS, CHAPPAL |
| 3 | Weighing bridge | 1 | Model – Modular U Shape Weighbridge, Load Capacity; 10t To 150 |
| | | | Capacity – 30 Tonne (10-150 Tonnes) |
| | | | Size – 5 to 10 m |
| | | | Power Supply 90V to 270V |
| | | | Shape – S Shape |
| | | | Accuracy – 5 Kg |
| 4 | Ballistic Separator | 1 | Drive Power (15 HP) – 1 No.<br>Blower- 1 No.<br>Screen Size - 70*70 MM<br>Material of Construction – IS:2062 ( MS )<br>Throughput Capacity - 30 TPH<br>Output Material - 3 Fraction ( RDF , Inert, Compost)<br>Automatic Feeding Conveyor<br>Drive Power (7.5HP)<br>Feeding Conveyor Inclined<br>Drive Power (7.5HP)<br>Inert Conveyor<br>Drive Power (1.0HP)<br>RDF Conveyor |

| A | Machinery | Nos | Technical Specification |
|---|---|---|---|
| | | | Drive Power (3.0HP)<br>Compost Conveyor<br>Drive Power (3.0HP)<br>Material of Construction – IS:2062 ( MS )<br>Electrical Control Panel Complete With Wiring |

*Table 44 Vehicle Details*

| B | Vehicle | Nos | Technical Specification |
|---|---|---|---|
| 1 | Back Hoe Loader | 2 | Type = BS 6<br>Bucket min. Capacity = 0.6 cum<br>Gross Power = 94 HP<br>Fully power shift transmission source from the internationally renowned ZF, with heavy duty cluth packs for smooth and easy click of the knob gear shift as per approved design standard |
| 2 | Tipper | 5 | Type = BS 6<br>Hydraulic Lifting Capacity = 10 cum single stock front end hydraulic system<br>Wheel consist of heavy duty steel radials with spare wheel along with 6 cylinder engine, inter cooled as per approved design standard with current pollution |
| 3 | Tractor (separately) | 2 | Mahindra 275 Eco Tractor (BS-6)<br>Fuel Tank Capacity = 45L<br>Brake Type = Oil Brakes<br>Engine Rated RPM = 1900 r/min<br>Main Cluth Type = Single Clutch Heavy Duty Diaphragm type<br>Tyre = 13.6 * 28 / 12.4 *28 (Front / Rear) |
| 4 | Trolley for tractor (separately) | 1 | Janta Enterprise Trolley Making<br>Material = MS |

| Sl | Vehicle | Nos | Technical Specification |
|---|---|---|---|
| | | | Size of Trolley = 1700*825*1200 |
| | | | Capacity = 7 Tonne |
| | | | Weight = 900 Kg |
| 5 | Water Tanker for tractor (separately) | 1 | Brand = QEE |
| | | | Capacity = 500-10000 Litres |
| | | | Materials = MS |
| 6 | Front End Loader | 1 | Types = BS 6 |
| | | | Minimum Capacity = 1 cum |
| | | | Gross Power = 125 HP |
| | | | Fully power shift transmission source from the internationally renowned ZF, with heavy duty clutch packs for smooth and easy click of the knob gear shift. |

*Table 45 Equipment Details*

| C | Equipment | No.S | Technical Specification |
|---|---|---|---|
| 1 | CCTV | 5 | 4 MP IP Bullet Colour Camera with Mic EA4IL2C-GP (Nos. -4) |
| | | | 4CH NVR 104-FI |
| | | | 1 TB HDD |
| | | | 4+2POE Switvh CP-DNW- GPU4G2-4II |
| | | | 6U Rack 600Depth |
| | | | 2.2 KV UPS |
| | | | RJ45 Connector |
| | | | CDBOX |
| | | | CAT6 Cable |
| | | | Monitor Cell 22"inch |
| 2 | GPS System For Vehicle | 5 | Vehicle Type = truck, Bus, Ship, Generator |
| | | | Model Name = RT wireless Fuel sensor |
| | | | Available Accessories = Wires |

Annexure-I

# PROPOSED OPERATIONAL PLAN

## Proposed Operational Plan

The project of the Bio-mining with land recovery will be implemented through 100% outsourcing model. The detailed operations of land recovery is provided below:

### 1. Project Kick-off

The existing legacy waste dumpsite should be visited jointly by representative of implementation agency, officials ULB and experts of PMU/PMC & TSC for the following

- ✓ For assessment of ***As –Is Situation*** of local settings viz., human settlement & environmental settings etc.,
- ✓ For validation of profile, quantity & physical characterization of legacy waste.
- ✓ Available services viz., electrical power, source of water and access road etc.,
- ✓ For ground truthing the sampling locations of baseline environmental parameter, locations where monitoring will conduct during operation phase and post reclamation phase
- ✓ For sensitizing/awareness of the upcoming the project activity to the stakeholders within the vicinity of the dumpsite.
- ✓ For understanding the sensitive of environmental & social aspects/social considerations viz., educational institutions, religious places and settlements settings.
- ✓ For ensuring that the implementation agency understands and to complies with all local and national regulations related to project activities.

### 2. Site Management Plan

The position of the machineries and other auxiliary machineries/equipment's in-line with the defined process of bio-mining with land recovery play imperative role in effective implementation of the project activities.

