GOVERNMENT OF MIZORAM
URBAN DEVELOPMENT & POVERTY ALLEVATION DEPARTMENT

SOLID WASTE MANAGEMENT SYSTEM FOR LUNGLEI TOWN

EIA REPORT

Prepared by

VOYANTS SOLUTION PVT LTD & ECO-MANAGEMENT SERVICES (ECOMS MIZORAM)

Executive Summary of EIA Report

Name of Project –

"EIA Report on Soild Waste Management System for Lunglei Town"

File No. -

For

GOVERNMENT OF MIZORAM

URBAN DEVELOPMENT & POVERTY ALLEVATION DEPARTMENT

Structure of EIA Reports		
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CHAPTER 1: INTRODUCTION

1.1 PREAMBLE

Directorate of Urban Development & Poverty Allevation Department (UD&PA) Mizoram, has assigned work to its Expert Technical team for preparation of Detailed Project Report on Lunglei Solid Waste Management. As per the scope of work specified, Technical team has prepared a detailed project report (DPR) which includes allied Engineering Drawings on Solid Waste Management Plan for Lunglei Town on an integrated approach in line with the guidelines of MoEF/CPCB and MSW Rules 2000.

Since, Environmental Management plays a vital role in the sustainable development of a country. Recognizing its importance, the Ministry of Environment and Forest, Government of India had formulated policies and procedures governing the industrial and other developmental activities to prevent indiscriminate exploitation of natural resources and to promote integration of environmental concern in project development. The Ministry of Environment, Forest and climate change (MoEF&CC) has made obtaining prior Environmental Clearance (EC) for developmental projects mandatory through its notification issued on 14th September, 2006 and its subsequent amendments.

UD&PA has appointed M/s. Voyants Solutions Pvt. Ltd and Eco-Management Services as a consultant for master planning for the project and consultant for grant of prior environmental clearance.

1.2 PURPOSE OF THE REPORT

The project is categorized under Schedule 7(i). The proponent is an Urban Local Body i.e. Lunglei, Mizoram. This report is being prepared as a part of the appraisal process for obtaining prior environmental clearance from MoEFCC.

The purpose of the EIA study is to evaluate and identify the potential effects of the proposed development of a SWMC. Environment Impact Assessment Study has been carried out considering the 10 km surroundings of the proposed project. The project falls under the Schedule 7 (i) Category B and will be appraised by the State Expert Appraisal Committee (SEAC), MoEF&CC.

The objectives of the present study are:

- To establish the existing environmental settings of the project area based on information obtained from primary data (baseline studies) and compilation of secondary data from published literature.
- To evaluate potential environmental impacts from the project during construction and operational phases and identify appropriate mitigation measures.
- To prepare an effective Environment Management Plan for proper implementation and monitoring of mitigation measures. To develop a post study monitoring program.

1.3 BRIEF DESCRIPTION OF NATURE, SIZE, LOCATION OF THE PROJECT

Lunglei is the second-largest city in Mizoram and is the headquarters of the Lunglei district. It is located in south-central Mizoram, 131 miles (211 km) south of Aizawl, the state capital. The geographical area of the district is 1382.51Sq.Kms. which is 6.56% of the state total geographical area. It is situated in between 23 º - 5' to 24 º - 35' North Latitude and 92 º - 3' to 93 º East Longitude. The District is covered by Humid Sub-tropical Hill Zone and Humid mild tropical zone. The solid waste management facility is away from the habitation clusters, Reserve /protected forest areas, National parks, wetlands or other places of importance.It is located at Tlabung Road near Riangvai Thlanmual (22°52'44.51"N, 92°43'48.88"E.) about 8.5 km away from town.

There is a need to enhance the existing SWM system for Lunglei town and thus improve the health and living standards of its residents. The project aims to improve the existing SWM practices within Lunglei, recognize deficiencies/gaps in the present system and propose a comprehensive plan for SWM in Lunglei town in compliance with the MSW Rules, 2000.

Lunglei district is situated in the south central region of the state surrounded by Aizawl, Mamit and Serchip district in the north, Hnahthial to the east and Bangladesh to the west. Total population of Lunglei as per 1991 census was 35,599 and as per 2001 census was 47,137 and as per 2011 census was 57.011. Table 1.1 shows the projected population of Lunglei town from 2017 to 2032. The averages of arithmetical & incremental increase methods have been considered for designing the SWM system for 15 years. The proposed plant is a sustainable resource management for non-biodegradable Solid waste of 14.27 = say 14.20 TPD, it is proposed that 15 TPD capacities. Waste collected from Lunglei Town is dumped at disposal site at Tlabung Road, 8.5 km away from Lunglei town core area, without segregation or preprocessing. The site is in used from last 8 years. An analysis of the

extensive survey data indicates that a total quantity of 25.65 TPD waste is generated in Lunglei Town (2011) out of which 30.10% (7.72 TPD) is biodegradable, 49.09% (12.59 TPD) is recyclable and 20.81% (5.34 TPD) is inert ash & debris. The calculations also suggest that per capita per day waste generation is around 0.450 kg/ capita/ day. The Proposed site is located at Tlabung Road near Riangvai Thlanmual (22.874268, 92.730476). A total land of 7.2 hectare has been identified for the project in which approx 33% of the total area will be reserved for green belt and open area.

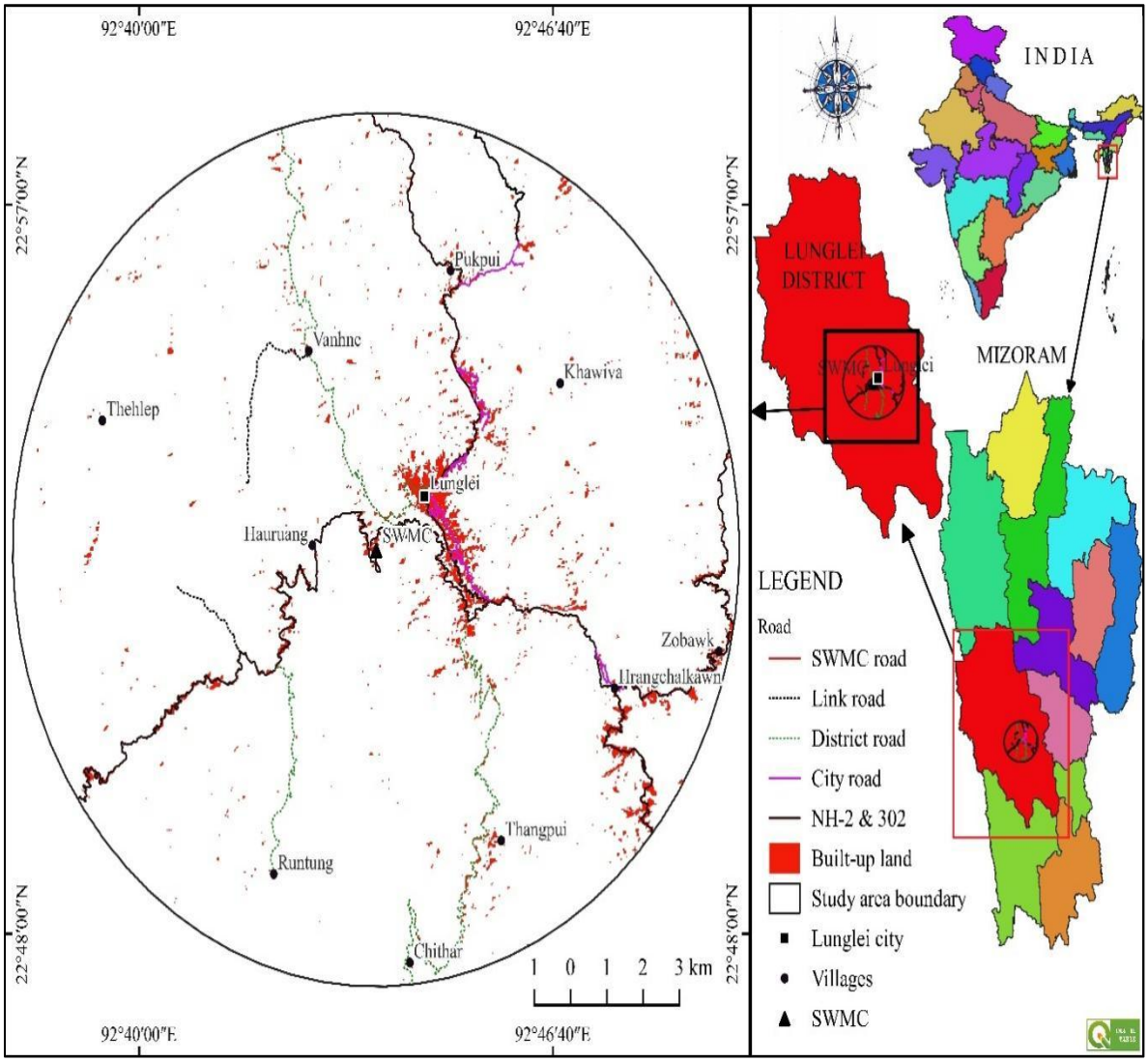

Figure 1.1 Location Map of the Project

Table1.1: Projected population of Lunglei town from 2017 to 2032

Year	Arithmetic Increase method	Geometric Progression Method	Incremental increase method	Average of All Method	Average of Arithmetic Increase method and Incremental increase method
2011	**57011**	**57011**	**57011**	**57011**	**57011**
2012	58082	58375	58353	58270	58218
2013	59152	59772	59745	59556	59449
2014	60223	61203	61186	60871	60705
2015	61293	62667	62676	62212	61985
2020	62364	64167	64215	63582	63290
2017	**63435**	**65703**	**65804**	**64981**	**64620**
2018	64505	67275	67443	66408	65974
2019	65576	68885	69130	67864	67353
2020	66646	70534	70868	69349	68757
2021	67717	72222	72654	70864	70186
2022	**68788**	**73950**	**74490**	**72409**	**71639**
2023	69858	75720	76375	73984	73117
2024	70929	77532	78310	75590	74620
2025	71999	79387	80294	77227	76147
2026	73070	81287	82327	78895	77699
2027	74141	83232	84410	80594	79276
2028	75211	85224	86542	82326	80877
2029	76282	87264	88723	84090	82503
2030	77352	89352	90954	85886	84153
2031	78423	91490	93234	87716	85829
2032	**79494**	**93680**	**95564**	**89579**	**87529**
2033	80564	95922	97942	91476	89253
2034	81635	98217	100371	93408	91003
2035	82705	100568	102848	95374	92777
2036	83776	102974	105375	97375	94576

2037	84847	105439	107952	99413	96400
2038	85917	107962	110578	101486	98248
2039	86988	110546	113253	103596	100121
2040	88058	113191	115977	105742	102018
2041	89129	115900	118751	107927	103940
2042	**90200**	**118673**	**121574**	**110149**	**105887**
2043	91270	121513	124447	112410	107859
2044	92341	124421	127369	114710	109855
2045	**93411**	**127399**	**130340**	**117050**	**111876**

Source: Mizoram Statistical Handbook 2021

Table 1.2: Salient Feature of the Project

S. No.	Item	Description
1	Title of the project	Solid Waste Management System for Lunglei Town, Mizoram
2	Location and Area	The Proposed site is located at Tlabung Road near Riangvai Thlanmual (22.874268, 92.730476) with an area of 72888.57 sq.m.
3	District	Lunglei
4	Corporation/Municipality/Panchayat	UD&PA, Lunglei Municipal Corporation
6	Implementing agency / SPV	UD&PA
7	Nature of the project (New / Existing / Upgradation)	New
8	Total estimated cost and item wise cost break up	6 cr.
9	Social Amenities	Social amenities like safe drinking water facility, better road connectivity will be developed along with the residential township.

- **Airport Connectivity**: The project site area is located at a distance of approx. 201 kms from Lengpui Airport.
- **Rail Connectivity:** No Railway connectivity near the project site
- **Road Connectivity:** The nearest National Highway is NH 302.
- **Sea Port:** No Seaport available near the project site.

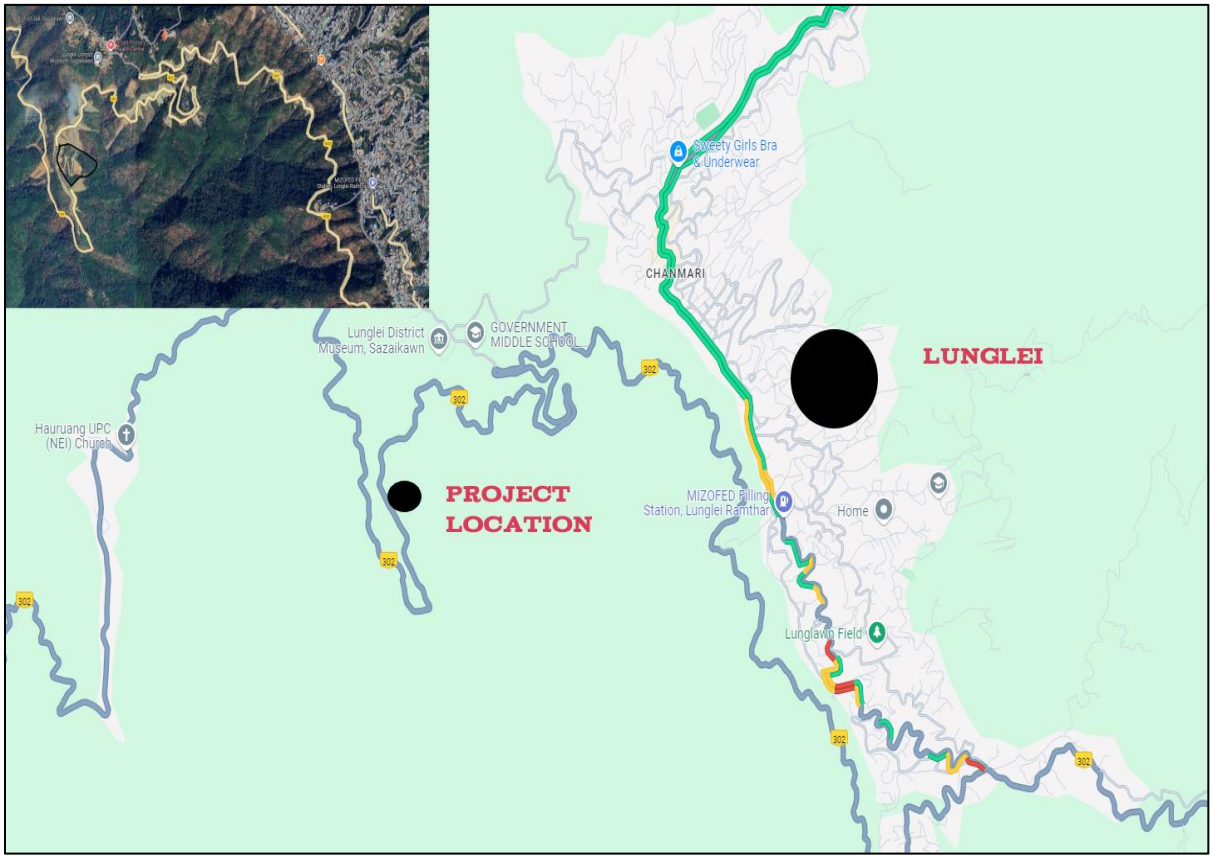

Figure 1.2 Regional Location Map of the Project

1.4 EIA CONSULTANT

M/s. Voyants Solution Pvt. Ltd., 403, 4th Floor, BPTP Park Centra, Sector-30, NH-8, Gurugram – 122001, Haryana has been retained for preparation of Detailed Project Report (DPR) and as Environmental Consultant to carry out EIA-EMP study. The organization is accredited with NABET/ Quality Control of India to conduct the Environment Impact Assessment Studies for Industrial estates/ parks/ complexes/ Areas, export processing zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes.

Eco-Management Services, Zemabawk North, Tlangveng Aizawl Mizoram 796017, is a young promising partnership firm dealing in different fields of Environmental monitoring and Impact assessment including hydrological surveys inside the state of Mizoram. The organization have several experiences in the field of environmental components such as Air, Water, Soil and Noise quality Monitoring also on floral diversity assessment. They deal with clients from different Government departments as well as some consultancy firms inside Mizoram.

1.5 IMPORTANCE TO THE COUNTRY, REGION

India's achievement in economic growth and poverty reduction in recent years has been remarkable. Contribution of reforms in Health and hygiene sector especially improvement in Municipal Solid waste management, Water Supply and Sewerage condition is considerably significant. However, regional imbalances and disparities in income and poverty persist. While the poverty incidence is less than 15% in some northwestern and southern states, in many central and eastern states more than 40% of the population remains below the poverty line.

The poor quality of urban infrastructure is one factor constraining the urban development of major part of the state. The proposed project "development " is strategically proposed with respect to its accessibility through existing road (tlabung road). In recent past major migration from rural areas and development in housing and educational institution has been observed in Aizawl city, this pattern is continuing for Lunglei Town. The improved Municipal Solid Waste Management Facility will contribute to development in Housing, commercial and educational Institution as well as economic opportunities and poverty reduction in the area that the proposed project serves, and in turn improve the overall health and hygiene condition and economic wellbeing of the city and Mizoram state.

1.6 SCOPE OF STUDY

The scope of the Environment Impact Assessment (EIA) study covers to identify, predict and evaluate potential environmental and socio-economic impacts which may result from the proposed Municipal Solid Waste Management project and to develop suitable Environment Management Plan (EMP) to mitigate the impacts by formulating suitable remedial measures.

The study is conducted to:

- Establish the baseline environmental conditions at the project site and surrounding areas within 10 Km radius of the project site.
- Identifying and quantifying the adverse impacts of the proposed project on the environment, socio-economic conditions of the people etc.
- Preparation of Environmental Management Plan (EMP) entailing remedial measures.
- Development of post construction environmental monitoring programme.
- The EIA study shall be conducted as per the applicable guidelines of Ministry of

Environment and Forests & Climate Change, Govt. of India. The Terms of Reference of the project has been issued by State Expert Appraisal Committee(SEAC).