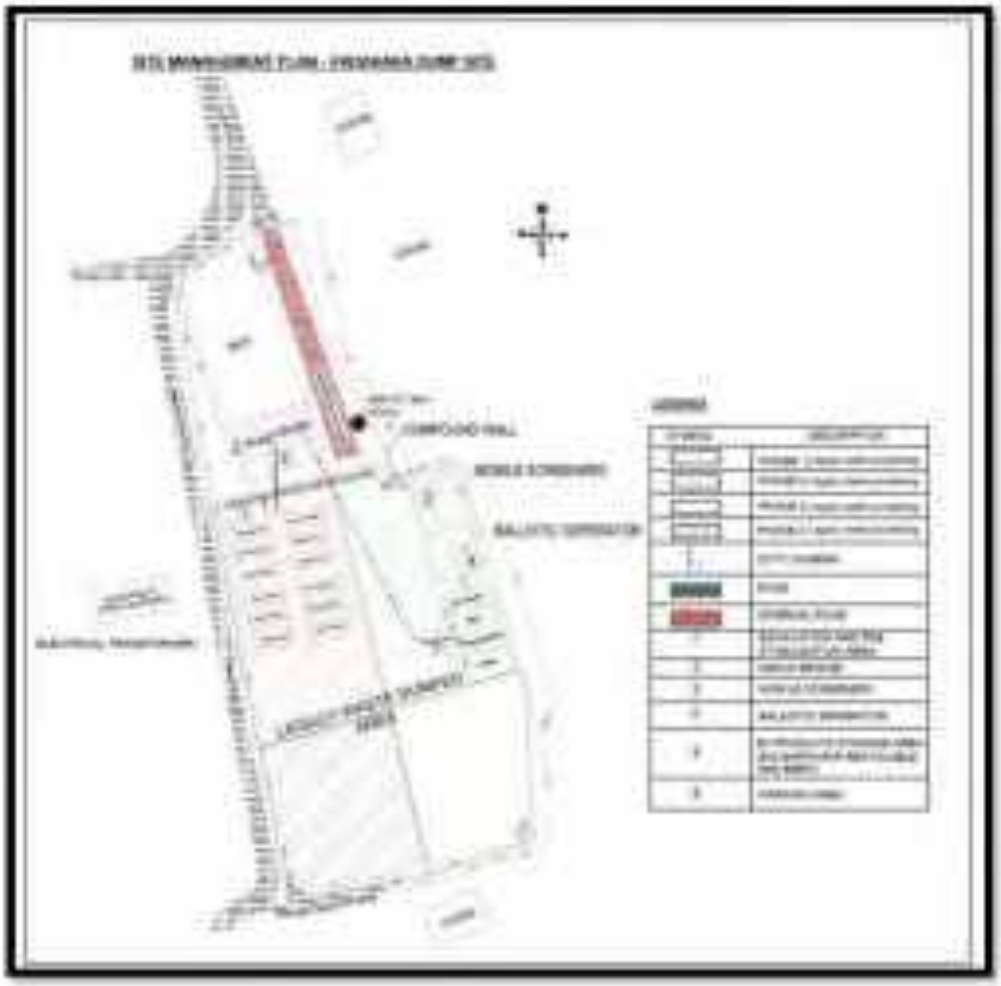
A detailed site management plan is prepared including the details of excavation & pre stabilization area in phases (1 to 4), machineries, weigh bridge, area allocation for by-products storage, vehicle parking area and position of CCTV cameras. The detailed site Management plan is provided below.

### 3. Site Preparation

The portion of the legacy waste dumpsite will be clear vegetation and levelling the area to create a stable & level platform for positioning of bio-mining machineries/equipment's and for processing of legacy waste.

### 4. Procurement of Machinery & Vehicles and Equipment's

An indicative list of Machineries &Vehicles and equipment's are proposed to for effective processing the quantity of existing legacy waste in-tune to the timeline of NGT orders. The indicative list of the Machinery & Vehicles and equipment's are provided in the Section 8.3.2



3. Mobilization of Manpower

For effective management of the project activities, an indicative list Manpower provided in the Section 8.4.1 shall be mobilize required.

4. Statutory Approvals

The implementation agency is responsible for obtaining all required permission/consent/approvals from the competent authorities. The ULB/DPMU/DPMC will only facilities implementation agency in obtaining the approvals etc. The indicative list of statutory approvals required for the project is provided below:

a. Site Authorization from KSPCB in conforming to SWM Rules 2016 and Consent to Establish/Operate KSPCB
b. Dept. of mining and geology
c. Necessary permission for storage of process materials and chemicals
d. NOC from Dept. of Fire and Rescue
e. Segregated Hazardous waste disposal arrangement (eg: KEIL Ambalamedu, Kochi)
f. NOC from Heritage/Archaeology if the site is in regulated zone of heritage/protected building
g. Any other statutory approvals/ permissions

## 7. Establishment of forward linkages

The By-products from the bio-mining process/operations viz., Bio earth/ C&D waste (Inert), RDF and Recyclables will be stored in the designated place (as indicated in the site management plan) within the dumpsite. The contractor is responsible for management/establishment of forward linkages. Utilization of Bio earth/C&D (inert) may be finalized in consultation with ULB. An indicative forward linkage is provided in the Section 9.1. The compost should conform to Schedule II of SWM Rules 2016, and RDF should conform to the Guidelines on Usage of RDF in various Industries issued by MoHUA. Bi-weekly sampling will be carried out to confirm the same.

**Bio-mining operations**

- Step-1 – Waste Stabilization

The initial step involves the use of a front-end loader to excavate the legacy waste, allowing for the leachate to dry out through exposure to solar radiation and for the removal of trapped methane from the heap. To ensure the decomposition of biodegradable waste such as discarded food, fruits, flowers, and garden waste, proper aeration is necessary to prevent the generation of leachate and odors. The top layer of the legacy waste, approximately 150 mm in depth, is repeatedly loosened using the front-end loader. Additionally, the waste is lightly mist-sprayed with bio-cultures to manage odors and disperse decomposing microbes throughout the waste. The loosened legacy waste forms windrows.

- Step-2 – Windrow Formation

The second step involves creating windrows of the legacy waste using backhoe. Composting bio-cultures are added to accelerate decomposition and generate biological heat within the waste, aiding in drying it out and reducing its volume. These windrows are turned every 3 days to ensure proper biological treatment and moisture loss. After 1-2weeks, when the heaps have reached a suitable consistency for screening, the material is weighed and transferred to a Mobile Trommel, which consists of rotating cylinders with different-sized perforations.

- Step-3 – Sorting and Segregation by Mobile Trommel

The third step is to move stabilized waste to mobile trommel to get 3 different sizes of fractions

- ✓ Fraction 1 – (minus 30 mm) – Bio Soil/earth -Used for side development/ filling.
- ✓ Fraction 2 – (30-80) mm – Mixed fraction – Plastics with C&D (send to Ballistic Separator)
- ✓ Fraction 3 – (80 +) mm – Mixed fraction – (send to Ballistic Separator)

The Fraction-2 & Fraction-3 (30-80) mm & (80 +) mm is required to move for further separation process through ballistic separator.