1.7 EXISTING SOLID WASTE MANAGEMENT IN LUNGLEI

The existing SWM practices prevalent in Lunglei town including sources of waste generation, current waste collection practices, waste transportation & disposal mechanism and gaps in existing SWM system. The information provided in this chapter was collected by a team through site investigations, survey, interactions with concerned officials of Local Authorities, staff of SWM service providers, local residents and various other stakeholders. The survey methodology adopted for collection of required data is as follows:

i. Identification & survey of major sources of waste generation based on the field survey and discussions with various stakeholders in Lunglei town

Various sources of waste generation were identified in Lunglei Town by field survey and discussions with various stakeholders in town. During discussions with the stakeholders it was highlighted that major sources of waste generation in Lunglei town are residential areas, commercial areas, hotels/restaurants/banquet halls, street sweeping, drain cleaning & construction and demolition sites. Survey was conducted by Staffs of UD&PA Dept. Lunglei within Lunglei town of major waste generation points viz households, commercial area and Sabzi Mandis etc. with an aim to study existing SWM practices including waste collection, storage & transportation infrastructure, frequency of waste collection, segregation, recycle & disposal practices, quantification & characterization of waste. Sample survey sheets are appended in Annexure 3.1.

ii. Analysis of findings of the quantification & characterizations of waste

As the available population figures are from census data, hence adequate projections have been made as per the methodology provided in the SWM Manual.

iii. Study of handling & management of waste from generation point to ultimate disposal

The analysis results were considered for understanding the existing waste management system and then in further planning of the proposed system. The details of existing waste management system of Lunglei Town are given in the subsequent sections of this chapter.

1.8 ENVIRONMENT SENSITIVITY STUDY

The environment sensitivity study of 15km radius around the project boundary is explained below in Table 1.3

S. No.	Areas	Name / Identity	Aerial distances (within 15 km.) Proposed project location boundary.
1.	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related values.	No	None identified in the study area or in close proximity.
2.	Areas, which are important or sensitive for ecological reasons – Wetlands, watercourses or other water bodies, coastal zone, biospheres. Mountains, forests etc.	Yes	Raungte river is located towards the south West of the proposed project site having a distance of 2.1 Km.
3.	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, overwintering, migration.	No	None has been identified in the study area.
4.	Inland, coastal, marine or underground waters	No	None in the study area
5.	State, National boundaries	No	None
6.	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	No	None
7.	Defence installations	No	None in the study area
8.	Densely populated or built-up area	Yes	Lunglei town is located on North East of the project site.
9.	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	No	None
10.	Areas containing important, high quality or scarce resources (groundwater resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	No	None
11.	Areas susceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions)	No	The project area may vulnerable to the Cyclones due to adverse climatic conditions.

Table 1.2: Sensitivity Study of 15KM Radius

1.9 ENVIRONMENTAL POLICY, LEGISLATION & REGULATORY FRAMEWORK

The important environmental legislations in India are given in the following table. Some of the legislations mentioned in below table may not directly affect/relevant to the environment management and there is no specific order of listing with reference to relevance, coverage and time of enforcement.

Table 1.3: Overview-Environmental Legislations in India

Name	Scope and Objective	Key Areas	Operational Agencies/Key player
Water (Prevention and Control of Pollution) Act, 1974,	To provide for the prevention and control of water pollution and enhancing the quality of water	Control sewage and industrial effluent discharges	MoEF&CC, Central and State Pollution Control Boards
Air (Prevention and Control of Pollution) Act, 1981,	To provide for the prevention and control of air pollution	Controls emission of air pollutants	MoEF&CC, Central and State Pollution Control Board
Wildlife (Protection) Act, 1972,	To protect wildlife	Creates protected areas (national parks / sanctuaries) categories of wildlife which are protected	Wildlife Advisory Boards, Central Zoo Authorities
Environment (Protection) Act, 1986	To provide for the protection and improvement of environment	An umbrella legislation, supplements pollution laws	Central government nodal agency, MoEF&CC can delegate to state departments of environment
Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.	To define responsibility of hazardous wastes generators, require safe handling practices and maintenance of manifest systems during transport of hazardous waste and describe technological aspects to be followed up by re-refiners and recyclers of hazardous wastes. Also, define liabilities of occupier,	Providing control, specifying the responsibilities and regulating generators and transporters of Hazardous wastes.	State and central pollution control board, MoEF&CC

Name	Scope and Objective	Key Areas	Operational Agencies/Key player
	transporter and operator of a facility for any damages caused due to improper handling and disposal of hazardous wastes by reinstating or restoring environmental damages caused.		
Construction and Demolition Rules, 2016	To segregate the waste at source into four streams, its handling, consumption of the materials generated during construction and demolition activities. Devise storage, processing, recycling facilities and dump the un-utilized waste at a suitable landfill site. To define roles and responsibilities of waste generators, service providers, setting up duties of State Government, local authorities, CPCB, SPCB to set up a system for waste management and handling. To lay down standards for products of Construction & Demolition waste and make provisions for processing and recycling facilities.	Waste generators who generate more than 20 tons or more in one day or 300 tons per project in a month shall segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar and shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition or remodeling work and keep the concerned authorities informed regarding the relevant activities from the planning stage to the implementation stage.	State Government and Central Government
Solid Waste Management Rules, 2016	To mandate waste generator to segregate and store the waste generated by them in three separate streams namely biodegradable, non-biodegradable and domestic hazardous wastes in suitable bins	Segregation of waste at source, Collection and disposal of Sanitary waste, user fees for collection, Waste processing & treatment	State and Central Pollution Control Boards. Local Governing bodies

Name	Scope and Objective	Key Areas	Operational Agencies/Key player
	and handover segregated wastes to authorized waste pickers or waste collectors as per the direction or notification by the local authorities		
Forest (Conservation) Act, 1980,	To consolidate acquisition of common property such as forest, halt India's rapid deforestation and resulting environmental degradation	Regulates access to natural resources, state has a monopoly right over land, categories forests, restriction on de-reservation and using forest for non-forest purpose	State Government and Central Government
EIA Notification 2006 and amendment thereof	Prior environmental clearance for new developmental projects – procedure and categorization.	To institute mechanism for grant of prior environmental clearance for new development projects and expansions of existing projects	Project Development authorities, State Environmental Impact Assessment Authority (SEIAA) and MoEF&CC
National Water Policy, 2012	Legislation needed in view of inequalities in distribution and lack of unified perspective in planning, management and use of water resources with due consideration to environmental sustainability and holistic benefit to the people.	To recognize and consider while planning the environmental needs of aquatic ecosystem, wetlands and embanked flood plains besides adaptation to strategies to provide a mechanism for dealing with increased variability due to climate change.	State and Central Government
Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013	To address concerns of farmers and those whose livelihoods are dependent on land being acquired and at the same time facilitating land acquisition in a timely and transparent manner and for ensuring a comprehensive package for the land owners for	Social issues	Central and State Government

Name	Scope and Objective	Key Areas	Operational Agencies/Key player
	calculation of market value of the land besides comprehensive rehabilitation and resettlement package for land owners.		
Industrial (Development and Regulation) Amendment Act, 2016	To take necessary actions for planning and development of Industries, regulate the path of Industrial development and implementation of Industrial policy, also to control the activities, their performance and outcome of Industrial undertakings in the public interests.	Promote development of Industries, regulate and monitor the implementation of policy and performance of undertakings.	Central Government
The Indian Factories Act, 1948 & state rules	To regulate the working conditions in factories, to regulate health, safety, welfare, and annual leave and enact special provisions in respect of young persons, women and children who work in the factories.	General duty of the employer to ensure as far as practicable health, safety and welfare of all workers while they are at work in the factory. A general policy with respect to H&S of the workers at work should be in the form of a written statement and brought to the notice of the workers per the provision of the Act Provisions relating to Safety are those relating to the usage of machinery, handling of hazardous substances and the latest amendments include safety measures for hazardous processes.	Directorate of Industrial Safety and Health (DISH) / Deputy Chief Inspector of Factories

1.10 STRUCTURE OF THE EIA REPORT

Any major project is likely to affect the quality of the surrounding environment during construction as well as operation phases. The nature and magnitude of impacts on various components of the environment vary depending on the nature and size of the project, as well as its geographical location.

The impacts can be quantified through EIA studies for various components like air, noise, water, land, biological and socio-economic environment prior to the implementation of the project. The EIA studies form the basis for preparing an Environmental Management Plan to protect and conserve the quality of the environment in the region. The EIA studies can be divided into three distinct phases. The first is the identification of significant environmental parameters and assessing their baseline (pre-project) status within the impact zone. The second phase is prediction of impacts on various identified environmental parameters due to proposed project using mathematical models. Data regarding the nature of the project, waste generation, characteristics of storage materials and site conditions of the impact zone form the inputs for the prediction models. The third phase includes the evaluation of final impacts after superimposing the predicted impacts over the baseline status and preparation of Environmental Management Plan, which helps in incorporation of proper mitigation measures, wherever necessary, for preventing deterioration in the quality of the surrounding environment.

Contents of the EIA and EMP study reports have been arranged in 12 separate chapters as follows:

Table 1.4: EIA Report Structure

Chapter No.	Chapter Heading	Chapter Description
1	Introduction	Describes general information of Industrial Estate, study methodology, Environment Clearance method, brief description of proposed Project, location and connectivity, identification of project & project proponent, legislation applicable to the project, EIA report structure, ToR Compliance etc.
2	Project Description	This chapter elaborates the project salient features, location, technology and process description, components of project, etc.
3	Description of the	The chapter defines study area, study period, concept and

Chapter No.	Chapter Heading	Chapter Description
	Baseline Environmental Components	methodology adopted for baseline data collection, establishment of baseline for valued environmental components covering physico-chemical, biological and Socio-economic components and base maps of environmental components.
4	Anticipated Environmental Impacts & Mitigation Measures	Assessment of anticipated environmental impacts due to project activities and suggesting measures for mitigating those impacts are the main crux of this chapter.
5	Analysis of Alternatives (Technology and site)	General information of alternative technology, alternate site, details of building materials, energy conservation, and transportation.
6	Environmental Monitoring Programme	Describes the environment-monitoring programme for area of concern and environment management group. Details of Environment policy/violation of environment norms/hierarchal system and environment monitoring plan during operational phase.
7	Additional Studies	Describes Risk assessment and Disaster Management, natural resource conservation, impacts on Traffic, occupational Health and Safety.
8	Project Benefits	Describes social and other benefits of the project
9	Environmental Cost Benefit Analysis	Describes the ratio of benefit to the investment cost of the project
10	Environmental Management Plan	Describes the management plan to mitigate the impact of project activities on environment
11	Summary and Conclusion	This chapter describes the brief summary of project and recommendations
12	Disclosure of Consultant	This chapter depicts the team of consultants engaged in the study

1.11 RESPONSE TO TERMS OF REFERENCES

Preparation of Environmental Impact Assessment, Environmental Monitoring Plan and Environment Management Plan for Solid Waste Management Centre at Lunglei, Lunglei District, Mizoram.

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Sl.No	Terms of references	Responses to ToR
1	Project Name and Location	Solid Waste Management Center at Lunglei, Mizoram.
2	Site selection of the project- nature of land- Agricultural (single/double crop) barren, Govt/private land, status of its acquisition, nearby (in 2-3 km.) water body, population, within 10km, other industries, forest, eco-sensitive zones.	The detailed Site selection is given on 2.3 Location of the project site on page no.12-13. Land used Pattern is given on Fig: 3.11 page 79.
3	Occupational health issues. Baseline data on the health of the population in the impact zone and measures for occupational health and safety of the personnel and man-power.	Occupational health issues is given on on Chapter 8, under Public Health Monitoring on page No.142 and 151. Measures Will be taken during construction phase.
4	A 10 km radius map (on survey of India toposheet) showing location with co-ordinates of project site, national highway, approach road, river/stream, natural drainage, protected areas, archeological sites, natural lake, flood area, human settlements (with population), industries high tension electric line, prominent wind direction (summer and winter), effluent drain, if any and ponds etc. should be presented and impacts assessed on the same.	Figure 3.1 of Chapter 3. presents the latest topographical map from Survey of India (SoI) covering 10km radius from the project location.
5	Layout plan/map of the project site showing storage area, green belt area (33% of the project area), all roads prominent wind direction, processing plan & other infrastructure, etc.	Layout plan/map of the project, all roads prominent wind direction, processing plan & other infrastructure, etc. Shown in annexure. Greenbelt area map given in page 109.

6	Detailed plan for construction of retaining wall to check dispersal of waste to other areas.	Included in Annexure.
7	Fire control plan to check fire break in adjoining areas. Open burning in landfill sites should be discontinued. Risk assessment and on-site emergency plan should be prepared.	Fire control Plan is mentioned under the heading Fire Fighting System on page no.124 of Chapter 7.
8	Details of storm water/leachate collection from the compost area.	Drawing and Plan included in Annexure.
9	Details of monitoring of water quality around the landfill site. Water analysis shall also include for nitrate and phosphate.	Water quality will be monitored seasonally during construction and operational phase. Baseline data in pg 59 & 60 of chapter 3.
10	Details of odour control measures	Odour control measures given on Page 166 in Chapter 9. Page 43 (Landfill gas and management) of chapter 2 also highlight measures for landfill gas.
11	Details of surface hydrology, depth of ground water, water bodies and drains located all around the site and also examine the impacts on the nearby habitats/settlements, drainage and water bodies/rivers/streams and mitigative measures during rainy seasons.	Details of surface hydrology, depth of ground water, water bodies are given on page 61 and 62 of chapter 3. Drainage section on Pg 51.
12	Status of ambient air quality and surface and groundwater quality, soil type, cropping pattern, land use pattern, population, socio-economic status, anticipated air and water pollution.	Status of ambient air quality and surface and groundwater quality, soil type, cropping pattern, land use pattern, population, socio-economic status is written on Chapter 3

		starting from page No 77.
13	Details of impact on water bodies/rivers/ponds and mitigative measures during rainy season.	Drawing and Plan included in Annexure. Impact on water bodies/rivers/ponds and mitigative measures during rainy season is higlighted in EMP PAge no.170.
14	Submit the criteria for assessing waste generation. Any segregation of hazardous and bio-medical waste.	Categorization of waste is given in Chapter 2 table 2.1.
15	Submit a copy of the land use certificate from the competent authority.	A copy of the land use certificate is submitted.(Annexure)
16	Details of one complete season AAQ data (except monsoon) with the dates of monitoring, impact of the project on the AAQ of the area (including H_2S, CH_4).	Details of one complete season AAQ data (except monsoon) with the dates of monitoring is given on page No.Page 57 on chapter 3 under Air Quality.
17	Submit a copy of the topography of the area indicating whether the site requires any filling, quantity of fill material required, its source and transportation, etc.	Topography of the area is mentioned in Chapter 3 page No.46.
18	Detail plan of Waste Management	Detail plan of Waste Management is given under pg 13 & 17 of chapter 2.
19	Details of protection from surface drainage, and action plan for measures to be taken for excessive leachate generation during monsoon period.	Drawing and Plan included in Annexure. Action Plan given in pg.41 under Chapter 2 and pg 170 under chapter 9.
20	Details of impact on environmental sensitive areas.	No environmental sensitive areas.
21	Details of air emission, effluents generation, solid waste generation and their management.	It will be complied during operation phase.

22	Details of rehabilitation/compensation package for the project effected people, if any.	No rehabilitation/compensation package for the project effected people as the project located outskirt of the town.
23	Details of various waste management units with utilities indicating size and capacity of the proposed project.	Included in DPR
24	Methodology for remediating the project site, which is being used for open dumping of garbage.	It will be closed scientifically after construction of new MSWC.
25	Detailed Environmental Monitoring Plan and Environmental Management Plan with costs and parameters.	Detailed Environmental Monitoring and Environmental Management Plan with costs and parameters Plan is given on Chapter 8 and 9.
26	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.	The proposed capital cost for the project is INR 6.69 Crores and total investment on environmental improvement i.e EMP works is envisaged Rs. 20.00 lakhs as written on page 135.
27	Details of pending against the project, if any, with direction/order passed by any court of Law against the project should be given.	There is no litigation is pending against the proposed project. Hence not applicable.
28	The draft EIA/EMP report as per above ToR shall be submitted to the state Pollution Control Board for public hearing and issues raised by the public shall be incorporated in the Final EIA/EMP report.	The draft EIA/EMP report as per above ToR will be submitted to Mizoram Pollution Control Board for public hearing and issues raised by the public and will be incorporated in the Final EIA/EMP report.
29	Public hearing may also be conducted for	It will be conducted as mentioned in

	the project, in accordance with provisions of Environmental Impact Assessment Notification, 2006.	ToR no. 29.
30	In addition, the following safeguards may be included in the project: a) Timeline for shifting to zero landfill and 100% waste utilization, treatment and processing. Focus need to be on creation of waste to wealth. b) Retaining wall along the dumping site may be built to check the dispersal of waste. Moreover, adequate infrastructure may be created to avoid leakage of pollutants from dumped waste through underground water.	It will be complied as per ToR.

1.12 EXTENT OF EIA STUDY

EIA was conducted based on feasibility report and project details provided by the design team during the preparation of this report. Certain changes may occur in the project structural components but these changes are unlikely to cause significant environmental impacts. The extent of EIA has been decided considering all likely Impacts and risks analyzed in the context of the project's area of influence. The area of influence encompasses

(i) the primary project site(s) and related facilities

(ii) associated facilities whose viability and existence depend exclusively on the project

(iii) areas and communities potentially affected by cumulative impacts from further planned development of any existing project or condition, and other project-related developments that are realistically defined at the time the assessment is undertaken; and

(iv) areas and communities potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at different locations.

The core zone of impact is taken as the outer boundary of proposed municipal land fill facility and its immediate vicinity. The assessment also considers the areas and activities related to associate facilities viz construction of worker camp, Construction yard, transportation routes etc. The study area considered up to 10 km radius of proposed project site for larger analysis of land use and other environmental features. Assessment is carried out for all components of environment covering terrestrial and aquatic ecology, soil, water, noise and socio economic aspects.

1.13 SITING GUIDELINES

These are the guidelines, stakeholders may consider while siting the developmental projects, to minimize the associated possible environmental impacts. While in some situations, adhering to these guidelines is difficult and unwarranted. Therefore these guidelines may be kept in the background, as far as possible, while taking the decisions. Setting up of such facilities in critically polluted areas identified by MoEF from time-totime may be avoided to the maximum extent possible.

Siting guideline specifications for landfill as per MSW rules 2000 include the following:

- In areas falling under the jurisdiction of 'Development Authorities' it shall be the responsibility of such Development Authorities to identify the landfill sites and hand over the sites to the concerned municipal authority for development, operation and maintenance. Elsewhere, this responsibility shall lie with the concerned municipal authority.
- Selection of landfill sites shall be based on examination of environmental issues. The Department of Urban Development of the State or the Union territory shall co-ordinate with the concerned organizations for obtaining the necessary approvals and clearances.
- The landfill site shall be planned and designed with proper documentation of a phased construction plan as well as a closure plan.
- The landfill sites shall be selected to make use of nearby wastes processing facility. Otherwise, wastes processing facility shall be planned as an integral part of the landfill site.

- The existing landfill sites, which continue to be used for more than five years, shall be improved in accordance of the specifications given in this Schedule.
- Biomedical wastes shall be disposed off in accordance with the Bio-medical Wastes (Management and Handling) Rules, 1998 and hazardous wastes shall be managed in accordance with the Hazardous Wastes (Management and Handling) Rules, 1989, as amended from time to time.
- The landfill site shall be large enough to last for 20-25 years.
- The landfill site shall be away from habitation clusters, forest areas, water bodies, monuments, National Parks, Wetlands and places of important cultural, historical or religious interest.
- A buffer zone of no-development shall be maintained around landfill site and shall be incorporated in the Town Planning Department's land-use plans.
- Landfill site shall be away from airport including airbase. Necessary approval of airport or airbase authorities prior to the setting up of the landfill site shall be obtained in cases where the site is to be located within 20 km of an airport or airbase.

CHAPTER 2: PROJECT DESCRIPTION

2.1. TYPE OF PROJECT

Proposed project is of Municipal Solid Waste Management Facility having capacity of 15 MTPD. Municipal Solid Waste Management Facility in Lunglei Town, an analysis of the extensive survey data indicates that a total quantity of 25.65 TPD waste is generated in Lunglei Town (2011) out of which 30.10% (7.72 TPD) is biodegradable, 49.09% (12.59 TPD) is recyclable and 20.81% (5.34 TPD) is inert ash & debris. The calculations also suggest that per capita per day waste generation is around 0.450 kg/ capita/ day. At present, waste collected from Lunglei Town is dumped at disposal site at Tlabung Road, 8.5 km away from Lunglei town core area, without segregation or pre-processing. The site is in used from last 8 years, since crude dumping is being done at this site, it posses severe negative impacts on environment.

2.2. NEED FOR THE PROJECT

The poor quality of urban infrastructure is one factor constraining the urban development of major part of the Mizoram state. The proposed project "development of Solid Waste Management Centre" is strategically proposed w.r.t to its accessibility through Tlabung road. In recent past major development in housing, educational institution has been observed in Lunglei City. The improved Municipal Solid Waste Management Facility will contribute to development in Housing, commercial and educational Institute as well as economic opportunities and poverty reduction in the area that the proposed project serves, and in turn improve the overall health and hygiene condition and economic well being of the Lunglei Town and Mizoram state. Since Mizoram is one of the least-developed states (as measured by social and economic indicators), this development is expected to contribute to the overall reduction of interstate disparities in India. The Project's immediate outcome will be improved health and hygienic and beautification in the project area resulting from 0.reduction in health and hygienic problem in the project city.

2.3. LOCATION OF THE PROJECT SITE

Lunglei district is situated in the south central region of the state surrounded by Aizawl, Mamit and Serchip district in the north, Hnahthial to the east and Bangladesh to the west.

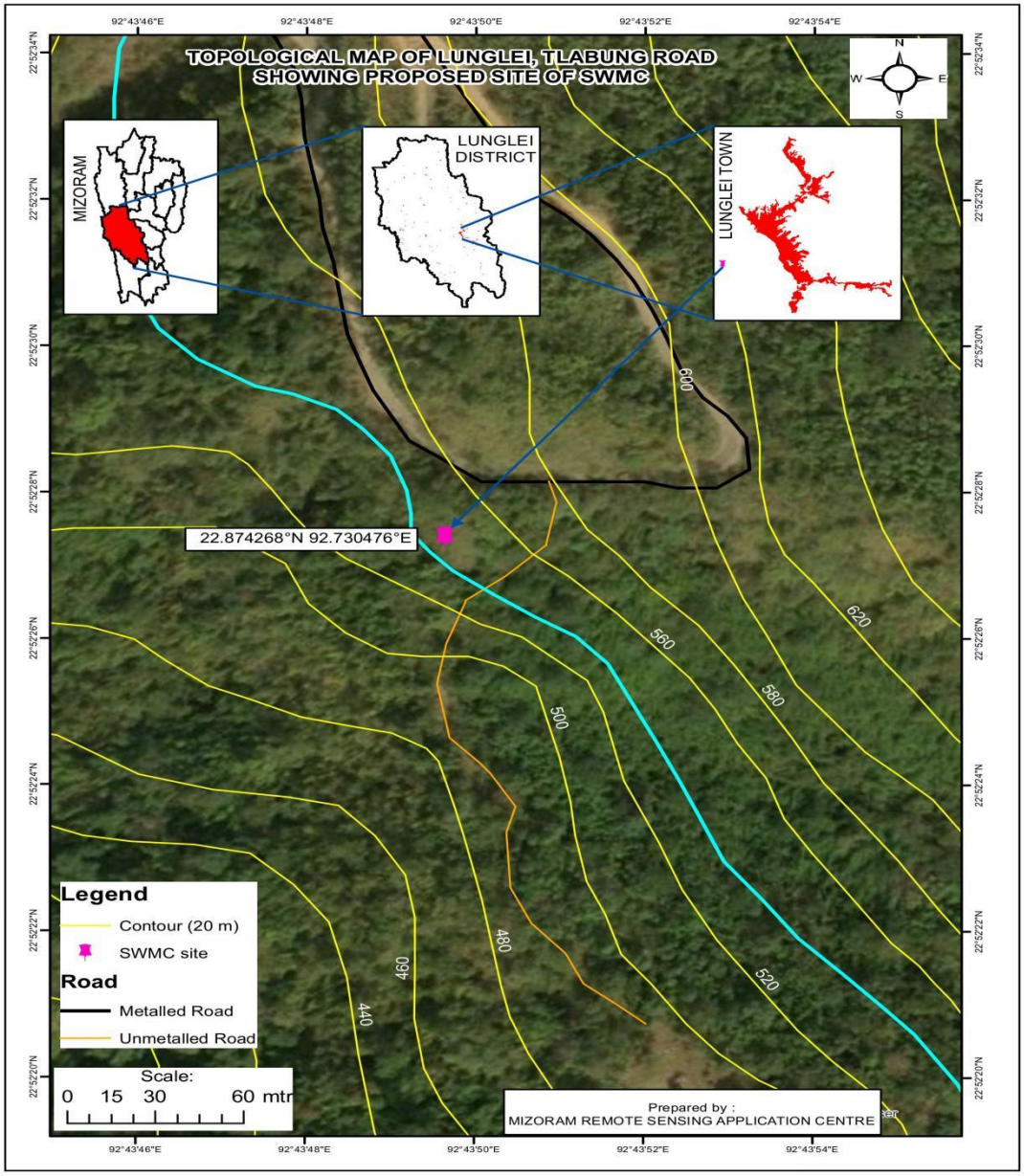


Figure 2.1 Topology Map of Lunglei SWMC

The Lunglei Town encompasses an area of 36.00 km^2 divided into 24 wards. As per census 2011, the population of Lunglei is 57,011. The total length of roads is about 54.08 kms. . The proposed plant is a sustainable resource management for non-biodegradable Solid waste of 14.27 = say 14.20 TPD, it is proposed that 15 TPD capacities. The Proposed site is located at Tlabung Road near Riangvai Thlanmual (22.874268, 92.730476). A total land of 7.2 hectare has been identified for the project in which approx 33% of the total area will be reserved for green belt and open area.

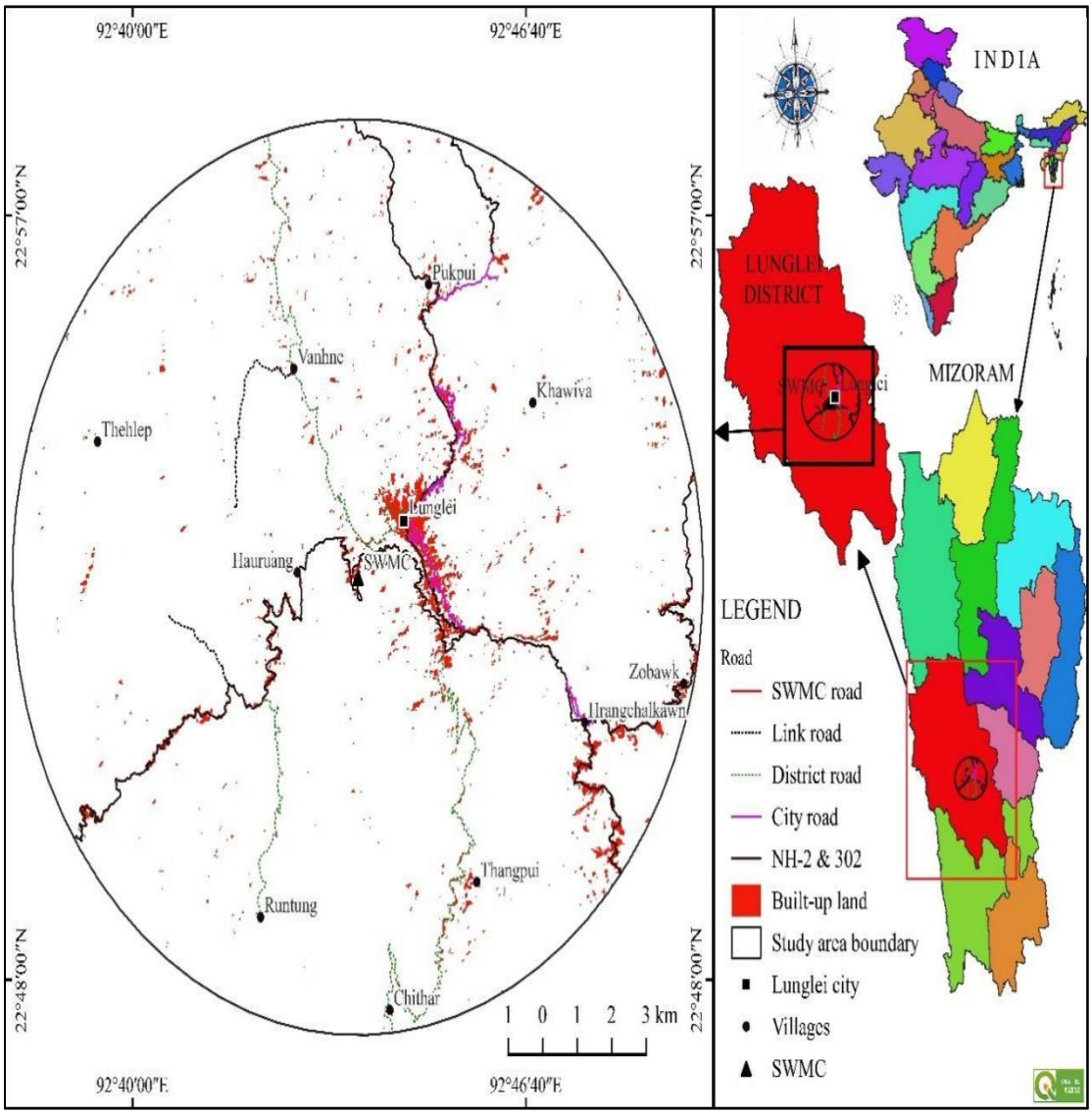


Figure 2.2 Location Map of the Project

2.4 CURRENT WASTE MANAGEMENT PRACTICES

Presently in Lunglei, primary collection of waste in most of the areas is done either twice a week or thrice a week except at few places where it takes place about all 6 days of a week except Sundays and holidays. No waste collection takes place in any of the areas on holidays. Also, presently waste is not being stored in a segregated manner.

In order to meet the requirements of Municipal Solid Waste (Management & Handling Rules), 2020 waste would be stored in a segregated manner at household level. Proposed system emphasizes on 100% point-to-point collection of waste on daily basis including holidays. UD&PA, Lunglei shall ensure that infrastructure is made available for undertaking this

activity in compliance with the MSW Rules, 2020. UD&PA, Lunglei may identify and authorize private operators/NGOs for undertaking this activity. The private operator/NGO authorized for a particular area shall ensure that there is proper waste collection as per the route proposed (Table 2.2) from all sources in his area. The infrastructure is calculated at ward level.

Overall management of Solid Waste in Lunglei is looked after by sanitation wing of Lunglei headed by District Urban Development Officer.

Table 2.1 Current Staff Details of Lunglei SWM Department

S.NO.	Designation	staff
1	Sanitary Inspector	1
2	Drivers	2
3	Helpers & Sweepers	22
	Total	**25**

2.5 PROPOSED MSW MANAGEMENT SYSTEM

This chapter provides an integrated SWM plan for primary & secondary waste collection and transportation system for Lunglei town. The proposed plan also includes the infrastructure requirements, quantities and corresponding cost estimates for the collection and transportation systems. The proposed SWM system is broadly based on the 5R Environmental Protection Rules (Reduce, Recycle, Reuse, and Recover) and is in accordance with the MSW 2020 Rules.

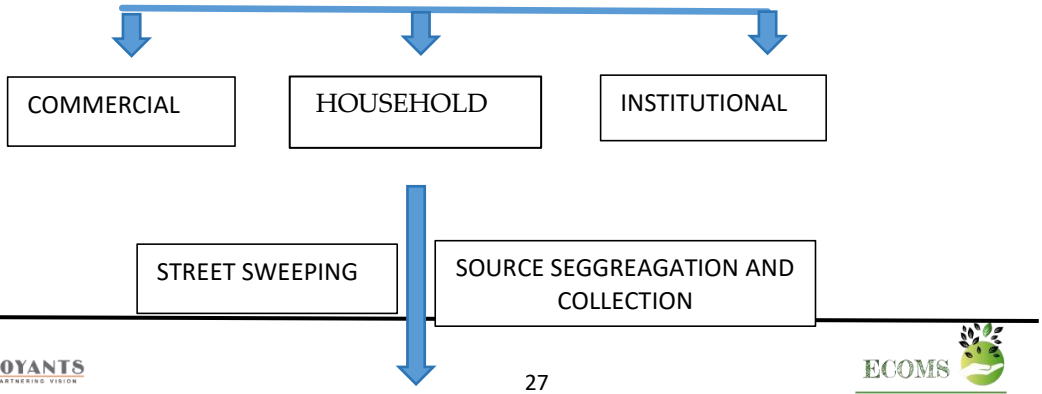
The primary aspects of the proposed plan include the following:

- Compliance with Municipal Solid Waste (Management & Handling) Rules, 2020
- Segregation at source
- Provision of segregated infrastructure at all stages of collection and transportation
- Waste to be covered at all stages of handling
- Elimination of manual handling of waste and the provision of proper PPEs to the workers

- 100% collection and transportation of the generated waste
- Maximum recovery of resources by segregating recyclables and biodegradable
- Advocate 5R's i.e. reduce, recycle, reuse, and recover materials through MSW management
- Adopt proven technologies for waste processing
- Promote information, education and communication to ensure system efficiency and sustainability
- Ensure economic sustainability of the proposed system by introducing PPP in MSW management
- Adequate health and safety provisions for workers at all stages of waste handling
- Regular environmental monitoring at waste processing and disposal facilities
- Have robust complaint-handling system in place
- Conduct regular internal and external independent audits on the efficiency of the entire SWM system

In order to propose a waste management plan and infrastructure/equipment for waste collection and transportation system for Lunglei town, the following points were considered:

- Census data of the year 1981,1991,2001 & 2011
- Projected populations for the design year i.e 2032
- Area of Lunglei town (54.08 sq km)
- Site located at Tlabung Road near Riangvai Thlanmual (22.874268, 92.730476) with an area of 72888.57 sq.m.
- Current MSW quantities
- Projected MSW quantities based on the present values
- Per-capita waste generation in base year(2017) and design year (2032)
- Characterization of the current and projected waste quantities



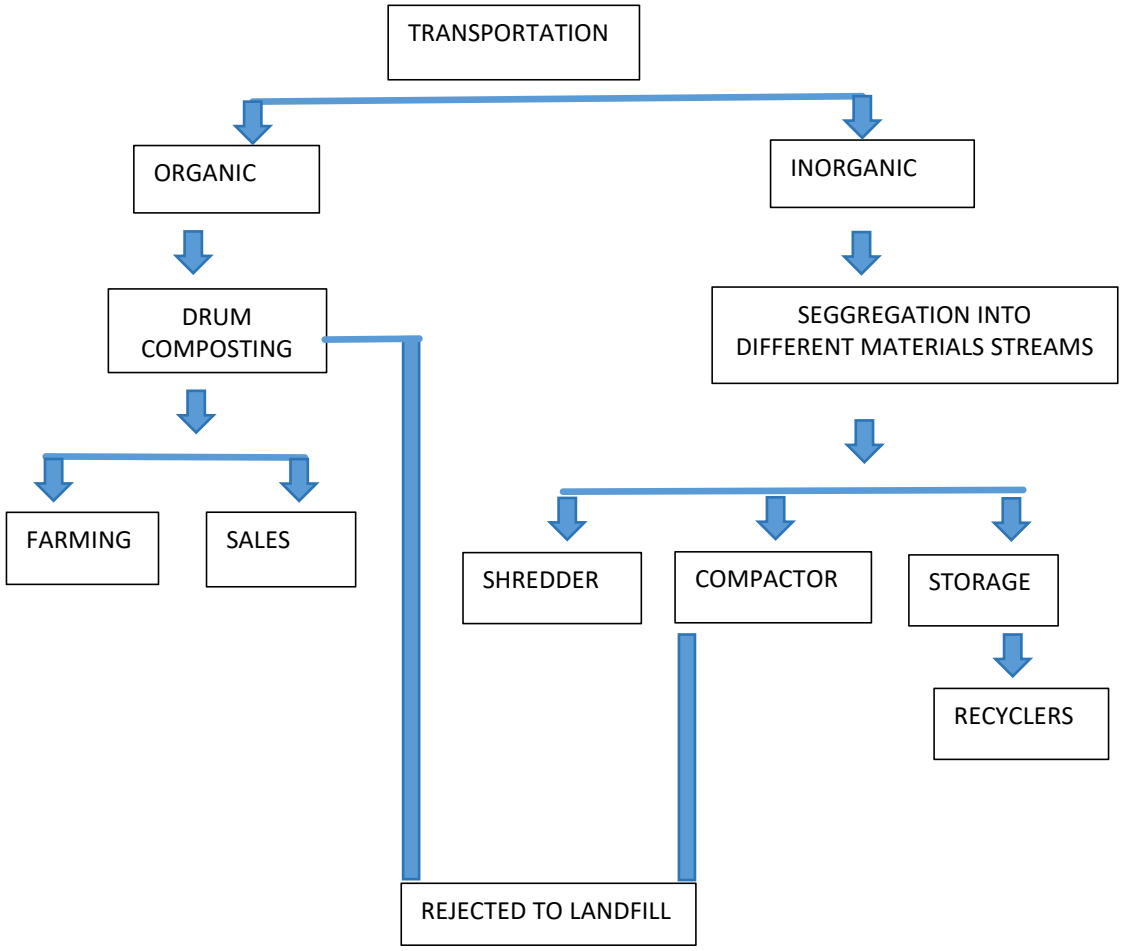


Figure 2.4 Proposed Municipal Solid Waste Management Plan for **Lunglei** *City.*