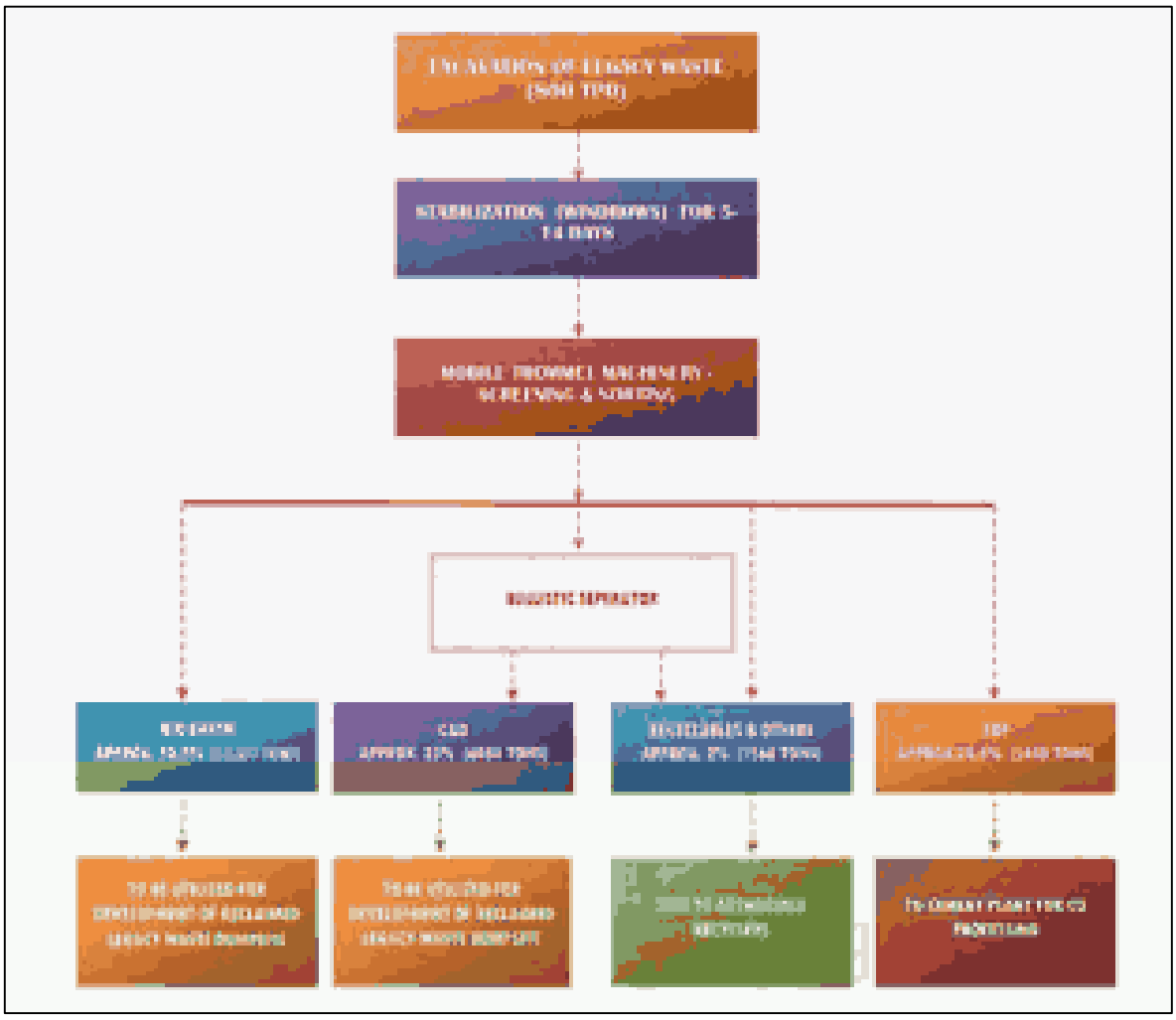


- Step-4 – By - products – C&D materials

In the fourth step, the fraction-2 and fraction-3 are sorted into three types based on their shape and weight: heavy and rolling fraction (referred to as 3D) - C&D Material, light fraction (referred to as 2D) - RDF, and the sieved fraction (or under-screen fine fraction) - Plastic.

- Step-5 - Byproducts – RDF

In the fifth step, the RDF sorted by the ballistic separator (30TPH) is moved to the baling machine (50TPD) for packaging the RDF fractions. The baled RDF is then transported to Cement plants via a weigh bridge (30Ton), where a co-processing facility is available.



## 8. Monitoring & Supervising Mechanism

Supervision and monitoring during dumpsite remediation by TSC/PIU/DPMU

## 9. Record keeping and Reporting

i. The Implementation agency shall maintain a record of the daily processed legacy waste and also keep proper record of all the recovered and disposed of materials.

ii. The Implementation agency shall maintain authorized weigh bridge records at the point of receipt by end designated agency. A consolidated weigh bridge records certified by the Plant Manager/competent authority of the authorized Cement plant/ WtE or such units certifying the total RDF received from the Project is a valid proof of compliance.

iii. The Implementation agency shall maintain all the statutory records, as per SWM Rules, 2016, and also conditions stipulated in Site Authorization/Consent to Establish/Operate by KSPCB if any, KSWMP/WB requirements and other project relevance statutory requirements.

iv. The site shall be operated in CCTV surveillance with data storage of entire contract period. For CCTV surveillance High-Definition IP based cameras in adequate numbers. As per the requirement of the ULB/KSWMP link with mobile compatibility may be provided for online monitoring of the project activities.

v. The vehicles engaged for the project activities shall be equipped with Vehicles Tracking System (VTS) by equipping with GPS and online monitoring system.

vi. The agency is required to maintain loading and unloading weighbridge slips, e-way bill, LR copy, RDF receipt acknowledgement letter from the cement factory/ WtE facility for complete traceability of the recovered fractions.

## 10. Land recovery/project closure

Land shall be reclaimed to its original state prior to dumping of waste i.e. all the legacy waste must be removed till it reaches the surface of the original land. The Machinery & Vehicles of the implementation agency shall be vacated within 7 days from date completion of bio mining of legacy waste. The encumbrance free reclaimed land shall be handed over to ULB.

Annexure-J

# LSGD GUIDELINES FOR REMEDIATION OF LEGACY WASTE DUMPSITES THROUGH BIOREMEDIATION

# GOVERNMENT OF KERALA

## Abstract

Local Self Government Department - Guidelines for Remediation of Legacy Waste Dumpsites through Bio Remediation - orders issued.

## DEPARTMENT

G.O.(Rt)No.2629/2022/LSGD Dated,Thiruvananthapuram, 29-10-2022

Read 1 Letter No. 2683/C2/2022/SM dated 16.09.2022 from Executive Director Suchitwa Mission.

## ORDER

As per the letter read above, Executive Director, Suchitwa Mission had submitted draft guidelines for implementation of project for remediation of Legacy Waste Dumpsites through Bio Remediation.

2) Government have examined the matter in detail and are pleased to approve the guidelines enclosed herewith for implementation of project for reclamation of legacy waste dumpsites through bio remediation.

(By order of the Governor)
SHIBI ABRAHAM
DEPUTY SECRETARY

To:

Principal Director Local Self Government Department

Director Local Self Government(Urban) Department

Director, Local Self Government (Rural) Department

Executive Director, Suchitwa Mission

Principal Accountant General (A&E/Audit-I/Audit-II)Kerala, Thiruvananthapuram.

Executive Director, Information Kerala Mission.