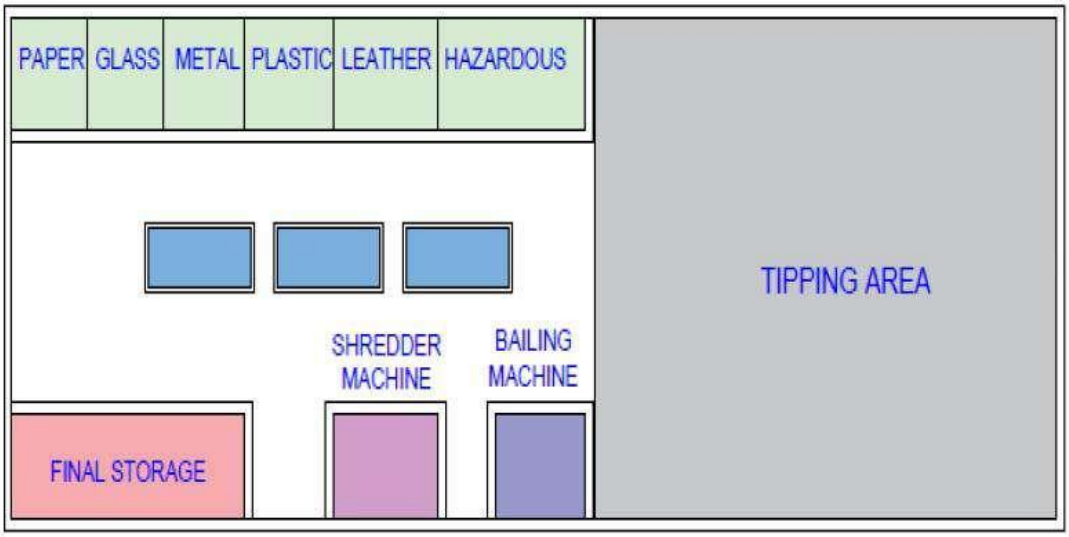


Figure -2.5 Layout of Tipping and Plastic Segregation Site

2.5.2 STEPS INVOLVED IN THE PROPOSED MSW MANAGEMENT PLAN FOR LUNGLEI:

A. COLLECTION OF MUNICIPAL WASTE

Effective collection of solid waste is very essential for successful MSW management system. For this purpose, following approach needs to be adopted by the residents as well as by the municipal/ private staff engaged in SWM services.

- Waste generated from households would be stored in segregated manner i.e biodegradable waste in green dustbin & recyclable waste in black/blue dustbin. Door-to-door collection of waste would be done through tipper trucks and/or small auto-tippers depending on quantity of waste generated in the respective area/pocket/locality. It would start early in the morning around 6 a.m. and would take place till 2 pm. The vehicle will be provided with driver, helper & a waste collector and a whistle or bell. The vehicles will be assigned a fixed area for collection of waste. The vehicle would stop at the sanitation points, as identified by Local Authorities, where residents would come to dispose off the waste. These vehicles after getting filled with waste, would either go to the disposal site i.e. either Mechanical or Resource Management Centre (Dry Waste) depending upon the type of waste. The overall route plan is given in subsequent sections of this chapter. Residents of various localities including those of slum/remote areas

would be motivated to bring the segregated waste of their households to the sanitation point where the waste collection vehicle stops for collecting waste.

- UD&PA Street Sweepers shall do street sweeping on daily basis. Street waste would be collected in wheel barrows by the street sweeper and finally transferred to the vehicle reaching the area.
- Lunglei town is a bin free town. Considering the same no secondary storage points are proposed in the system. However, there would be assigned sanitation points where the vehicle would stop at a fixed time for defined interval for waste collection.
- The construction and demolition wastes would be used for filling-up the low-lying areas. The local residents would hand-over the construction waste generated from private construction activities to UD&PA workers for proper use.
- Most of the waste generated from slaughter houses such as bones, skin and horns are recyclable and shall be sold to the recyclers. The only solid waste generated from the slaughter houses is flesh cuttings, which shall be buried in a designated area.
- The proposed plan would include provision of PPEs and other equipment's required for SWM services in order to avoid direct contact of workers with waste.

Figure 2.6 Two bins for biodegradable and non – biodegradable waste segregation

Source segregation is very essential for the management of dry waste. At the household level waste should be segregated as wet waste and dry waste. From the household level the conservancy staff takes the wet waste to the compost yard and dry waste to the waste resource center. At the waste resource center the dry waste is segregated in to different

categories based on the category and value demanded by the buyer who uses the recyclable waste to manufacture consumer products.

Proposed system emphasizes on 100% door-to-door collection of waste on daily basis including holidays. UD&PA, Lunglei shall ensure that infrastructure is made available for undertaking this activity in compliance with the MSW Rules, 2000. UD&PA, Lunglei may identify and authorize private operators/NGOs for undertaking this activity. The private operator/NGO authorized for a particular area shall ensure that there is proper waste collection as per the route proposed from all sources in his/her area.

The workers involved in SWM also need to be equipped with adequate personal protective equipment's (PPEs). Each worker engaged in door-to-door collection of MSW shall be provided with gloves, boots and uniform.

Therefore,

Required number of pair of gloves = 10

Required number of pair of boots = 10

Required set of uniform = 16

Required number of dustpans (to be provide to only collectors) = 10

Figure 2.7 Wheelbarrow for Street Sweeping

B. TRANSPORTATION

It is proposed to use Tipper trucks (3.5 cum) and auto-tippers (2 & 3 cum capacity) for door-to-door collection of waste. The number of vehicles required has been estimated based on

quantity of waste generated and area of ward. Ward wise estimation has been done for requirement of vehicles. The existing vehicles with AMC are quite old and will not be used in the proposed system. In the proposed system, 2 tipper, available with UD&PA, Lunglei, found in good working condition will be utilized. All other will be purchased new.

Table 2.2 Proposed Route plan for waste collection & transportation

Sl. No.	Proposed route Plan	Type & no. of Vehicle
1	Pukpui & Zotlang & Serkawn	Medium Tipper & Light Vehicle Tipper
2	Zohnuai & Rahsi Veng	Medium Tipper & Light Vehicle Tipper
3	Bazar Veng & Electric Veng	Medium Tipper & Light Vehicle Tipper
4	Ramthar & Lunglawn & Moria	Medium Tipper & Light Vehicle Tipper
5	Theiriat & Zobawk	Medium Tipper & Light Vehicle Tipper
6	Chanmari I & II & Serkawn	Medium Tipper & Light Vehicle Tipper

As per DPR prepared by UD&PA

Table 2.3 Consolidated list of vehicle's required

Ward No.	**Vehicle Type**	**Number of vehicles required**		**Remarks**
		For Biodegradable waste	**For Non-Biodegradable waste**	
1	3.5 cum Tipper Truck	2	2	Starts from UD&PA office for collection and finally disposes waste at landfill
2	1.5 cum Tipper Truck	1	1	Starts from UD&PA office for collection and finally disposes waste at landfill
TOTAL		**3**	**3**	

As per DPR prepared by UD&PA

Table 2.4 Breakup for vehicles

Vehicle Type	Number of vehicles required		Total
	Biodegradable	Non-biodegradable	
Tipper (3-3.5cum capacity)*	2	2	4
Auto Tipper (2-3 cum capacity)	1	1	2
TOTAL			**6**

As per DPR prepared by UD&PA

***Two tipper available with UD&PA shall be used in the proposed system & the new required shall be 4**

Number of drivers required per day = 6

Number of waste collectors/helpers required per day = 10

This activity will be undertaken by a private operator. The total number of workers required by a private operator is based on the assumption that the private workers will not get more than 60 days leave in a year.

Number of drivers required per day = 6x1.2 =6

Number of waste collectors/helpers required per day = 10

The usual timings of waste collection will not be feasible for markets as shops normally open after 9 am. It is proposed that street sweeping in market area shall be done in the early morning hours. As the shop is opened collecting vehicle will come and shopkeepers will bring the waste and carefully put into the vehicle. Shopkeepers dealing in trading meat, fish etc. shall be asked to keep close containers in their premises for collection of waste. Waste from close container shall be given to waste collector of the area.

Table 2.5 Infrastructure Required for Waste Collection and Transportation

Equipment	Description	No.	Rate (Rs.)	Total Cost (Rs.)
Two covered bins for households	20 litre capacity Plastic bins	11591	550	12750000
Tata 407 Tipper	3.5 cum capacity	4	2250000	9000000
Tata Xenon	1.5 cum capacity	2	1300000	2600000
Gloves	for all safai karamcharis	40	150	6000

Boots	for all safai karamcharis	40	300	12000
Shovels	for street sweepers	40	280	11200
Broom	for street sweepers	40	170	6800
Dustpan	for waste collector	40	280	11200
Uniform (two sets of uniform + two sweaters)	for all safai karamcharis	70	1500	105000
Safety mask	for street sweepers	40	90	3600
Wheelbarrows	for street sweepers	40	9500	380000
Street bins	To prevent littering	208	550	114400
Approach road construction	Cutting and filling, side drains, etc	0.73Km		7600000
Total				**25000200.00**

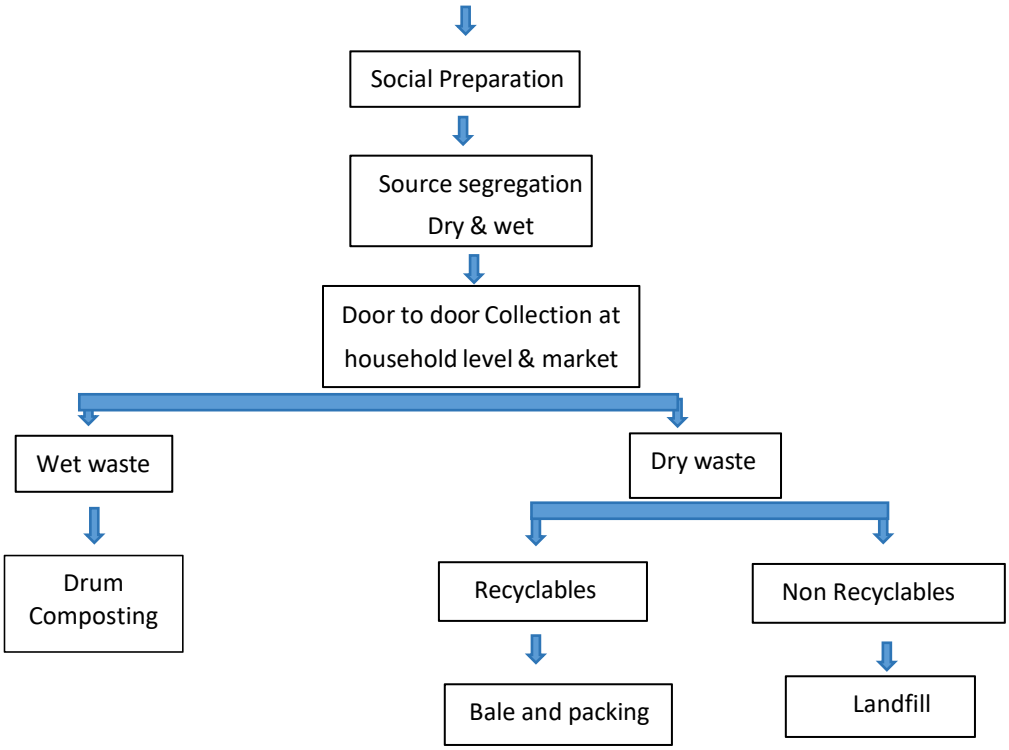
Table 2.6 O&M Cost for Waste Transportation Infrastructure and Personnel

S. No.	Description	Annual Cost (Rs.)
1	Cost of 6 drivers for waste collection & transportation vehicles @ Rs. 8000 per month	5,76,000.00
3	Cost of 10 waste collectors @ Rs. 6000 per month	7,20,000.00
4	Cost of 40 street sweepers @ Rs. 5000 per month	24,00,000.00
5	Cost of 2 supervisors @ Rs. 8000 per month	1,92,000.00
6	Cost of Equipment's & PPEs –broom @Rs. 170, gloves@ Rs. 95, boots @Rs. 210, Uniform @Rs. 1500, Dust Pan @ Rs. 280, Shovel @Rs.280 and safety mask @ Rs. 60	1,40,770.00
7	Diesel cost for Tipper (3.5 cum capacity) (covering approximately 1800 km and consuming 1L for 7 kms) @ Rs. 58.27 per liter	1,82,052.00
8	Diesel cost for Tata Xenon(1.5 cum capacity) (covering approximately 250 km and consuming 1L for 10 kms) @. Rs. 58.27 per liter	17,700.00
9	Annual maintenance of vehicles	1,00,000.00
Total		**43,28,522.00**

C. WASTE SEGGREGATION

The first line of Waste segregation would be from households where waste would be stored in segregated manner i.e wet waste in green dustbin & dry/recyclable waste in black/blue dustbin. Door-to-door collection of waste would be done through tipper trucks and/or small auto-tippers depending on quantity of waste generated in the respective area/pocket/locality.

Fig 2.8 Concept of Proposed Waste Segregation



In order to achieve the first step of segregation, Awareness programme and capacity building activities as well as social preaparation is a must. Once the waste are transported from the source to the SWMC, all the wet waste will be directly transported to the Vermicomposting center.

Table 2.7 Waste Quantities and Waste Characterization

2011 Population (Last Census)		57011		
2015 Population (base year)		64620		
2030 Population (Design Year for WRC)		87529		
Waste Composition	Percentage Waste	Quantity (MT/day) in 2011	Quantity (MT/day) in 2015	Quantity (MT/day) in 2030
Bio-degradable/Wet Waste	30.10%	7.72	8.75	11.86

Recyclable/Dry Waste	**49.09%**	**12.59**	**14.27**	**19.34**
Inert Ash & debris	20.81%	5.34	6.05	8.2
Total Waste	100	25.65	29.08	39.39
15% of the waste are considered as Debris and Demolition waste and the remaining 8% of Inert Matter will go to the landfill.				
Inert & other going Directly to the landfill	8% of Total waste	2.05	2.33	3.15

Rejects from Composting to Landfill	10% of Wet Waste	2.57	2.91	3.94
Rejects from Resource Centre to Landfill	20% of Dry Waste	5.13	5.82	7.88
Total Reject/Inert going to Landfill	TPD (%)	9.75	11.05	14.97
Per-capita Waste Generation		410 gms/day/person	490 gms/day/person	520 gms/day/person

As per DPR prepared by UD&PA

Hence, to achieve a sustainable resource management for non biodegradable Solid waste of 14.27 = say 14.20 TPD, it is proposed that 15 TPD capacity Waste Resource Centre is required.

It is observed that MSW at Pilot project area contains, an average, 79.19 % Wet/biodegradable/compostable matter. The biodegradable matter of 30.10% favors vermi-composting as a processing option. The average percentage of paper was observed to be 8.40% with maximum being 13.46% and the lowest as 7.56%. On an average, 7.96 % of plastics was present in MSW samples with maximum percentage being 10.58% while the lowest being 5.33%. The proportion of glass and ceramics was observed to be 5.20% (average) with the values varying between 3.26 – 7.13%. Comparatively higher percentage of

paper, plastic, glass and ceramics was observed due to typical living style. Percentage of metals was observed to be 6.92% with a maximum and minimum being 9.53 and 4.32%. Average Percentage of inerts Waste was observed as 8.44% with maximum and minimum values were 11.43 and 5.45%, respectively. The total amount of remaining other Inert matter such as debris etc. was observed to be 4.76% with a minimum being 3.73% and a maximum percentage being 5.80%. It may be noted that within the *Lunglei* Area, Demolition and construction waste are not covered by the Municipal Solid Waste.

As per Pilot project survey data, Waste in *Lunglei* are observed as follows:-

(a) Biodegradable = 30.10% = say **30%**

(b) Recyclables = 49.09% = say **49%**

(c) Inert Matter = 20.81% = say **21% TOTAL = 100%**

(d) Population within Project Areas = 57011

(e) Per Capita waste Generation per day = 0.45 Kg/day

(f) Quantity of waste generation per day = 25.65 TPD

(g) = 25650 Kg/day.

A detailed inventory survey indicated that, approximately 25.65 tons (in the year 2015) of solid waste will be generated daily in *Lunglei* of which biodegradable waste is 7.72 tons, recyclable waste is 15.59 tons, and inert ash & debris is 5.34 tons. 30.10% of total waste is Wet Waste, 49.09% of total waste are considered as Dry waste. The total landfill-able waste quantity for a period of 15 years by future projection has been taken as 5965 cum*(2.41 tons = 1 Cum). in the designing of MSW landfill adopting a waste density of 1.10 MT/m^3. For the purpose of cost estimates and design only a period of 15 years (design year 2020) has been considered.

Table 2.6: The physical compositions of both studies and Pilot project are as follows:-

Sl.No.	Particulars	NEERI study done in 2011
1	Total Waste generated	0.49 kg/capita/day
2	Biodegradable waste	30.10 % say 30%
3	Non Bio-degredable waste	49.09% say 49%
4	Inert Material	20.81% say 21%

As per DPR prepared by UD&PA

2.6 LAND BREAKUP

The proposed land Consist of the following Infrastructure:

1. Main Gate- Located at the entrance of the facilities.

2. Office -Side office will be located at the entrance for inspection of vehicles.

3. Weighing Bridge- Weighing bridge will be located near the entrance for inspection/documentation of total weight of the waste transported.