The Information Officer (Web & New Media ) I&PRD

Stock File / Office Copy

G.O.(Rt)No.2629/2022/LSGD

Forwarded /By order

Signed by Prasanth C
Date: 29-10-2022 14:53:04

Section Officer

**Copy to:- PS to Minister LSGD**

**PA to ACS LSGD**

**CA to SS LSGD**

I/5470223/2022

**ബയോ**റെമഡിയേഷൻ വഴി തദ്ദേ**ശ** സ്വ**യംഭരണ** സ്ഥാപന**ങ്ങ**ളിലെ ലെഗ**സി മാ**ലിന്യ **നിക്ഷേപ** സൈ**റ്റുകൾ/ഭൂമികൾ** വീ**ണ്ടെടു**ക്കുന്നതി**ലേ**ക്കുള്ള പദ്ധതികൾ **ന**ടപ്പിലാ**ക്കുന്ന**തിന**ുള്ള** മാർഗ്ഗനിർദ്ദേശങ്ങൾ

ഖരമാലിന്യ സംസ്കരണ ചട്ടങ്ങൾ 2016-ലെ വ്യവസ്ഥകൾ അനുസരിച്ച കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ പുറപ്പെടുവിച്ച മാർഗ്ഗനിർദ്ദേശങ്ങളുടെ അടിസ്ഥാനത്തിൽ ലെഗസി മാലിന്യങ്ങൾ നിർമ്മാർജ്ജനം ചെയ്യുന്നതിനും അത്തരം ഭൂമി വീണ്ടെടുക്കുന്നതിനും തദ്ദേശ സ്ഥാപനങ്ങളെ ചുമതലപ്പെടുത്തിയിട്ടുണ്ട. ടി മാനദണ്ഡങ്ങൾ പ്രകാരം നിർമ്മാർജ്ജനം ചെയ്യേണ്ട മാലിന്യത്തിന്റെ സ്വഭാവവും അളവും വിലയിരുത്തൽ, ലെഗസി മാലിന്യ നിക്ഷേപങ്ങൾ ഉറക്കുന്നതിനുള്ള ഉത്ഖനന പ്രവർത്തനങ്ങൾ, മാലിന്യം തരംതിരിക്കുന്നതിനായി സ്ക്രീനിംഗ് സോർട്ടിംഗ്, വീണ്ടെടുക്കപ്പെട്ട വസ്തുക്കളുടെ പുനരുപയോഗം, വിൽപ്പന/വിപണനം, തിരസ്കൃത വസ്തുക്കളുടെ ശാസ്ത്രീയ നിർമ്മാർജനം എന്നിങ്ങനെ വിവിധ പ്രവർത്തനങ്ങൾ ആയതിൽ ഉൾപ്പെടുന്നു. കൂടാതെ ഇത്തരം സൈറ്റുകൾ/ഭൂമികൾ വീണ്ടെടുക്കേണ്ടതിന്റെ ആവശ്യകത 17.07.2019 ലെ OA 519/2019-ലെ ഉത്തരവിൽ ബഹു: ദേശീയ ഹരിത ട്രൈബ്യൂണൽ നിർദ്ദേശിച്ചിട്ടുണ്ട. ഇതിനെത്തുടർന്ന, പ്രവർത്തനങ്ങൾ വേഗത്തിലാക്കുന്നതിനായി 22.03.2020 ലെ സ.ഉ (സാധാ) നം 702/2020/തസ്വഭവ പ്രകാരം ബയോമൈനിംഗ വഴി ലെഗസി മാലിന്യ നിക്ഷേപ ഭൂമികൾ വീണ്ടെടുക്കുന്നതിന വിവിധ സ്റ്റേക്ക ഹോൾഡർമാരുടെ ഉത്തരവാദിത്തം ഉൾപ്പെടെയുള്ള നിർവ്വഹണ സ്ട്രാറ്റജി അംഗീകരിച്ച ഉത്തരവായിരുന്നു. എന്നാൽ, നാളിതുവരെ ഇത്തരം പദ്ധതികളുടെ നിർവ്വഹണത്തിൽ ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ പുരോഗതി കൈവരിച്ചിട്ടില്ലാത്തതാണ. ലെഗസി മാലിന്യ നിർമ്മാർജ്ജന പദ്ധതികൾക്ക പ്രോജക്ടിന്റെ അംഗീകാരം മുതൽ നടപ്പിലാക്കുന്ന രീതി (വീണ്ടെടുത്ത വസ്തുക്കളുടെ വിൽപ്പനയും സംസ്കരണവും ഉൾപ്പെടെ) വരെയുള്ള നടപടിക്രമങ്ങളിൽ വ്യക്തതയില്ലാത്തതാണ ഒരു പ്രധാന കാരണമായി കണക്കാക്കുന്നത. ഇത്തരം പദ്ധതികൾ പൊതു നിർമ്മാണ/സിവിൽ പ്രവൃത്തികൾക്ക സമാനമല്ലാത്തതിനാലും, നിലവിലുള്ള ഒരു ലെഗസി ഡംപസൈറ്റിൽ നിന്ന വീണ്ടെടുക്കാൻ കഴിയുന്ന വസ്തുക്കളുടെ സ്വഭാവം, ഗുണമേന്മ, അളവ എന്നിവ അത്തരം ഡംപസൈറ്റുകൾ ഉറക്കാതെ കൃത്യമായി മുൻകൂട്ടി നിർണ്ണയിക്കാൻ കഴിയാത്തതിനാലും, മറ്റ പൊതുമരാമത്ത പ്രവർത്തികൾ പോലെ ഇത്തരം പ്രവൃത്തികൾക്ക എസ്റ്റിമേറ്റ തയ്യാറാക്കുന്നത പ്രായോഗികമല്ല. ഈ പ്രശനങ്ങൾ പരിഹരിക്കുന്നതിനായി, സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-നും സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന "അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ (Adv sory on Landf Rec amat on)" പുറപ്പെടുവിച്ചിട്ടുള്ളതാണ. ആയതിലെ അനുയോജ്യമായ വ്യവസ്ഥകൾ കേരളത്തിൽ ഇത്തരം പദ്ധതികൾ നടപ്പിലാക്കുന്നതിന സ്വീകരിക്കാവുന്നതാണ. മേൽ സാഹചര്യത്തിൽ, സർക്കാർ ഇക്കാര്യം വിശദമായി പരിശോധിക്കുകയും തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ മുഖേന ലെഗസി മാലിന്യ നിർമ്മാർജ്ജന പദ്ധതികൾ നടപ്പിലാക്കുന്നതിന ഇനിപ്പറയുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങൾ പുറപ്പെടുവിക്കുന്നു.

പാ**ലി**ക്കേണ്ട **മാന**ദ**ണ്ഡ**ങ്ങളും **മാർ**ഗ്ഗനി**ർദ്ദേശ**ങ്ങ**ളും**

- കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ 2019-ൽ പുറത്തിറക്കിയ "ഗൈഡലൈൻസ ഫോർ ഡിസ്പോസൽ ഓഫ ലെഗസി വേസ്റ്റ (ഓൾഡ മുനിസിപ്പൽ സോളിഡ വേസ്റ്റ)"

- കേന്ദ്ര പാർപ്പിട-നഗരകാര്യ മന്ത്രാലയവും (MoHUA) സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന 2020 ൽ പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ (SBM U - Adv sory on Landf Rec amat on)"

- പ്രസ്തുത വിഷയവുമായി ബന്ധപ്പെട്ട കാലാകാലങ്ങളിൽ കേരള സർക്കാർ പുറപ്പെടുവിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങൾ

**തദ്ദേശ** സ്വയം**ഭരണ** സ്ഥാപനങ്ങ**ൾ** മു**ഖേ**ന **ലെഗ**സി **മാ**ലിന്യ **നി**ർമ്മാർജന പദ്ധതികൾ നടപ്പി**ലാ**ക്കുന്നതിനുള്ള **മാതൃകക**ൾ

- 100% ഔട്ടസോഴസ ചെയത മോഡൽ (MoHUA-യും CPHEEO-യും പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഫിൽ റിക്ലമേഷൻ" പ്രകാരം)

**ലെഗസി മാ**ലിന്യ **നിർമ്മാർ**ജന പദ്ധതികളു**ടെ നിർവ്വഹ**ണ ഉദ്യോഗ**സ്ഥ**ൻ

- ലെഗസി മാലിന്യ നിർമാർജന പദ്ധതികളുടെ നിർവ്വഹണ ഉദ്യോഗസ്ഥൻ തദ്ദേശ സ്വയംഭരണ സ്ഥാപനത്തിന്റെ എഞ്ചിനീയർ ആയിരിക്കും

നിർമ്മാർജനം ചെയ്യേണ്ട ലെഗസി മാലിന്യ നിക്ഷേപങ്ങളുടെ അളവ തിട്ടപ്പെടുത്തൽ

- പൊതുവായി, നിർമ്മാർജ്ജനം ചെയ്യേണ്ട ലെഗസി മാലിന്യത്തിന്റെ അളവ (ക്യൂബിക മീറ്ററിൽ) ടോട്ടൽ സ്റ്റേഷൻ സർവേയിലൂടെ കണ്ടെത്താവുന്നതാണ. എന്നാൽ ടോട്ടൽ സ്റ്റേഷൻ സർവേ സാധ്യമല്ലാത്ത സാഹചര്യത്തിൽ, ഒരു ലക്ഷം ക്യൂബിക മീറ്റർ വ്യാപ്തിയിൽ കൂടുതലുള്ള വലിയ ഡംപസൈറ്റുകളുടെ കാര്യത്തിൽ ഡ്രോൺ സർവ്വേ രീതി സ്വീകരിക്കാവുന്നതാണ.

- ആവശ്യമുള്ള പക്ഷം, പുറമെയുള്ള സർവേ ഏജൻസികളെ നിശ്ചിത നടപടിക്രമങ്ങൾ പാലിച്ച ഇതിനായി ഏർപ്പെടുത്താവുന്നതും, അതിനുള്ള ചെലവ ലഭ്യമായ ഫണ്ടിൽ നിന്ന തദ്ദേശ സ്വയംഭരണ സ്ഥാപനം വഹിക്കേണ്ടതുമാണ.

- സൈറ്റിന്റെ കോണ്ടൂർ മാപ്പ തയ്യാറാക്കേണ്ടതും ആയത തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ പരിശോധിച്ച അംഗീകരിക്കേണ്ടതുമാണ.

എസ്റ്റിമേറ്റ തയ്യാറാക്കലും പദ്ധതി രൂപീകരണവും

- സൈറ്റിന്റെ നിലവിലെ അവസ്ഥ, മാലിന്യത്തിന്റെ സ്വഭാവം/തരം, മാലിന്യ നിക്ഷേപത്തിന്റെ കാലയളവ, മറ്റ അടിസ്ഥാന വിശദാംശങ്ങൾ എന്നിവയെക്കുറിച്ചുള്ള വിശദമായ റിപ്പോർട്ട അനുബന്ധം- I ൽ നൽകിയിരിക്കുന്ന പ്രൊഫോർമയിൽ തയ്യാറാക്കേണ്ടതാണ

- അനുബന്ധം-II ൽ നൽകിയിരിക്കുന്ന സ്പെസിഫിക്കേഷനും ഡാറ്റയും അനുസരിച്ച ബയോമൈനിംഗ മുഖേന പ്രവൃത്തി നടപ്പിലാക്കുന്നതിന എസ്റ്റിമേറ്റ തയ്യാറാക്കേണ്ടതാണ.

- പ്രൊപ്പോസൽ തയ്യാറാക്കുന്നതിന്റെ ഭാഗമായി പ്രസ്തുത പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള എല്ലാത്തരം ചെലവുകളും പരിഗണിക്കേണ്ടതാണ.

- വാർഷിക പദ്ധതിയുടെ ഭാഗമായി പ്രോജക്ട ഏറ്റെടുക്കേണ്ടതും ലഭ്യമായ സ്രോതസ്സുകളിൽ നിന്നും ഫണ്ട വകയിരുത്തേണ്ടതുമാണ.

സാങ്കേതിക അനുമതി

നിലവിലുള്ള സാമ്പത്തിക അധികാരങ്ങൾ അനുസരിച്ച തദ്ദേശ സ്വയംഭരണ വകുപ്പ(ലോക്കൽ ഇൻഫ്രാസ്ട്രക്ച്ചർ & എഞ്ചിനീയറിംഗ വിങ) ലെ ബന്ധപ്പെട്ട എഞ്ചിനീയർ പ്രോജക്ടിന സാങ്കേതിക അനുമതി നൽകുകയും മാനദണ്ഡങ്ങൾ പാലിക്കുന്നതിനായി ചീഫ ടെക്നിക്കൽ എക്സാമിനർക്ക (ഫിനാൻസ വിംഗ) ആവശ്യമായ റിപ്പോർട്ടിംഗ ഉറപ്പാക്കുകയും ചെയ്യേണ്ടതാണ.