4. Waste Seggregation Center.

5. Waste Processing Center.

6. Main Office.

7. Godown.

8. Landfill.

9. Leachate Treatment Plant.

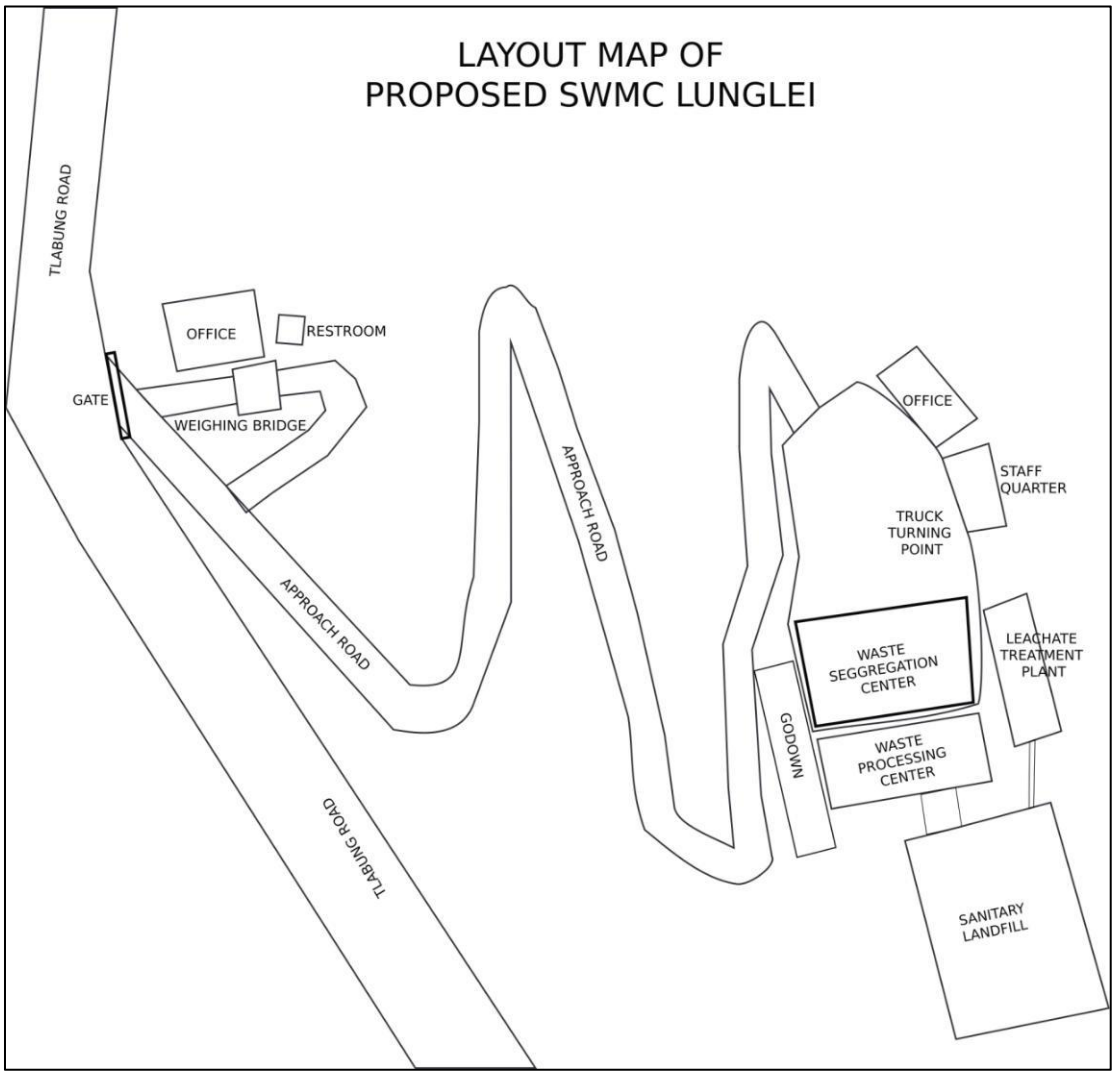


Fig 2.9 Layout Map of Lunglei SWMC

2.7 WASTE PROCESSING

A. Wet Waste Processing

This chapter discusses the biological treatment of MSW generated in Lunglei. The bio-degradable waste primarily comprises of organic matter like kitchen & yard waste, refuse from vegetable markets and food waste from hotels and restaurants. It can either be stabilized before sending to landfill or can be converted into valuable material like compost, fertilizer, biogas, filler material. However the landfill requirements and further contamination of the environment can be avoided by processing of bio-degradable waste into usable material.

The proposed preferable method for biodegradable waste treatment is **Mechanical Drum Composting.**

Drum composting is a revolutionary, aerobic composting method that utilizes a rotating drum to break down organic waste efficiently and effectively. This innovative technology accelerates the natural decomposition process, converting organic materials into a nutrient-rich compost in a fraction of the time required by traditional composting methods. A drum composter typically consists of a cylindrical or oval-shaped container, often made of durable materials such as galvanized steel or high-density plastic, with a rotating mechanism that ensures optimal aeration and mixing of the waste materials.

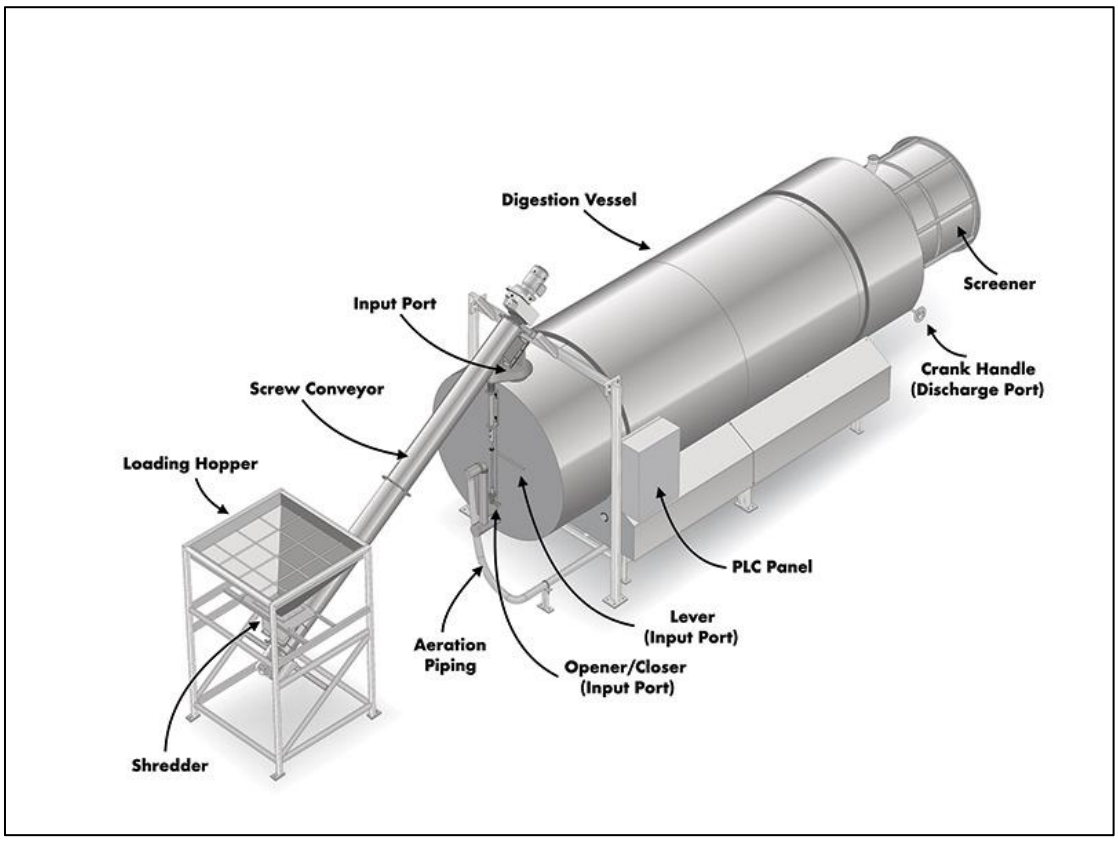
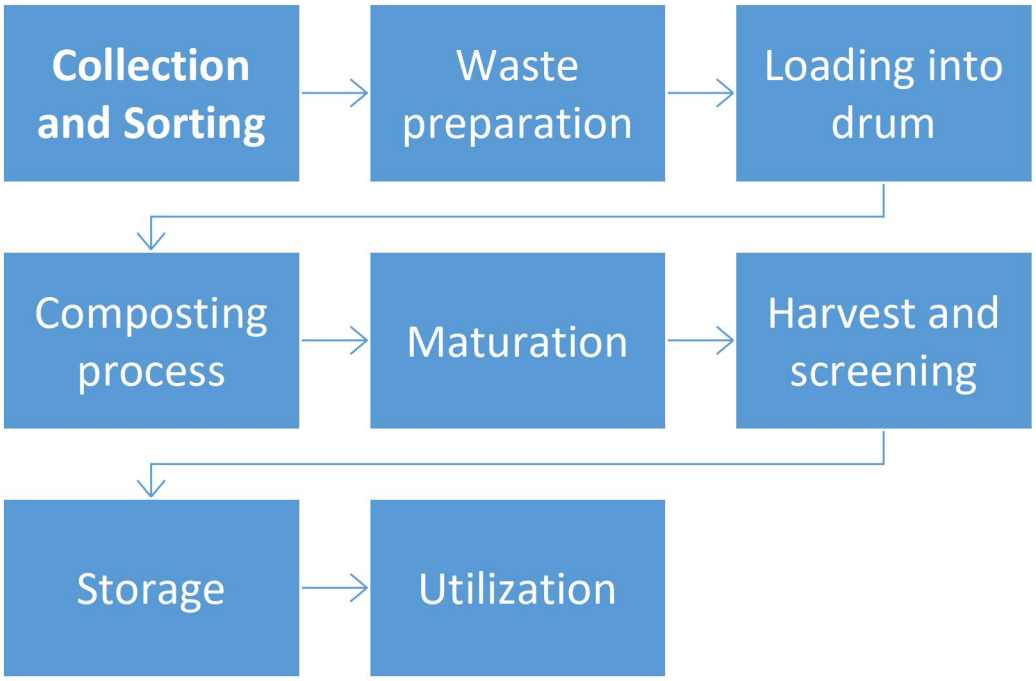


Fig 2.10 Mechanical Drum Composting Machine.

The drum's design allows for precise control over temperature, moisture, and oxygen levels, creating an ideal environment for microbial activity to thrive. As the drum rotates, organic waste is systematically broken down by microorganisms, eliminating pathogens, weed seeds, and pests, while preserving valuable nutrients. The result is a homogeneous, earthy-smelling compost that is teeming with beneficial microorganisms, perfect for enriching soil, promoting plant growth, and supporting sustainable agriculture practices.



2.11 Drum composting Flow chart

Drum composting is a meticulously designed process that harnesses the power of microorganisms to break down organic waste into nutrient-rich compost. The process unfolds within a rotating drum, where oxygen, moisture, and heat converge to create an ideal environment for decomposition. Here's a step-by-step overview:

Step 1: Loading

Organic waste, such as food scraps, yard trimmings, or agricultural residues, is loaded into the drum composter.

Step 2: Rotation

The drum is rotated, either manually or mechanically, to ensure optimal aeration and mixing of the waste materials.

Step 3: Aeration

As the drum rotates, oxygen is introduced, supporting aerobic decomposition and minimizing odors.

Step 4: Moisture Control

Moisture levels are maintained through controlled addition of water or wastewater, ensuring optimal conditions for microbial activity.

Step 5: Temperature Regulation

The composting process generates heat, with temperatures reaching 130°F – 140°F (54°C – 60°C). This heat kills pathogens and weed seeds.

Step 6: Microbial Activity

Microorganisms, containing fungi and bacteria, break down organic matter into smaller compounds.

Step 7: Decomposition

The combination of oxygen, moisture, and heat accelerates decomposition, transforming organic waste into compost.

Step 8: Maturation

The compost is allowed to mature, ensuring complete breakdown of organic matter and elimination of pathogens.

Step 9: Harvesting

The finished compost is removed from the drum, sifted, and prepared for use as a nutrient-rich soil amendment.

Additional considerations include:

– Ventilation and moisture control systems to maintain optimal composting conditions
– Pest and odor control features to minimize unwanted attractants
– Space constraints and portability requirements for urban or compact settings
– Energy efficiency and power requirements for automated models
– Budget and cost-benefit analysis for initial investment and long-term savings
– Certifications and compliance with local regulations and standards

Infrastructure needed for Mechanical Drum Composting:

1.Three Phase Stainless Steel Drum composter with conveyor with a capacity of 12 TPD

2.Shed of steel structure with light weight roofing and cement concrete flooring, of suitable size with PVC fencing wire mesh / net protection above 80 cm high parapet wall, on all sides to prevent birds, mouse, dogs etc, to house the following provisions:-

a)Receipt/segregation platform 50cm high (raised floor) for spreading one day's waste and segregating the non- biodegradable items if any

b)Drum compost bays each of 1.5 m to 2m width of required length to treat the waste for a period upto 20 days. Each bay to stack one day's waste. In smaller plants one bay may cater for more than one day waste.

c)Space for shredding.

d)Masonry pits(tanks) to accommodate one days waste duly treated for a period of 15 to 20 days in the drum compost bays. Bottom of the tank to have adequate slope to drain the leachate . A water channel to prevent entry of ants.

e) Adequate space around for the movements of men and materials

f) Space for placing the sieve, storing the sieved manure, weighing machine, packing the manure in polythene bags and stiching the same

g) Store with locking arrangements for storing 90 days production

h) 50 mm PVC pipe under the floor to drain the leachate from tanks to the draining channel and the draining channel below the floor level with cast iron removable covers flush with the floor, to drain the leachate that comes out from tanks and drum bays to the leachate collection tank

i)Leachate collection tank of suitable size as shown in the drawing.

j)Lighting at the rate of 12W CFL per 12 sq.metre area

Other Miscellaneous items

a) Office and rest room with toilet and wash area

b) Water storage and supply system

c) Septic tank with soak pit to treat leachate and the sewage

d) Minor tools like, chopper, showels, spade, wheel-borrows, baskets, buckets -2 sets for 250 kg capacity and additional one set each for additional 250 kg capacity each.

e) Surgical hand gloves and boots for staff-2 pairs each per staff.

Mechanical equipments

a) Shredder -manual for plants upto 10TPD capacity.

b) Bag sealing machine

c) Platform balance

d) Manual rotary sieve.

B. Dry waste processing

At the waste resource center the dry waste is segregated in to different categories based on the category and value demanded by the buyer who uses the recyclable waste to manufacture consumer products.

The dry waste is classified based on the recyclable value and category. The waste which is no recyclable value will be sent to land fill and the waste which has the recycle value will be

segregated based on the value. The value of the recyclable waste varies from place to place. Market study is required to identify the best buyer. Some of the waste can be converting as raw material in the campus itself. List of the key classification of waste is given.

I.List of categories of recyclables

1)Paper item

News paper,paper cups and paper plates

2)hard board packing material

Thin, medium and thick hard boards

3)Text book / computer printed paper / fine and super fine

4)Plastics

5)Carry bag (above 40 microns), Milk sachet, oil sachet

6)Metal

a)Aluminum, steel, Copper, Iron, Brass etc.

7)Electronic waste

8)Rubber

II.List of non recyclables

Thermocol, Broken tube lights, bulbs, Shampoo sachet, old cloths, Medical waste(syringes, cotton used for surgery, medicine vials other hospital waste), Hard plastics. All these non recyclable waste will go to the Landfill.

Infrastructure needed for dry waste processing:

i) Waste Resource Centre Campus:

A site of 1 no. of 15 m X 30m= 450 sq.m area will be needed for locating the primary segregation centre and waste resource centre, toilet and wash room facility will be provided for the staff. The designed period of Resource Centre is considered as 15 years, where 2015 is the Base year and 2030 is the Design year.

ii) The waste resource centre main building

The waste resource centre main building will consist of area for secondary segregation, compartments for different types of recyclable waste, area for bailing and packing, storage space for bales, rest area for workers, seats and cupboard, steel almirah, table and chair for administrative purpose.

iii) Secondary segregation

Segregated dry waste from primary segregation shed is stocked here and will be classified by the team based on the value.

iv)Compartment for different type of waste

The classified waste in secondary segregation area will be kept ready for baling in respective compartment. All compartments will be named as per the material to be stored.

v)Optional

Client room, Retail counter in the WRC, compound or fencing for the campus.

Table 2.8 Equipment and furniture needed for Dry Waste processing:

Sl.No	Particulars	Unit	Rate (Rs)	Amount (Rs)
Furniture				
1	Steel almirah	2	7500	15,000
2	Table	2	3000	6,000
3	Chair	10	300	3,000
4	Table fan	3	1500	4,500
5	Water filter	2	3500	7,000
6	Files, register and etc	1	3000	3,000
	Sub total			**38,500**
Safety equipments				
1	Mask	40	90	3,600
2	Gloves (set)	25	150	3,750
3	First aid kit	2	1000	2,000
	Sub total			**9,000**
Cleaning equipments				
1	Plastic / Aluminum basket	10	250	2,500
2	Plastic Bucket and Mug	2	150	300
3	Broom stick	10	80	800
4	Phenol, Acid, brush	1	1000	1000
	Sub total			**4,600**
Packing Equipments				
1	Packing Machine & role and clip	2	200000	4,00,000
2	Bale box	10	4000	40,000
3	Bora bag	50	105	10,500
	Sub total			**4,50,500**
	Shifting the material – Wheelbarrow	5	9,500	47,500
	Overall total			**5,50,100**

As per DPR prepared by UD&PA

2.8 QUANTITY OF COMPOST GENERATED

The estimated quantity of compost generated from a **25 TPD (Tons Per Day) waste processing** using **mechanical drum composting** depends on factors like the organic fraction of waste, moisture loss, and degradation efficiency.

Key Assumptions:

1. **Organic Waste Content**: Typically **50% - 60%** of total waste (12.5 - 15 TPD).
2. **Decomposition & Moisture Loss**: **40% - 50%** reduction due to biodegradation and evaporation.
3. **Final Compost Yield**: **25% - 30%** of the organic fraction.