തദ്ദേശ സ്വയംഭരണ സ്ഥാപനങ്ങൾ ലെഗസി മാലിന്യ നിക്ഷേപ സൈറ്റുകൾ/ഭൂമികൾ വീണ്ടെക്കുന്നതിനുള്ള പദ്ധതി നിർവ്വഹണം നടത്തുന്നതിനുള്ള നടപടി ക്രമങ്ങൾ

ടെൻഡറിംഗ

- ലെഗസി മാലിന്യ നിക്ഷേപ സൈറ്റുകൾ വീണ്ടെടുക്കുന്നതിനുള്ള പ്രവൃത്തിയുടെ വിശദമായ സ്കോപ്പ ഓഫ വർക്ക, നിബന്ധനകളും വ്യവസ്ഥകളും മുതലായവ വ്യക്തമായി പരാമർശിക്കുന്ന 'ടു കവർ ബിഡ്സ താല്പര്യപത്രം'(Request for Proposa - wo Cover Bd) തയ്യാറാക്കേണ്ടതും ആയത നടപടിക്രമങ്ങൾ പാലിച്ച പ്രസിദ്ധീകരിക്കുകയും ചെയ്യേണ്ടതാണ.

- കേന്ദ്ര പാർപ്പിട-നഗരകാര്യ മന്ത്രാലയവും (MoHUA) സെൻട്രൽ പബ്ലിക ഹെൽത്ത & എൻവയോൺമെന്റൽ എഞ്ചിനീയറിംഗ ഓർഗനൈസേഷനും (CPHEEO) ചേർന്ന പ്രസിദ്ധീകരിച്ച "സ്വച്ഛ ഭാരത മിഷൻ (അർബൻ)-അഡ്വൈസറി ഓൺ ലാൻഡ്ഫിൽ റിക്ലമേഷൻ" ൽ നൽകിയിരിക്കുന്ന മാർഗ്ഗനിർദ്ദേശങ്ങളെ

അടിസ്ഥാനമാക്കി RFP-യിലെ വ്യവസ്ഥകൾ/യോഗ്യതാ മാനദണ്ഡങ്ങൾ നിശ്ചയിക്കാവുന്നതാണ.

- കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ പുറപ്പെടുവിച്ച "ഗൈഡലൈൻസ ഫോർ ഡിസ്പോസൽ ഓഫ ലെഗസി വേസ്റ്റ (ഓൾഡ മുനിസിപ്പൽ സോളിഡ വേസ്റ്റ) " പ്രകാരം ലെഗസി മാലിന്യ നിക്ഷേപങ്ങൾ നിർമ്മാർജ്ജനം ചെയ്യേണ്ടതാണെന്ന നിബന്ധന പ്രവൃത്തിയുടെ 'സ്കോപ്പ ഓഫ വർക്കിൽ' ഉൾപ്പെടുത്തുന്നുണ്ടെന്ന ഉറപ്പ വരുത്തേണ്ടതാണ.

- ലഭ്യമാകുന്ന ടെക്നിക്കൽ ബിഡ്സുകൾ പരിശോധിച്ച വിലയിരുത്തേണ്ടതും സാങ്കേതിക യോഗ്യത നേടുന്ന ബിഡ്ഡർമാരെ ബിഡ/ടെൻഡർ അംഗീകാരത്തിന്റെ തുടർ ഘട്ടത്തിനായി ഷോർട്ടലിസ്റ്റ ചെയ്യേണ്ടതുമാണ. ടെക്നിക്കൽ ബിഡ്സുകളുടെ മൂല്യനിർണ്ണയം നടത്തുന്നതിനായി താഴെപ്പറയുന്ന അംഗങ്ങളെ ഉൾപ്പെടുത്തി തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ സാങ്കേതിക സമിതി രൂപീകരിക്കേണ്ടതാണ;

    - സെക്രട്ടറി
    - LSGD (LID & EW) എഞ്ചിനീയർ
    - ഹെൽത്ത വിഭാഗം ഉദ്യോഗസ്ഥൻ (നഗര തദ്ദേശ സ്ഥാപനങ്ങളുടെ കാര്യത്തിൽ)
    - ജില്ലാ ശുചിത്വ മിഷനിൽ നിന്നുള്ള സാങ്കേതിക വിദഗ്ധൻ
    - ജില്ലാ മലിനീകരണ നിയന്ത്രണ ബോർഡിന്റെ പ്രതിനിധി
    - അക്കാദമിക സ്ഥാപനങ്ങളിൽ നിന്നുള്ള മറ്റ വിദഗ്ധർ

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ സാങ്കേതികമായി ഷോർട്ടലിസ്റ്റ ചെയ്ത ബിഡഡർമാരുടെ ഫിനാൻഷ്യൽ ബിഡ്സുകൾ തുറക്കേണ്ടതും നടപടിക്രമങ്ങളും മാനദണ്ഡങ്ങളും പാലിച്ച അംഗീകരിക്കേണ്ടതുമാണ.

- തിരഞ്ഞെടുത്ത കരാറുകാരന/ഏജൻസിക്ക ലെറ്റർ ഓഫ അവാർഡ (L O A) നൽകുകയും കരാറിൽ ഏർപ്പെടേണ്ടതുമാണ.

നിർവ്വഹണം, മേൽനോട്ടം, ബില്ലുകൾ തയ്യാറാക്കൽ

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന തലത്തിൽ തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയറും മാലിന്യ പരിപാലന പ്രവർത്തനങ്ങളുടെ നിരീക്ഷണ ചുമതലയുള്ള ഉദ്യോഗസ്ഥനും അടങ്ങുന്ന ഒരു മേൽനോട്ട സമിതി (Superv s on Commttee) രൂപീകരിക്കേണ്ടതാണ

- R F P ഡോകുമെന്റിലും കരാറിലും ഉൾപ്പെടുത്തിയിട്ടുള്ള 'സ്കോപ്പ ഓഫ വർക്ക' കരാറുകാരൻ കൃത്യമായി പാലിക്കുന്നുണ്ടോ എന്ന നിരീക്ഷിക്കുന്നതിനായി തദ്ദേശ സ്വയംഭരണ സ്ഥാപനം മേൽനോട്ട സമിതിയെ ചുമതലപ്പെടുത്തേണ്ടതാണ.

- പ്രസ്തുത പ്രവൃത്തി 'സ്കോപ്പ ഓഫ വർക്കിൽ' നിഷ്കർഷിക്കുന്ന പ്രകാരമാണോ നടപ്പിലാക്കുന്നതെന്ന മേൽനോട്ട സമിതി കൃത്യമായും പരിശോധിക്കുകയും നിരീക്ഷിക്കുകയും ചെയ്യേണ്ടതാണ.

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ കരാറുകാരന/ ഏജൻസിയ്ക്ക സൈറ്റ ഹാൻഡ ഓവർ ചെയ്ത നൽകേണ്ടതും പ്രവൃത്തി നടപ്പിലാക്കുന്നതിനുള്ള/ നിർവഹിക്കുന്നതിനുള്ള പിന്തുണ നൽകുകയും ചെയ്യേണ്ടതാണ.