Estimated Compost Output Calculation:

Parameter	**Value**
Total Waste Processed	25 TPD
Organic Fraction (50%-60%)	12.5 - 15 TPD
Weight Loss (50%-60%)	6 - 9 TPD
Final Compost Output	**6 - 7.5 TPD**

Final Estimated Compost Production:

6 - 7.5 Tons Per Day (TPD) or **180 - 225 Tons Per Month** (assuming 30 days operation).

Odour Control Measures for Mechanical Drum Composting

Odour management is a critical aspect of mechanical drum composting, as the decomposition of organic waste can generate foul smells due to ammonia, hydrogen sulfide, and volatile organic compounds (VOCs). Below are effective odour control measures:

1. Proper Waste Segregation & Pre-Treatment

- Ensure **proper segregation** of wet and dry waste before composting.
- Avoid **high moisture content (>60%)**, as it leads to anaerobic conditions and odour generation.
- **Shred waste** before feeding into the drum to accelerate decomposition and reduce anaerobic pockets.

2. Aeration & Drum Operation Optimization

- **Maintain optimal aeration** inside the drum to promote aerobic conditions and reduce odour.

- Adjust the **rotation speed and residence time** (typically 7–14 days) to prevent anaerobic decomposition.
- Install **forced aeration** or **biofilters** in exhaust vents to capture odorous gases.

3. Biofilters & Scrubbers

- **Biofilters** (using compost, wood chips, or activated carbon) can effectively absorb and neutralize odorous gases.
- **Wet scrubbers** can be used to wash out ammonia and other volatile compounds from exhaust air.

4. Use of Odour Neutralizers & Microbial Cultures

- Spray **eco-friendly bio-deodorizers** or essential oil-based neutralizers to mask odours.
- Use **effective microorganisms (EM)** or specialized bacterial cultures to enhance microbial activity and reduce odour formation.

5. Maintaining Proper C:N Ratio (Carbon to Nitrogen Ratio)

- Maintain a **C:N ratio of 25:1 to 30:1** to avoid excess ammonia release.
- Add **bulking agents** like sawdust, wood chips, or dry leaves to balance nitrogen-rich organic waste.

6. Leachate Management

- Regularly drain and treat **leachate** to prevent foul-smelling stagnant water.
- Use **leachate recirculation** in controlled amounts to enhance composting efficiency.

7. Enclosed Facility & Ventilation

- Conduct composting in a **closed shed or tunnel** with proper ventilation.
- Install **chimneys or exhaust fans** to direct air through biofilters or scrubbers.

8. Regular Cleaning & Maintenance

- Periodic **cleaning of the drum, surrounding areas, and leachate collection tanks** prevents odour buildup.
- Ensure regular **turning of compost** post-drum processing to enhance aeration.

By implementing these odour control measures, **mechanical drum composting** can be efficiently managed without causing environmental nuisance.

Components of a Leachate Management Plant

1. Leachate Collection System

- **Sloped Flooring & Drains**: Ensure the composting facility floor is sloped to direct leachate towards collection points.
- **Leachate Collection Tank**: Store leachate in an underground or overhead tank with proper lining to prevent seepage.
- **Leachate Recirculation**: Some leachate can be sprayed back into the composting process in controlled amounts to maintain moisture balance.

2. Leachate Treatment System

Depending on the leachate quality, the following treatment processes are used:

A. Primary Treatment (Solid Separation)

- **Screening & Sedimentation**: Remove large particles and settle suspended solids.
- **Oil & Grease Trap**: Separates floating grease and oils.

B. Biological Treatment

- **Aerobic Treatment (Activated Sludge or Biofilters)**:
  - Uses bacteria to break down organic matter.
  - Aeration tanks or biofilters (such as compost-based or wood-chip biofilters) help degrade pollutants.
- **Anaerobic Treatment (if necessary for high organic load leachate)**:
  - Anaerobic digesters or lagoons reduce biochemical oxygen demand (BOD) and chemical oxygen demand (COD).

C. Tertiary Treatment (Polishing & Disinfection)

- **Coagulation & Flocculation**: Uses alum or ferric chloride to remove suspended particles.
- **Filtration**: Sand or activated carbon filters remove fine particulates and odour.
- **Disinfection**: UV treatment or chlorination ensures pathogen-free discharge.

3. Reuse & Disposal

- **Reuse Treated Water**: Treated leachate can be reused for **compost moisture control**, **dust suppression**, or **landscaping**.

- **Disposal as Per Pollution Norms**: If not reusable, discharge must meet **CPCB/SPCB (Central/State Pollution Control Board) guidelines** before release into drains or water bodies.

Design Considerations for a Leachate Management Plant

Parameter	**Typical Value/Range**
Leachate Generation	**5%-10%** of input waste (1.25-2.5 KLD for 25 TPD)
pH	5.5 - 8.5
BOD (mg/L)	500 - 5,000
COD (mg/L)	1,500 - 10,000
TSS (mg/L)	200 - 2,000
NH_3-N (mg/L)	50 - 500

Flowchart for Leachate Management in Mechanical Drum Composting

1 **Leachate Generation**

↓

2. **Leachate Collection & Storage**

- Sloped flooring & drainage system
- Leachate collection tank

↓

3. **Primary Treatment (Solid Separation)**

- Screening (removes large debris)
- Sedimentation (settles suspended solids)
- Oil & grease trap (removes floating contaminants)

↓

4. **Biological Treatment**

- **Aerobic Treatment** (Activated Sludge/Biofilters)
- **Anaerobic Treatment** (if high organic load)

↓

5. **Tertiary Treatment (Polishing & Disinfection)**

- Coagulation & flocculation (removes fine particles)
- Filtration (sand/activated carbon)

- Disinfection (UV/chlorination)

  ↓

  6. **Reuse or Safe Disposal**
- **Reuse in composting process** (moisture control, dust suppression, landscaping)
- **Safe disposal as per CPCB/SPCB norms**

2.9 WATER REQUIREMENT

For a **Solid Waste Management (SWM) plant** in **Lunglei, Mizoram**, securing a reliable water supply is essential for operations such as equipment cleaning, dust suppression, and composting processes. Potential water sources include:

1. **Municipal Water Supply**: Utilizing the existing municipal water infrastructure can provide a consistent and treated water source, ensuring compliance with quality standards.
2. **Surface Water Bodies**: Lunglei is endowed with various perennial streams and rivers. According to the Mizoram Water Data, streams like the **Rangte River** and **other Stream** are utilized for domestic purposes and could be potential sources for industrial use, subject to necessary permissions and treatment to meet operational standards.
3. **Groundwater Extraction**: Implementing borewells to tap into groundwater reserves is another option. However, this requires a thorough assessment of groundwater availability and quality, as well as adherence to regulatory guidelines to prevent over-extraction and environmental degradation.
4. **Rainwater Harvesting**: Given Mizoram's significant rainfall, collecting and storing rainwater can be an effective and sustainable water source. This approach not only supplements water needs but also aligns with environmental conservation efforts.
5. **Recycled Water**: Treated wastewater from sewage treatment plants (STPs) can be repurposed for non-potable uses within the SWM plant. The Mizoram Pollution Control Board has noted that treated wastewater is utilized for recharging water bodies, indicating its potential for industrial applications.

The water requirement for a solid waste management system, specifically for processing 50 tonnes per day of waste, can vary based on the type of system used. Common types of systems include:

1. **Composting**

2. **Anaerobic Digestion**
3. **Landfilling (with leachate treatment)**
4. **Waste-to-Energy (WTE)**
5. **Mechanical Biological Treatment (MBT)**

Each of these systems has different water requirements for their operation, which depends on factors such as moisture content of the waste, technology used, and whether water is required for cooling, washing, or leachate management.

Here is an estimated breakdown of water requirements for each system:

1. Composting System

Composting requires water to maintain proper moisture levels in the waste. Ideally, the moisture content in the compost pile should be around 50% to 60%.

- **Water required**: Generally, composting requires about 50 to 150 liters of water per tonne of waste per day.
- For **50 tonnes per day**, the water requirement would be **2,500 to 7,500 liters per day**.

2. Anaerobic Digestion

Anaerobic digestion involves breaking down organic waste in the absence of oxygen, and while it does require water for mixing and maintaining appropriate slurry consistency, it typically uses less water compared to other systems.

- **Water required**: Typically around 100 to 200 liters of water per tonne of organic waste per day.
- For **50 tonnes per day**, the water requirement would be **5,000 to 10,000 liters per day**.

3. Landfill (with Leachate Treatment)

Water may be needed in landfills mainly for managing leachate. If leachate treatment is necessary, water is also needed for dilution and filtration processes.

- **Water required**: Leachate treatment systems can vary widely but could require anywhere from 1,000 to 5,000 liters per day per tonne of waste, depending on the volume of leachate generated.
- For **50 tonnes per day**, the water requirement might range from **50,000 to 250,000 liters per day**.

4. Waste-to-Energy (WTE)

Waste-to-energy plants, which incinerate waste to generate energy, generally require water for cooling purposes in the combustion process.

- **Water required**: On average, WTE plants require about 2 to 5 liters of water per kilowatt-hour (kWh) of energy produced. For 50 tonnes per day, this could translate to around **5,000 to 20,000 liters per day**, depending on the energy recovery efficiency.

5. Mechanical Biological Treatment (MBT)

MBT combines mechanical sorting with biological treatment. The water required is for processing and washing waste, as well as for biological treatment like anaerobic digestion or composting.

- **Water required**: Similar to composting or anaerobic digestion, MBT systems use between 100 to 300 liters of water per tonne of waste per day.
- For **50 tonnes per day**, the water requirement would be **5,000 to 15,000 liters per day**.
- For a **50 Tons Per Day (TPD) Solid Waste Management System** in India, the water requirement depends on various factors like processing technology, dust suppression, leachate management, washing, and domestic needs. Below is a general tabulation for water usage:
- **Water Requirement Breakup for 50 TPD Solid Waste Management System**

Category	Estimated Water Requirement (Liters per Day - LPD)
Processing & Composting	5,000 – 10,000
Leachate Treatment	2,000 – 5,000
Dust Suppression	3,000 – 6,000
Vehicle & Equipment Wash	4,000 – 8,000
Sanitation & Drinking	2,000 – 3,000
Green Belt & Landscaping	5,000 – 7,000
Total Daily Requirement	**21,000 – 39,000 LPD (21-39 KLD)**

Mechanical drum composting is an efficient method for processing organic waste, utilizing rotating drums to enhance aeration and mixing, which accelerates decomposition. The water requirement for such systems is influenced by factors including the moisture content of the input material, drum design, and ambient environmental conditions.

Water Requirements for Mechanical Drum Composting in India:

- **Moisture Content Maintenance:** Maintaining an optimal moisture level of 50% to 60% in the compost is crucial for microbial activity. This often necessitates adding water to the feedstock during processing.
- **Estimated Water Usage:** While specific data for a 25-tonne per day (TPD) facility in India is limited, general estimates suggest that composting operations can consume up to half their weight in gallons of water annually. For example, a site processing 50,000 tons of compost per year might use as much as 25,000 gallons annually.

Scaling this estimate, a 25 TPD facility could require approximately 12,500 gallons (about 47,000 liters) of water per year, averaging around 130 liters per day.

Considerations:

- **Variability:** Water usage can vary based on waste composition, seasonal climate variations, and specific operational practices. It's essential to monitor and adjust water addition based on real-time observations of moisture content and compost quality.
- **System Design:** Implementing features such as leachate recirculation and efficient drainage can optimize water use and reduce overall consumption. Ensuring the composting pad has a slight slope can prevent water stagnation and promote proper drainage.

For a mechanical drum composting facility processing 25 TPD in India, the daily water requirement is estimated to be around 130 liters, based on general industry averages. However, actual water usage may vary, and it's advisable to conduct site-specific assessments to determine precise water needs. Regular monitoring and system adjustments will help in maintaining optimal composting conditions while ensuring efficient water use.

2.10 LAYOUT OF MSW LANDFILL

Considering the broad parameters outlined above various possible layouts have been developed. The most optimum layout is only given in drawing. Detail Drawings of all facilities provided at Sanitary Landfill are as under:

- Cross Section Details of Storm Water
- Details of Landfill Section Liner System
- Details of Leachate Collection System
- Plan and Cross Section of Section of Sanitary Landfill Facility
- Architectural Plan of Leachate Tank for Landfill

- Foundation Plan of Leachate Tank for landfill
- Topographical map of existing Dumpsite
- Capping plan of Existing Dumpsite
- Sectional Detail of Capping Plan of Existing Dumpsite

These drawings provide detailed description of various supporting and infrastructure facilities. The landfill facility shall have fencing all along the boundary with one lockable secured gate 5 m wide. A complete list of the utilities, services and buildings that are planned in this MSW landfill are given in Table 1. The locations of the facilities are marked in these drawings.

Table 2.9: List of Infrastructure Provided at Sanitary Landfill

S. N.	Description	Area
1	Ground Water Monitoring Well	4 Nos.
2	Storm water drain along the approach road (600 mm x 600 mm)	408 m
3	Tipping Area	450
4	Green Buffer Area	800

As per DPR prepared by UD&PA

2.10.1 Completed Waste Fill Features

The base of landfill i.e. top of liner has been kept at ground level 286 m and 3 m high (above GL) earthen embankment has been provided to achieve the required storage capacity within the area available. Top width of the embankment has been kept at 3 m. Inner & outer slopes of the embankment have been kept at 1V: 2H for stability of slopes.

The geo-composite liner has been provided on the inner side of the landfill as per the requirement of Central and State Pollution Control board norms. Leachate collection system has been provided at the base of the landfill with 250 mm dia. HDPE header and 110 mm dia. perforated HDPE lateral pipes. Leachate shall be collected in the Leachate collection sump

from where it will be pumped to leachate holding tank. Leachate transfer pumps shall be provided of adequate capacity.

MSW shall be dumped in the landfill by refuge collector cum compactor, which shall be further levelled and compacted. Periodic waste audits will ensure that non-conforming waste shall not be dumped at the landfill site. The waste shall be compacted in thin layers using compactors and covered with a daily cover of soil layer or inert waste. After the landfill is filled it will be covered with top cover system with single liner arrangement and on the top,450 mm thick surface layer (Top Soil) shall be provided with vegetation. The slope of top cover shall be kept as 4% to provide quick drainage of surface runoff.

A suitable ramp to reach the embankment top shall be provided so that refuge collector cum compactor can reach the top of embankment and can directly dump the municipal solid waste in the landfill.

2.10.2 Estimation of landfill capacity

The sketch showing section of landfill is given below for the estimation of landfill capacity (figure 8.1). The capacity of landfill is worked out by considering mainly three parts of landfill which are as follows:

i. Middle part (V_1)

ii. Bottom part in the slope of header pipe (V_2)

iii)Top portion (V_3)

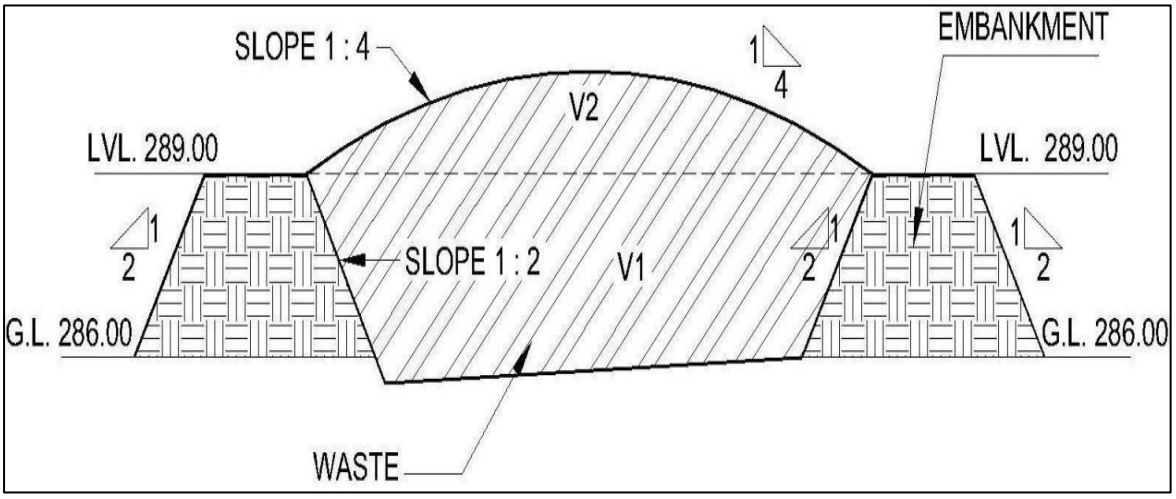


Fig. 2.12 Three Parts of Landfill

The leachate collection tank shall be provided outside the embankment. These shall be located 0.5 m above the lowest ground level. Waste conveying facilities are provided for mechanically depositing the residue into the MSW landfill after segregation.

No specific intermediate cover is provided other than the daily cover. However if the problem of odor persists intermediate cover may also be considered. In that case, one intermediate cover of soil of thickness 450 mm may be provided at the mid-level

The top cover shall have the highest point at the center and slopes towards the edges radially with around 4 % slope towards the embankment. A network of intercepting drains and peripheral drains are provided for quick draining of the rainwater. The facility shall have green belts, trees and turfing on the embankment/ formation slopes as slope protection and to present pleasing appearance

2.10.3 Selection of Liner System

The objective in the design of liners is to minimize the infiltration of leachate and gases into subsurface soils below the landfill eliminating the potential for ground water contamination. Composite liner designs employing a geo-membrane and clay layer provide more protection and are hydraulically more effective than other types of linings. Liners provide an effective hydraulic barrier beneath the waste to contain the waste and to allow for effective removal of leachate generated during containment.

In the present MSW landfill, single composite liner system shall be provided meet stringent performance criteria that provide a high margin of safety. Each of the liner systems is discussed in more detail in the following sections.