- മാലിന്യ പരിപാലന പ്രവർത്തനങ്ങൾ നിരീക്ഷിക്കുന്നതിന്റെ ചുമതലയുള്ള ഉദ്യോഗസ്ഥൻ പ്രസ്തുത പ്രവൃത്തിയിൽ ഉൾപ്പെടുന്ന മാലിന്യ പരിപാലനവുമായി ബന്ധപ്പെട്ട പ്രവർത്തനങ്ങളായ വിൻട്രോ ഫോർമേഷൻ, മാലിന്യം

തരംതിരിക്കൽ, മലിനീകരണ നിയന്ത്രണ മുൻകരുതലുകളും ആരോഗ്യപരമായ കാര്യങ്ങളും ഉറപ്പുവരുത്തൽ എന്നിവയ്ക്ക മേൽനോട്ടം വഹിക്കേണ്ടതും കരാറുകാരന/ഏജൻസിക്ക മേൽനോട്ട സമിതി മുഖേന ആവശ്യമായ നിർദ്ദേശങ്ങൾ നൽകേണ്ടതുമാണ.

- തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ എംബുക്കിൽ 'ഇനിഷ്യൽ', 'ഇന്റർമീഡിയറ്റ്', 'ഫൈനൽ' ലെവലുകൾ എന്നിവ എടുത്ത അളവുകൾ രേഖപ്പെടുത്തേണ്ടതും, തദ്ദേശ സ്വയംഭരണ വകുപ്പിന ബാധകമായ അധികാരമനുസരിച്ച ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ വകുപ്പ (എൽ.ഐ.ഡി & ഇ.ഡബ്ല്യു) എഞ്ചിനീയർ ചെക്ക മെഷർമെൻറ നടത്തുകയും ചെയ്യേണ്ടതാണ.

- കരാറിൽ വിശദമാക്കിയിട്ടുള്ള ജോലിയുടെ വിവിധ ഘട്ടങ്ങൾ പൂർത്തിയാക്കിയ ശേഷം കരാറുകാരൻ/ഏജൻസി ക്ലെയിം ചെയ്യുന്ന പ്രവൃത്തിയുടെ വർക്ക ബില്ലുകൾ തദ്ദേശ സ്വയംഭരണ സ്ഥാപന എഞ്ചിനീയർ തയ്യാറാക്കേണ്ടതും തദ്ദേശ സ്വയംഭരണ സ്വയംഭരണ വകുപ്പിന ബാധകമായ അധികാരമനുസരിച്ച ബന്ധപ്പെട്ട തദ്ദേശ സ്വയംഭരണ വകുപ്പ (എൽ.ഐ.ഡി & ഇ.ഡബ്ല്യു) എഞ്ചിനീയർ ചെക്ക മെഷർമെൻറ നടത്തുകയും ചെയ്യേണ്ടതാണ.

- <u>GUIDELINES FOR IMPLEMENTATION OF PROJECTS FOR RECLAMATION OF LEGACY WASTE DUMPSITES THROUGH BIO REMEDIATION (BIO MINING AND MANAGEMENT OF RECOVERABLES AND REJECTS)</u>

As per the provisions of Solid Waste Management Rules 2016, local bodies are mandated to remediate legacy waste dumpsites and reclaim the land based on the guidelines issued by CPCB. Remediation of legacy dumpsites involves various activities such as assessment of the nature and quantity of waste to be remediated, excavation works to open the dumps, screening and sorting to segregate the waste fractions, reuse and sale/marketing of recovered materials, scientific disposal of rejects as per the norms. The remediation of dumpsites is further directed by Honorable NGT in its order on OA 519/2019 dated 17.07.2019. Subsequent to this, the Government of Kerala approved the Implementation Strategy for legacy waste remediation including demarcating the responsibility of various stakeholders for remediation of historical dumpsites through bio mining vide G.O (Rt) No.702/2020/LSGD dated 22.03.2020. However, the progress of implementation of such projects has not been satisfactory so far. One of the main reasons is that there is a lack of clarity in the procedures to be followed for legacy waste remediation projects right from the approval of the project to the mode of execution (including sale and disposal of recovered materials) by LSGIs since the nature of such projects is not similar to the general public construction/civil works. Also, the nature, quality and quantity of material that can be recovered from an existing legacy dumpsite cannot be accurately predetermined without opening up such dumpsites and hence it is not practical to prepare a workable estimate for the same like other public works . In order to tackle these issues, Swachh Bharat Mission(Urban) and CPHEEO have issued an "Advisory on Landfill reclamation", and suitable provisions of this advisory can be adopted for the State of Kerala. In these circumstances, the Government has examined this matter in detail, and the following guidelines are issued for the implementation of projects for remediation of legacy dumpsites by Local Self Government Institutions.

**<u>Standards, guidelines and advisories to be followed</u>**

- "Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)" issued by Central Pollution Control Board
- "SBM-U Advisory on Landfill Reclamation" published by MoHUA and

CPHEEO

- Guidelines issued by Government of Kerala in this regard from time to time

**Models for implementing legacy waste dumpsite remediation by LSGI's**

- 100% outsourced model (As per "SBM -U Advisory on Landfill Reclamation" published byMoHUA and CPHEEO)

**Implementing officer for legacy waste dumpsite remediation projects**

The implementing officer for legacy waste remediation shall be the Engineer of the LSGI

**Quantification of legacy waste to be remediated**

- The volume of legacy waste (in m3) to be remediated shall be generally assessed through Total Station Survey. If a total station survey is not feasible, a drone survey may be adopted for large dumpsites having a volume of more than 1 (One) Lakh m3.
- If required, external survey agencies may be engaged following laid down procedures and the cost for the same shall be met by LSGI from available funds.
- Contour mapping of the site shall be prepared and approved by the Engineer of the LSG

**Project Cost Estimation and Formulation by LSGI**

- Detailed report regarding the site conditions, nature of dump, history of dumping and other basic details shall be prepared in the format given in **Annexure - I**
- The estimate for biomining shall be prepared as per the specification and data given in
  - **Annexure -II**
- The overall cost for the implementation of the project shall be considered as part of the proposal.
- Project shall be taken up as per annual projects and funds from available sources shall be ear marked

**Technical Sanction**

- Technical sanction for the project shall be issued by the concerned Engineer in LSGD (LID & EW) as per the existing financial powers and necessary reporting to the Chief Technical Examiner (Finance Wing) may be ensured for compliance as per norms