Bottom Liners

The bottom portion of the landfill directly rests on stable compacted specially prepared soil bed. The various layers of liners from bottom to top are:

- 1000 mm thick compacted clay/ amended soil (k 10^{-7} cm/sec.)
- 1.5 mm thick High Density Polyethylene (HDPE) Geo-membrane
- 200mm thick silty sand protective layer
- 300 mm thick granular soil drainage layer (Leachate Collection Layer)

Side Liners

*The side slopes in the soil formation are similarly made on firm compacted specially prepared stable slopes of 2H: 1V.*The various layers of side liners from bottom to top are:

- 600 mm thick compacted clay/ amended soil (k 10^{-7} cm/sec.)
- 1.5 mm thick High Density Polyethylene (HDPE) Geo-membrane
- 100 mm thick protective layer (selected soil)

Top Cover Liners

*The top cover the landfill directly rests on compacted specially shaped waste surface. The bed shall be laid to 3 to 5 % slope (after allowing for pre-grade settlements of the waste) for providing good natural drainage.*The various layers of liners from bottom to top are:

- 450 mm thick granular soil (Gas Collection layer)
- 600 mm thick compacted clay/ amended soil (k 10^{-7} cm/sec.)
- 300 mm thick topsoil /Sweet earth laid to 4% slope

2.10.4 Selection of leachate control facilities

The leachate collection layer is provided in the granular soil (drainage) layer of the bottom liner system. The collection layer shall comprise of a network of perforated HDPE lateral pipes laid at a slope of 2% and 20 m c/c spacing. These laterals collect leachate and transfer it to the HDPE header pipe, which is laid at a slope of 1%. The header pipe ultimately transfers the leachate into the Leachate collection sump. The general arrangement of header and laterals is provided in the layout plan of MSW landfill.

The landfill receives municipal solid waste only. All operations are planned in such a way that generation of liquid waste is minimum and the leachate directly reaches the leachate

collection sump for treatment. Apart from the leachate generated as a result of inflow of rainwater into the landfill, the seepage from the moisture content present in the solid waste and the moisture present in the daily soil cover are the few sources of leachate generation. 10 % evaporation has been considered.

Max. Daily rainfall = 108.50 mm (recorded in *Lunglei*)

Maximum daily rainfall data i.e. 108.50 mm of 11th August, 2012 year has been considered. This is the highest daily rain fall in the past 10 years.

Estimated Leachate quantity

Estimate of leachate generation to be 25 – 50 % of precipitation Adopting 35 % leachate generation i.e. 0.35 x 108.50 = 37.975 mm/day

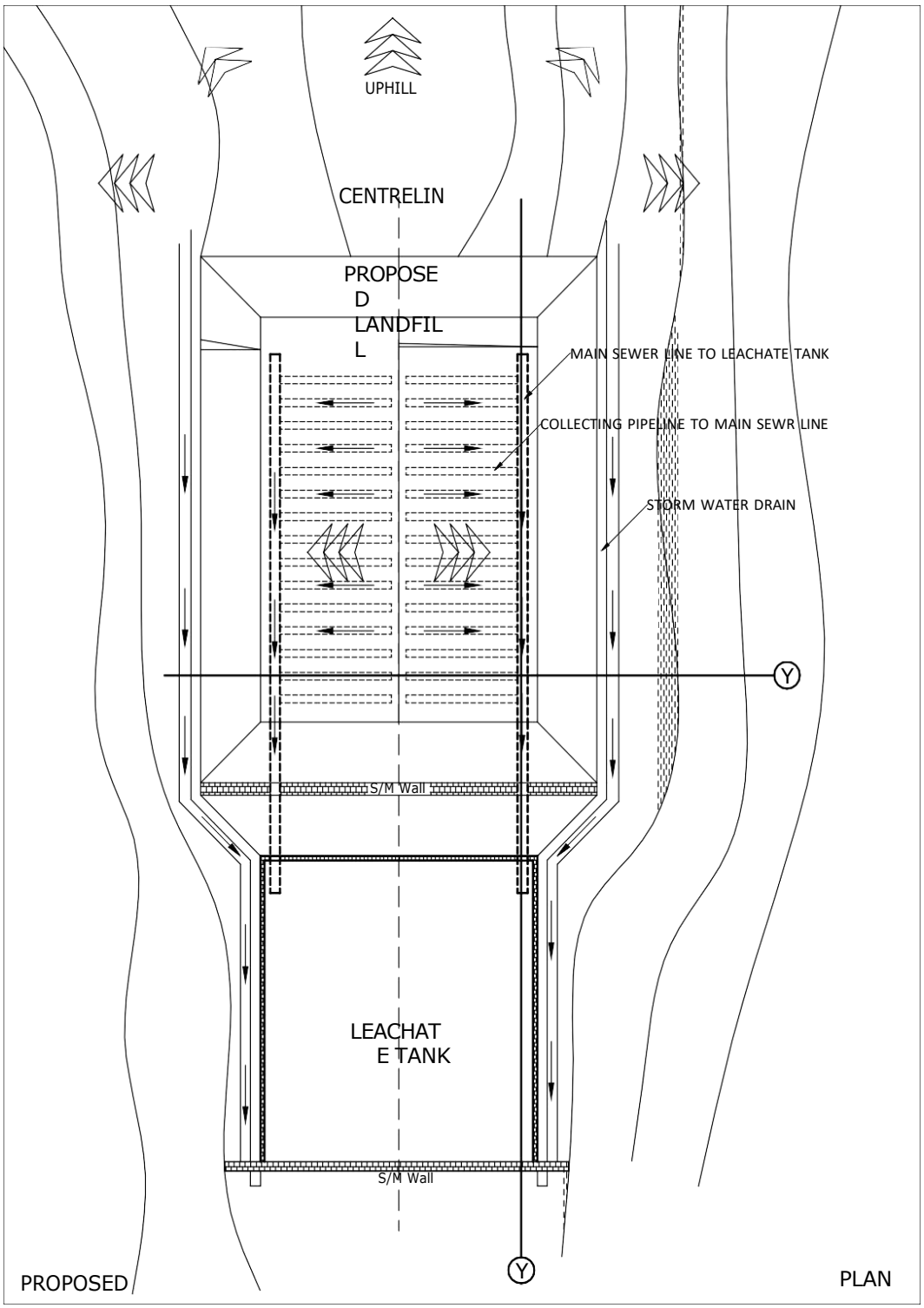
Leachate volume = volume of precipitation + volume of pore squeeze liquid – volume lost through evaporation – volume of water absorbed by waste

Leachate volume =

Provide a sump of size = 5m x 4m x 3m

Fig 2.13 Proposed Landfill with Leachate tank

2.11



SWMC AND LANDFILL DESIGN

Preliminary design & engineering has been done for the construction of sanitary landfill facility for **Lunglei**. This facility shall comprise of a secured landfill facility (SLF) and other associated facilities. After filling, it will be covered with top cover and subsequently filling of waste in the next phase area will be started. The integrated landfill facility shall require around **2400 sq. m** of area to accommodate the landfill able waste for **15 years** in Lunglei. The Total Life of landfill is also worked out for **15 years**.

2.11.1 Land Area

The design of MSW landfill facility has been planned by considering 2400 sq.m, this area would be utilized for landfill for first 5 years. The landfill can be further adjusted with the remaining available area for future use. Some of the area has been earmarked for green belts, associated facilities and buffer zones in as much as the surrounding environment is not disturbed/effected by noise, odors and defacement (from aesthetic considerations). All services are accommodated within this area.

2.11.2 Surface drainage facilities

The storm water routing within the MSW landfill site has been planned to effectively discharge storm water through storm water drains/ control structures to the offsite channel/drain. For this purpose storm water drains/peripheral drains/ toe drains are provided. The drains shall have **RCC construction** with lined bottom and sides.

2.11.3 Operational Plan

The facility shall be developed as a MSW disposal facility conforming to the statutory guidelines of MoEF/CPCB/SPCB with elaborate operation and management (O&M) plans matching to the size and environmental protection requirements. The O&M plan shall ensure operational efficiency and also timely feedback well before onset of any eventuality/emergency.

For this the following areas have been given emphasis:

2.11.4 Inventorization and Characterization of MSW

A mechanism shall be established whereby continuous update on MSW inventory in *Lunglei* is available. Special attention shall be placed in case of entry of any development of new colonies, institutions, markets etc.

Change in laws, governing rules/regulations, updates etc.

Conforming to changing scenarios and rulings of the governmental agencies due modifications/improvements shall be implemented. A liaison engineer shall be appointed for monitoring and updating these activities.

2.11.5 Operation Manual

An operation manual conforming to the procedures for effective running shall be developed wherein the landfill facility operator, local residents and the government agencies are apprised of their roles and responsibilities.

2.11.6 Emergency Management Program

In case of any emergencies like vandalism, fire, floods, earthquake, groundwater and soil contamination, etc. the emergency cell on site shall keep liaison with the concerned agencies such as firefighting squad, hospitals, police, district administration, local PCB office, etc. for a coordinated timely action.

Monitoring Program

Adequate instrumental monitoring systems for knowing the condition of the landfill and the surrounding areas (soil, groundwater, air) covering range of 2 km has been planned. These instruments shall be maintained and operated as per the operation manual. A well-equipped laboratory for exercising quality controls is also planned. A monitoring cell shall be responsible for upkeep of the monitoring program. Logbooks and records relating to waste quantities received, disposed in the landfill, etc. shall be maintained in soft and hard copies by this cell.

Human Resource Plan

A team shall be created for addressing issues related to environmental concerns, public unrest, grievances, on-site and off-site health hazards, compensations, etc. This team shall make timely and coordinated efforts to sorting out differences, if any.

2.11.7 Selection of landfill gas control facilities

The landfill is a secured landfill with single composite liners well in place at bottom, sides and top. The liner system consists of one-layer of geomembrane and one-layer of 2ft.

(600mm) thick amended clay as liners whereby the chances of gases escaping from the ground and contaminating the groundwater and soil are avoided . The gases developed due to continued confinement of degradable wastes, if any, are released through the gas extraction facilities provided in the landfill. For this purpose GI Vents are planned at every 200 c/c.

2.11.8 Aesthetic Considerations

Adequate measures are planned to give a facelift by utilizing the abundantly available on site natural soil for raising buffer zones /embankments. Two rows of vegetative plantation shall be developed along the circumference of the outer embankment along with turfing on the slopes. In addition the top cover shall also be developed as a green belt.

2.11.9 Monitoring Facilities

The soil, air and water in the area shall be continuously monitored for no contamination. Both sampling methods and non-sampling methods are adopted and monitored as per the monitoring plan for timely action to be taken before water contamination and leakage of gases into the soil. The facility is provided with a minimum four monitoring wells for soil water and gas measurements. The details of the monitoring plan are given in Table 7.2, wherein instruments /monitoring areas proposed are listed.

Apart from the above, regular inspection and monitoring of important components of the landfill shall be done as per the schedule given below:

Final Top Cover: Once in a year and after each substantial rainfall it should be checked for any erosion, landslides, movement of soil, slope, etc.

Vegetation: Four times in a year a check should be made for existence of dead plants/trees. Any plant/tree found dead shall be removed immediately.

Final Grade: Twice a year should be checked for ponding/logging of water. If any abnormalities found, slope should be corrected by putting soil.

Surface drains: Four times a year and after each substantial rain should be checked for any blockages. Leaves, debris or any other accumulation found in the drain shall be removed immediately.

Gas Monitoring: As required in the Management Plan it should be checked for strong presence of odor. The gas monitoring equipments (compressor, pipes, flaring stand, etc) should be checked to ensure their workability as they might become inoperable due to high gas generation.

Groundwater Monitoring: As per the Action Plan. A regular inspection shall be done to check for any failures in the monitoring system.

2.11.10 Determination of equipment requirement

The landfill facility shall have minimum operating equipment for the construction stages and no earth moving machinery is planned as the work shall be done by engaging suitable contracting agency. For the operations of daily cover the following nominal equipment shall be provided:

- Vibro Compactor -1No
- Front end loader with back hoe -1 No
- Water Tanker (capacity 5 KL) -1 No
- Tipper Truck -1 No

For power supply to equipment, lighting, services etc., a substation with transformer yard has been planned. All electrical systems shall have proper earthling and control systems. One number diesel- run electrical generator of 50 KVA is proposed for running the essential services

2.11.11 Technical Specifications

The detail technical specifications of the following items have been given:

- Preparation of work area/ clearing site/ jungle
- Striping
- Excavation & filling work
- Excavation of trenches
- Borrow areas
- Cast-in-situ cement concrete
- Formwork and staging
- Reinforcement

- Structural steel work
- Stone work-random rubble masonry
- Filling for clay liner and foundation
- Foundation for embankment
- Earthen embankment
- Turfing
- HDPE liner
- Clay liner
- Leachate collection system
- HDPE Pipes
- Sand layer
- Gravel layer

2.11.12 Site infrastructure

In addition to the landfill area, the site shall be provided with the following infrastructure:

- Waste reception facilities
- Haul roads
- Weigh bridge
- Site office
- Top soil storage
- Support services such as electricity, water supply telephones etc.
- Site security
- Vehicles and equipment
- Vehicle and equipment maintenance workshops and
- Site staff

2.11.13 Buffer zone (green belt)

A vegetative cover will have to be provided as buffer zone between the landfill site and the nearby localities. In addition to the buffer zone, a compound wall/rigid fencing all around the landfill site to a height of 3m or as suitable, shall also to be constructed, to totally seclude the site from outside activities.The proposed vegetative cover shall comprise trees and shrubs that improve the visual and aesthetic appearance of the site. In addition the waste reception

area, administrative area and segregation areas shall also be provided with vegetative cover to the extent possible.

2.11.14 Site Security

Security to the whole of landfill area shall be provided for all 24 hours the day. A compound wall all around the site shall be constructed to provide integrity to the site and also serve as noise barrier to the adjoining areas. The wall can be of masonry or any other suitable material / rigid fence. As unauthorized access to the site may pose significant health and safety risks, warning notices and access control shall be provided at the following locations of the site.

- Plant and equipment compounds
- Waste receipt point
- Leachate and Land fill gas collection and treatment locations and
- Parts of site undergoing construction Vehicles and Equipment

2.12 LEACHATE GENERATION AND TREATMENT

Water that percolates through the placed solid waste is known as leachate. During its progress through the waste, the water entrains suspended solids, extracsoluble constituents of the waste and soluble products of the waste degradation process. The composition of leachate depends up on the stage of waste degradation and the types of waste within the landfill. The main components of leachate will comprise:

- Major elements and ions including calcium, magnesium, iron, potassium, sodium, ammonia, carbonates, sulphates, chlorides, etc.
- Trace metals including manganese, chromium, nickel, lead, cadmium, etc.
- Organic compounds including phenols, poly aromatic hydrocarbons, etc. Microbiological components

The quantity of leachate generated will depend on the annual precipitation rates and active area of the landfill. This requires preparation of complete water balance of the landfill site, in accordance with the development phases of the project. It is now too early to anticipate a detailed phasing of the landfill site and hence it is assumed that an area equivalent to the total waste generated in a year would be the active area for the landfill site in the particular year. However, it is to be noted that the leachate generation trends vary drastically depending upon the quantity of waste deposited every day and the actual quantity shall be estimated by

considering the cumulative quantity of waste deposited in the landfill. The quantity estimated here will just give an idea for the area requirements of leachate treatment.

Leachate collection and removal

The leachate collection shall be achieved through the following measures:

a. Gravity drainage and grading of the floor of the landfill cell to fall into a sump, located at the lowest point of the cell. The gradients shall be 2% for main drainage with 1% cross fall.
b. Installation of leachate drainage blanket above the basal mineral liner over the floor of each cell and partially up the side walls, constructed of free drainage coarse granular fill comprising of graded 50mm crushed rock laid to a depth of 400mm with a permeability of 1 x 10-9cm/sec.
c. Inclusion of perforated HDPE pipes in the drainage blanket to facilitated leachate flow with pipes laid on a typical spacing of 50m.
d. Overlaying granular drainage blanket with 100m thick free draining fine granular fills of medium to coarse sand to act as a filter and protective layer.
e. Removal of leachate is effected by leachate collection chambers built up with successive lifts of waste and side slope risers located on the site perimeter.
f. The submersible pumps or adductor pumps should be used to remove leachate from the sumps and the collection chambers should be linked by permanent pipe work to the treatment plant.
g. The precise methods and degree of treatment shall accommodate the fluctuations in leachate generation. However the following steps shall be followed to meet the standards prescribed by the ministry.

- Balancing of Leachate flows and volumes.
- Redistribution and recirculation of leachate to dry absorptive waste to reduce volume and to enhance the rates of stabilization.
- Aerobic processing through lag

Estimation of Leachate Quality and Quantity

Leachate is generated on account of the infiltration of water into landfills and its percolation through waste as well as by the squeezing of the waste due to self weight. Thus, leachate can be defined as a liquid that is produced when water or another liquid comes in contact with

solid waste. Leachate is a contaminated liquid that contains a number of dissolved and suspended materials.

On a basis of review of liner systems adopted in different countries, it is recommended that for all MSW landfills the following single composite liner system be adopted (waste downwards) as the minimum requirement.

(a) A leachate drainage layer 30 cm thick made of granular soil having permeability (K) greater than 10^{-2} cm/sec.

(b) A protection layer (of silty soil) 20 cm to 30 cm thick.

(c) A geomembrane of thickness 1.5 mm or more.

(d) A compacted clay barrier or amended soil barrier of 1 m thickness having permeability (K) of less than 10^{-7} cm/sec.

The liner system adopted at any landfill must satisfy the minimum requirements published by regulatory agencies (MOEF / CPCB). The liner system may have to be more stringent in free draining alluvial soils at locations where water table level is close to the base of the landfill.

The recommendations for the liner system are not expected to be reduced. However in circumstances where it can be proven by subsoil investigations as well as by hydrological investigations that the leachate will not cause harmful impact to the soil as well as ground water, the norms can be reduced after approval by the regulatory authority.

(a) **Leachate Evaluation**

Average Total Precipitation in Lunglei = **235cm / year**

Only one phases is operative

every year Plan area of

operating phase = 68.7 sq.m

Assuming 80% precipitation (monsoon period), peak leachate quantity (thumb rule basis) = 200 cu.m per day

(b) **Leachate Collection Pipes**

Dia of HDPE pipes (perforated)= 15 cm

Spacing of pipe required (hydraulic analysis)= 22 m

(c) Leachate Holding Tank

Size of holding 3 days of leachate = 3m x 3m x 5m

Land preparation:

Cut-off Walls: When a landfill is underlain, at shallow depths, by an impervious layer, vertical cutoff walls may be constructed around a landfill to intercept off site migration. Cut-off walls are physical barrier (typical made of bentonite or bentonite-soil mix) and such barriers are aided by active pumping used to remove leachates from within the perimeter of the cutoff wall.