**Implementation steps for remediation of legacy waste dumpsites by LSGIs**

**Tendering**

- Request for Proposals (RFPs-Two cover bid) clearly mentioning the scope of work, terms and conditions for reclamation of legacy waste dump sites shall be prepared and published as per laid down procedures.
- Conditions/eligibility criteria in the RFP shall be fixed based on the guidelines given in"**SBM-U Advisory on Landfill Reclamation"** published by MoHUA and CPHEEO
- It shall be ensured to mention in the scope of work that remediation of legacy waste dumpsites shall be undertaken as per the **"Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)"** issued by Central Pollution Control Board.
- The technical proposals received should be evaluated and technically qualified bidders shortlisted for further stage of bid approval. A Technical committee shall be formed at LSGI level for evaluation of the technical bids with the following members;
    - Secretary
    - LSGD (LID & EW) Engineer
    - Health Official (in the case of Urban local bodies)
    - Technical expert from District Suchitwa Mission
    - Representative from District Pollution Control Board
    - Other experts from academic institutions if any
- Financial bids of the technically shortlisted firms should be opened at LSGI level and approved as per procedures and norms
- Letter of Award (LoA) is to be issued to the selected contractor agency and agreement executed

**Execution, Supervision and preparation of bills**

- LSGI shall constitute a supervision committee consisting of LSGI Engineer and the officer in charge of monitoring waste management activity
    - LSGI shall authorise the supervision committee to monitor that the contractor correctly follows the scope of work included in the RFP document and agreement
- The supervision committee shall inspect and monitor that the work is being carried out as per the scope defined.
- LSGI Engineer shall hand over the site and provide support for execution of work at the site by the contractor/agency
- The officer in charge of monitoring waste management shall oversee the waste management related activities such as formation of windrows, segregation of waste into various streams,ensuring pollution control measures and health matters involved in the project and shall give direction to the contractor/agency through the supervision committee.

- LSGI Engineer shall measure, record quantities by taking initial, intermediate and final levels in M-book and Check measurements shall be done by the officials of LSGD (LID & EW) as per the powers vested with in the Local Self Government Department.
- LSGI Engineer shall prepare the work bills claimed by the contractor/agency after completing stages of work detailed in the agreement and check measurement shall be made by the officials of LSGD (LID & EW) as per the powers vested within Local Self Government Department.

അനുബന്ധം - I

PROPOSAL FOR BIO MINING / BIO REMEDIATION OF LEGACY WASTE DUMPSITE AT ..... CORPORATION /MUNICIPALITY/ GRAMA PANCHAYAT

BASIC DETAILS OF DUMPSITE

| | | |
|---|---|---|
| Name of LSGI | : | |
| Name of location of legacy dumpsite | : | |
| Extend of land (Acres) | : | |
| Survey No | : | |
| Land owned by | : | |
| Volume of waste (m3) | : | |
| Maximum depth below ground level (m) | : | |
| Maximum height above ground level (m) | : | |
| Approx. level of water table (m) | : | |
| GPS location (Co-ordinates & link to google map) | : | |
| Period from which dumping is done (in Years) | : | |
| Whether waste is still dumped at the site (Yes/No) | : | |
| Availability of water source for remediation process (Yes/No) | : | |
| Availability of electricity (Yes/No | | |

I/5470223/2022

DE AILED REPOR

- Introduct on (Br ef about the s te nc udng s te photograph)
- Survey deta s (Methodo ogy adopted, Deta s of eve measurements and quant ty ca cu at on)
- Cost est mate
    - Abstract est mate
    - Deta ed est mate
    - Data

S gnat**ure**

Des**g**nat on **o**f E**ng**neer n **c**harg**e**

Nam**e o**f LSG**I**

അനുബന്ധം - II

SPECIFICA ION & OBSERVED DA A FOR RECLAMA ION OF LEGACY DUMPSI E HROUGH BIO R M DIA ION ( o m g, man gng ecove abe and eje t

Bo remedat on (Bo mnng, managng recoverab e and rejects) by

**a.** Excavat ng the ex st ng mxed compacted garbage wh ch underwent b o og ca degradat on n the and port on a ocated and spray ng w th m croba nocuum for san t s ng and stab s ng the excavated mass, s ev ng them us ng Mechan ca s ev ng mach ne or any other equ pment,

**b.** Contro of ma odour us ng deodor z ng agent and stab z ng the waste us ng Bo Cu ture for aerob c ompo t g

**c** o f e dy d o po t g po e o de to ed e t e mp t of d mp g te t e dj e t e

**d** eg eg te t e e v ted g b ge t e d po to e m ked, to m y k d d tego e poss b e by mechan ca means nc udng the cost of any power or fue consumpt on.

**e.** Creat on and mantenance of nfrastructure, fac t es and amen t es for s ev ng, the excavated garbage, stor ng the segregated mater a s.

**f.** Dep oyment of necessary manpower, mater a s, equ pment, too s and creat on of fac t es for hand ng, separat ng, segregat ng and stor ng for the operat on of the p ant.

**g.** Leve ng the earth's surface by bu -dosser or any other earth mov ng equ pment

h. Provding security arrangements for the plan project site, machineries, equipment etc.

DSR 2018 Cost Index- 1.00 (For reference)

| Code | Description of Items | Unit | Quantity | Rate | Amount |
|---|---|---|---|---|---|
| | *Details of cost for 50 m3/day* | | | | |
| | LABOUR | | | | |
| 115 | Cooli | day | 20.00 | 558.00 | 11160.00 |
| | MACHINERY | | | | |
| MR | Double stage screener with conveyor | day | 1.000 | 7200.00 | 7200.00 |
| MR | Magnetic separator- capacity 5HP | day | 1.000 | 600.00 | 600.00 |
| MR | Dust screenning remover | day | 1.000 | 900.00 | 900.00 |
| MR | Baling press | day | 1.000 | 450.00 | 450.00 |
| 17 | Hire and running charges of tipper 5 m3 | day | 2.000 | 1700.00 | 3400.00 |
| 20 | Hydraulic excavator 3D with driver and fuel | day | 1.000 | 7000.00 | 7000.00 |
| 18 | Hire and running charges of loader | day | 1.000 | 5000.00 | 5000.00 |
| 9999 | Deodorizer & Inoculum | L.S | 124.860 | 2.00 | 249.72 |
| | Total | | | | 35959.72 |
| | Market Rate cost | | | | 9150.00 |
| | Add water charges 1% on MR | | | | 91.50 |
| | Net Total ( A) | | | | 9241.50 |
| | Total excluding Market rate | | | | 26809.72 |
| | Add water charges 1% on this | | | | 268.10 |
| | Net Total (B) | | | | 27077.82 |
| | Total A + Cost Index B | | | | 36319.32 |
| | Add CPOH 15% | | | | 5447.90 |
| | Total for 50 m3 | | | | 41767.22 |
| | Hence for 1 m3 | | | | 835.34 |

NB:- **Rates shall be prepared based on the cost index applicable to each locality*

# Thankyou!

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