Leachate for Steep Slopes and Vertical Quarry Faces

A leachate collection system comprises of a drainage layer, a perforated pipe collector system, sump collection area, and a removal system. The leachate drainage layer is usually 30 cm thick, has a slope of 2% or higher and a permeability of greater than 0.01 cm/sec. A system of perforated pipes and sumps are provided within the drainage layer. The pipe spacing is governed by the requirement that the leachate head should not be greater than the drainage layer thickness. Pipe material selection is based on design requirements. HDPE pipes are most commonly used; other materials can also be examined for feasibility.

The design steps for the leachate collection systems are:

(a) Finalization of layout pipe network and sumps in conjunction with drainage layer slopes of 2%.

(b) Estimation of pipe diameter and spacing on the basis of estimated leachate quantity and maximum permissible leachate head.

(c) Estimating the size of sumps and pump.

(d) Design of wells / side slopes riser for leachate removal

(e) Design of a holding tank.

Leachate Management

The alternatives to be considered for leachate management are

Discharge of Lined Drains: This option is usually not feasible. It can only be adopted if the leachate quality is shown to satisfy all waste water discharge standards for lined drains, consistently for a period of several years.

A leachate recirculation facility should be designed by a water supply specialist in conjunction with a geotechnical engineer. Procedures for design are yet to be standardized and one may refer to Koerner for further details. A leachate treatment facility should be designed by a waste water treatment specialist. The treatment facility will depend on the quality of the leachate and some treatment systems are discussed by Hogland (1997).

Surface Water Drainage System

Surface water management is required to ensure that rainwater run-off does not drain into the waste from surrounding areas and that there is no water logging / ponding on covers of landfills.

a) Surface Water Runoff

Average Total Precipitation of Lunglei = 2350 mm/year

Peak discharge rate reaching drainage channel = 0.064 cu.m / sec.

Dimensions of drainage channel:

Depth = 0.6m, Base width = 0.6m, side slopes = 3:1

Sedimentation Tank: To remove suspended particles of size 40 microns and above tank size required

= 40x15x2 m

Leachate treatment Plant

Based upon the analyzed characteristics of the leachate collected, the treatment units are provided.

Treatment Process

Geo-textiles membranes: Removes unwanted solid particles that may cause clogging of the drainage system and also leads to wear & tear of further treatment units

Influent Leachate Storage Tank: For collecting and storing the leachate generated. Helps in flow equalization and allows controlled flow of leachate per treatment cycle.

Oil & Grease Trap: Efficient removal of oil & grease produced from decomposing organic matter using activated charcoal bag.

Moving Bed Bio-film Reactor: The inoculums are added after studying the characteristic of leachate to be treated. The bacteria/activated sludge grow on the internal surface of the carriers. The bacteria break down the organic matter from the waste water. The aeration

system keeps the carriers with activated sludge in motion. Only the extra amount of bacteria growth, the excess sludge will come separate from the carriers and will flow with the treated water towards the final separator.

Secondary Treatment: Here, the supernatant treated water is collected and stored in the sump tank, while the settled sludge received in the hopper at first compartment attached at the bottom of the treatment tank where the sludge will be transferred to the sludge drying bed or landfill.

Sump Tank: temporarily stores the water and provides further aeration

Activated Carbon filter and Sand/ Gravel Filter: Provides proper filtration from any unwanted particles.

Sludge Disposal: Sludge containing the carriers is dried at the sludge drying beds and used as manure for gardening.

The treated water is drained to phyto-remediation.

Design of Leachate Collection System Leachate Collection system

The primary function of leachate collection system is to collect and to convey the leachate out of the landfill unit/ waste storage unit and to control the depth of the leachate above the liner. The design leachate head is very important as flow of leachate through imperfections in the liner system increases with an increase in leachate head above the liner. Maintaining a low leachate level above the liner helps to improve the performance of the composite liner system. The main components of leachate collection system are leachate collection tank, feeder mains and header main. Leachate Collection Network Leachate Collection Network comprising header pipe and feeder pipe/ laterals has been proposed. The feeder pipes shall be of 110 mm diameter at a slope of 2 per cent and connected to header pipe. Similarly, the header pipe shall be 110 mm diameter at a slope of 2 per cent connected to leachate collection tank. Leachate Collection Sump The purpose of leachate collection tank is to collect the leachate from header pipe and active landfill area/waste storage area. The leachate collection tank would be supported by the pump to lift the collected leachate.

Feeder and Header Pipe Material

A leachate collection system is a network consisting, 110 mm diameter feeder pipe at lateral spacing of 10m connected to 110 mm diameter header pipe. The pipes shall be HDPE perforated pipes with sufficient strength and should be safe from particulate and biological

clogging and deflections. The generated leachate shall be transported to Leachate Treatment Plant (LTP) and treated to as per prescribed norms prior to its final disposal.

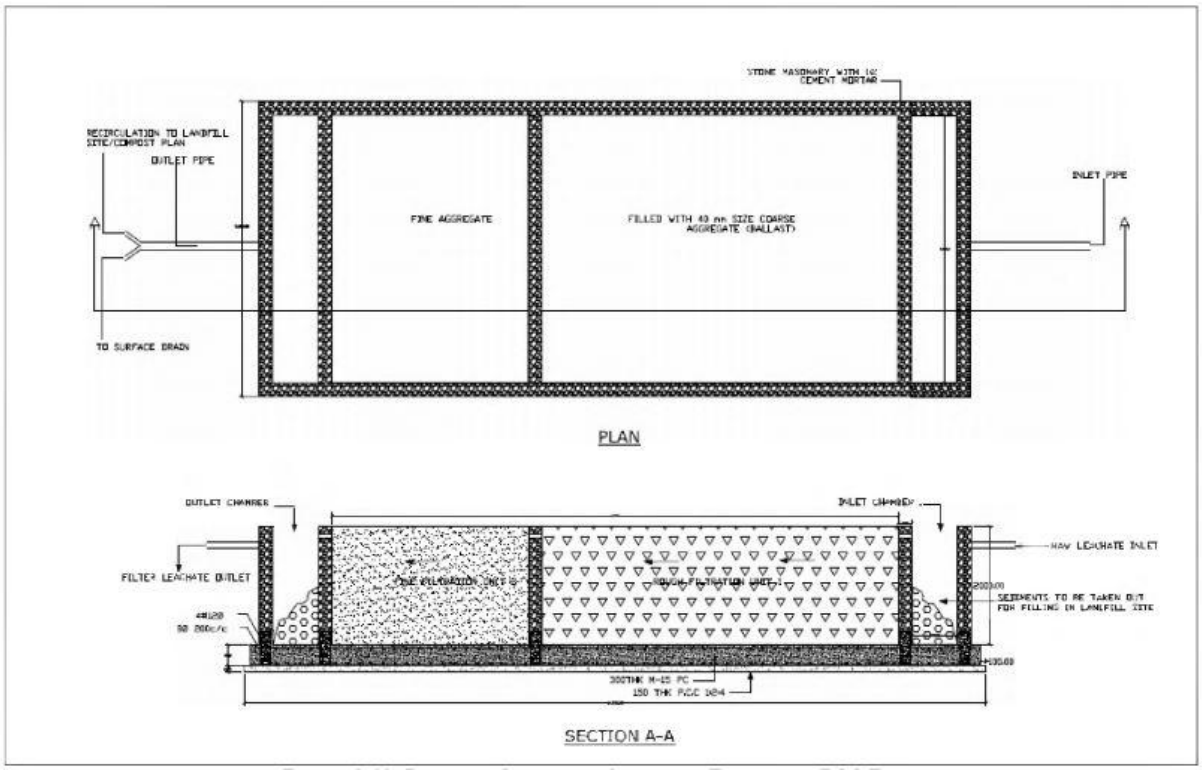


Fig 2.14 Proposed Leachate tank

2.13 ENVIRONMENTAL IMPACT & ITS MINIMIZATION

In line with the Solid Waste Management (SWM) Rules, 2020 as documented in Section 4.1, sanitary landfills minimize the harmful impact of solid waste on the environment through the use of the following mechanisms:`

a) reduction of groundwater contamination through leachate collection and treatment;

b) control of surface water contamination through runoff;

c) reduction of air contamination due to gases, litter, dust, or bad odour;

d) control of other problems due to rodents, pests, fire, bird menace, slope failure, erosion, etc.

Landfill gas generation, control and management

Landfill gas is generated due to the degradation of the organic matter in the wastes. Since the landfill material will be basically inert, the landfill gas generation will be minimal. However, a minor portion of un-composted material may also go to the landfill and therefore adequate gas ventilation system has to be provided as a part of the design.

Landfill gas and management

The primary measures to restrict the uncontrolled migration of landfill gas from the site will comprise

a. Low permeability containment layers and systems installed on the base and side walls.

b. Permeable gas drainage blanket of 0.3 m thickness laid beneath the capping layer and

c. Vertical gas chimneys vent and extraction wells.

The gas drainage blanket will be formed of a layer of fines free, graded granular fill overlain by a layer of fine sand 100 mm thick and provide protection to the capping layer Chimneys, vents and extractions wells shall be constructed by drilling from the surface of the capping layer. The extraction wells will have an outer diameter of 0.3 m to 1 m and a HDPE well pipe of 0.1 to 0.15 m within well body.

Ground and surface water run off

Conventional dewatering measures shall be employed within the landfill area to discharge and maintain groundwater levels below landfill foundation level. This will be ensured through

a. Pumping from perimeter trench drains installed on the bunds or from sumps installed below the landfill foundation level for areas undergoing preparation

b. Installation of temporary or permanent surface water interception drainage ditches to carry peak rainfall runoff and prevent flooding of landfill site.

Surface water run off Management:

Rainwater runoff comprises of storm water, which flows into both surface waterand groundwater. Proper management of this resource ensures that storm waterdischarge is free of contamination. Storm Water Management includes thefollowing:

- Good housekeeping in the above areas.
- Conducting routine inspections to ensure cleanliness
- Secondary containment and dykes in fuel/oil storage facilities
- Preparation of spill response plans, particularly for fuel and oil storage areas.
- Provision of silt traps in storm water drains.
- Regular inspection and cleaning of storm drains.

2.14 ENVIRONMENTAL CLEARANCE

Environmental clearance will be obtained from the State Pollution Control Board i.e. consent to establish for setting up of compost plant and sanitary landfill under section 21 of Air

(prevention & control of pollution) Act, 1981, Section 25/26 of Water (Prevention & Control of Pollution) Act, 1974 from Mizoram State Pollution Control Board (MSPCB).

CHAPTER 3: DESCRIPTION OF THE ENVIRONMENT

3.1 INTRODUCTION

As a precursor for the prediction of various types of environmental impacts likely to arise due to implementation of this project, it is essential to establish the baseline environmental status of the physio-chemical, biological and socio-economic parameters in the project area and within the project influence area.

3.2 STUDY AREA

Lunglei is the largest district in Mizoram with an area of 4,572.00 sq. km. Mamit and Aizawl bind the district in the north and Lawngtlai and Siaha in the south. The eastern region shares international borders with Myanmar and western region with Bangladesh. The district lies 722 meters above sea level and is located between 23.40780°to 22.49699 N° and 93.16474° to 92.34659° E. Mat and Tuichang Rivers along their tributaries form the major drainage systems. Geologically, the district is occupied by shale, siltstone, and sandstone of Surma formation of Miocene age (Central Ground Water Board, 2013).

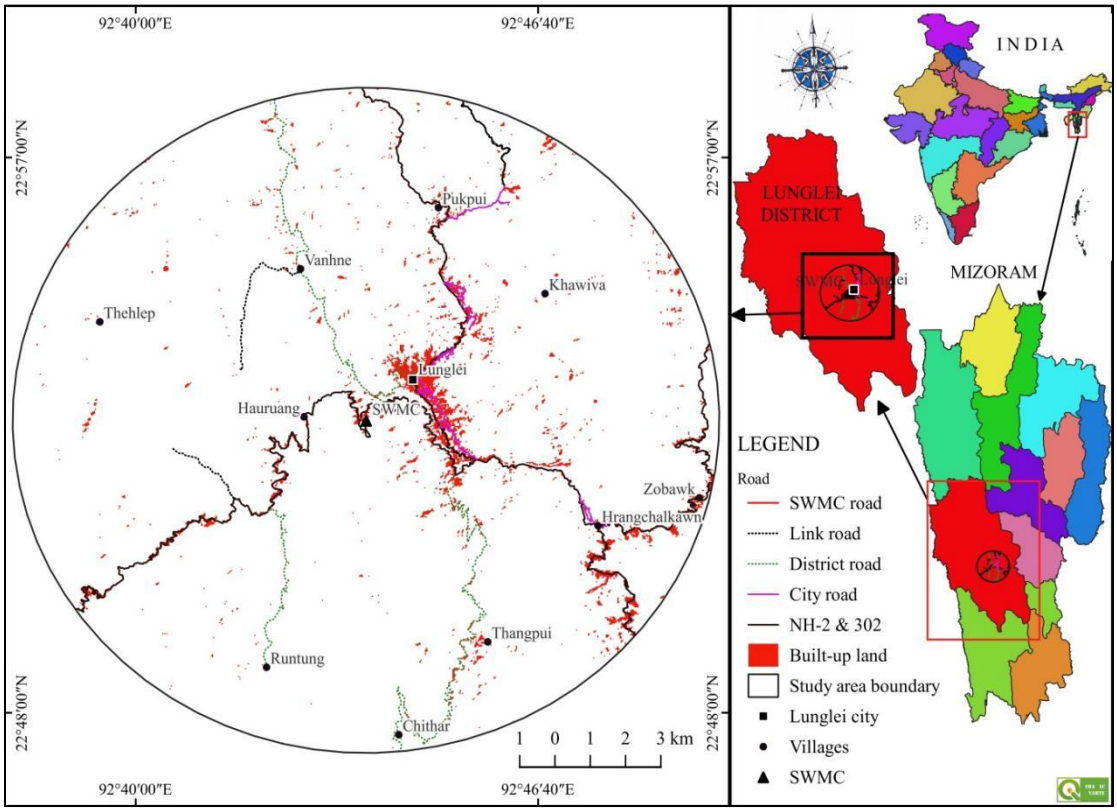


Fig 3.1. Map of study area

3.3 METHODOLOGY OF CONDUCTING ENVIRONMENTAL BASELINE MONITORING

The guiding factors for the present baseline study are the Ministry of Environment, Forests & Climate Change's (MoEF&CC) requirements for the Environmental Impact Assessment (EIA) notification and local regulations and directives. The studies were conducted by considering the following:

- The various environmental attributes were divided into primary and secondary studies. Primary attributes such as air environment, water, soil, noise, flora and fauna, and Socio-economic were assessed by conducting field studies, on-site monitoring and review of the past studies conducted.
- Baseline data on environmental attributes (Air, Noise, GroundWater Surface Water and Soil) have been collected in the study area. The data has been collected by the EIA Consultant by engaging NABL accredited laboratory and Research Laboratories.
- Secondary attributes such as land use studies, geology, physiological characteristics, and socio-economic environment have been assessed by literature review of previous studies conducted by various government publications.

An interdisciplinary team through discussions, criteria questions and professional judgement formulated the scoping and the extent of data generation. The baseline studies started with site visits and reconnaissance survey in the study area for fixing the monitoring locations for the primary data. As a secondary data review, various Government agencies were approached for procuring information and relevant data of the area.

3.4 PHYSICAL ENVIRONMENT

3.4.1 Meteorology and Climate

The climate condition of project areas is divided in 4 seasons viz. winter season (December to February), summer season (March to May), monsoon season (June to September) and retreating monsoon season (October to November). Climate in Mizoram is cool with tolerable humidity and plenty of rainfall. Climate in Mizoram is cool with tolerable humidity and plenty of rainfall. The air is humid nearly throughout the year. Relative humidity is highest during south-west monsoon when it is above 90 percent. The period from February to April is comparatively drier when the relative humidity is between 60 and 70 percent. The climate of Lunglei city is characterized by its coolness, relative high humidity nearly all the year round

and abundant rainfall. In brief, it enjoys pleasant climate which is neither very hot nor very cold throughout the year. The average annual rainfall is around 2350.9mm. About 20 percent of the annual rainfall occurs during the pre-monsoon months and is mostly in the form of thunder-showers and about 60 to 70 percent of the annual rainfall occur during the period from May to August.

3.4.2 Topography

The general topograophy of Lunglei District varies widely. While the eastern and northern parts of the district are charactaeised by a rather hilly terrain with high and prominent relief, the western and south western parts of the district, on the other hand is portrayed by comparatively low and less prominent ridges. There are, as a whole is characterized mainly by several ridge lines and intervening valleys.

The western flank of the district bordering Bangladesh is characretrized by several low undulating hillocks with varying dimensions. The western boundary of the district is formed by Sazuk lui (Bara Harina Chhara) until it joints the Karnaphuli River. Sazuk lui originates in the north-west side of the district near Saisen village, and flows towards southern direction for about 50 kms before it ultimately empties itself into the Karnaphuli River. The other half of the western boundary, i.e the south western boundary of the district, on the other hand, is formed by another two major rivers. Tuichawng river, which enter the district from Chawngte village flows towards north and forms the south-western boundary for about 25 km, before it flows inside the district. The Khawthlangtuipui (Karnaphuli) river is one of the most important rivers within the district. The total length of the Khawthlangtuipui River within the district is about 34 kilometers.

The western and southern parts of the District are characreterized by linear ridges which run more or less parallel to one another. The hills in this areas are generally low dissected, undulating and low relief. The ridges are long and slender and separated by wide valleys and small hills. One ridge starts from the south of Chawilung village which extend towards north for a distance of about 15 km. This ridge passes through Chawilung. Hmunthar and Zohmun villages, and is terminated by the Karnaphuli River. This ridge is locally named Puankhai Tlangdung.

To the east of this Puankhai Tlangdung runs Tuilianpui or Sazai lui which enters the study area from the Mamit district near Mar “S” village. On the eastern side of this ridge, flows Kau Lui which originates from Thorang tlang in the north. To the north Kau Lui, extends a

long ridge towards north which starts from Tleu tlang near Tleu village. This ridge passes through Kawnpui and Darngawn villages. The eastern side of this ridge is bounded by Tut (Gutur) river. The north-west boundary of the District is formed by Mar Lui which enters the town area from Mamit District.

Chhintuipui (Kolodyne) river is one of the most important rivers within the district. It enters the district from Myanmar and flows in the nort-west direction. The total length of the river within the ditsirtc is measured to be 77 kilometres.

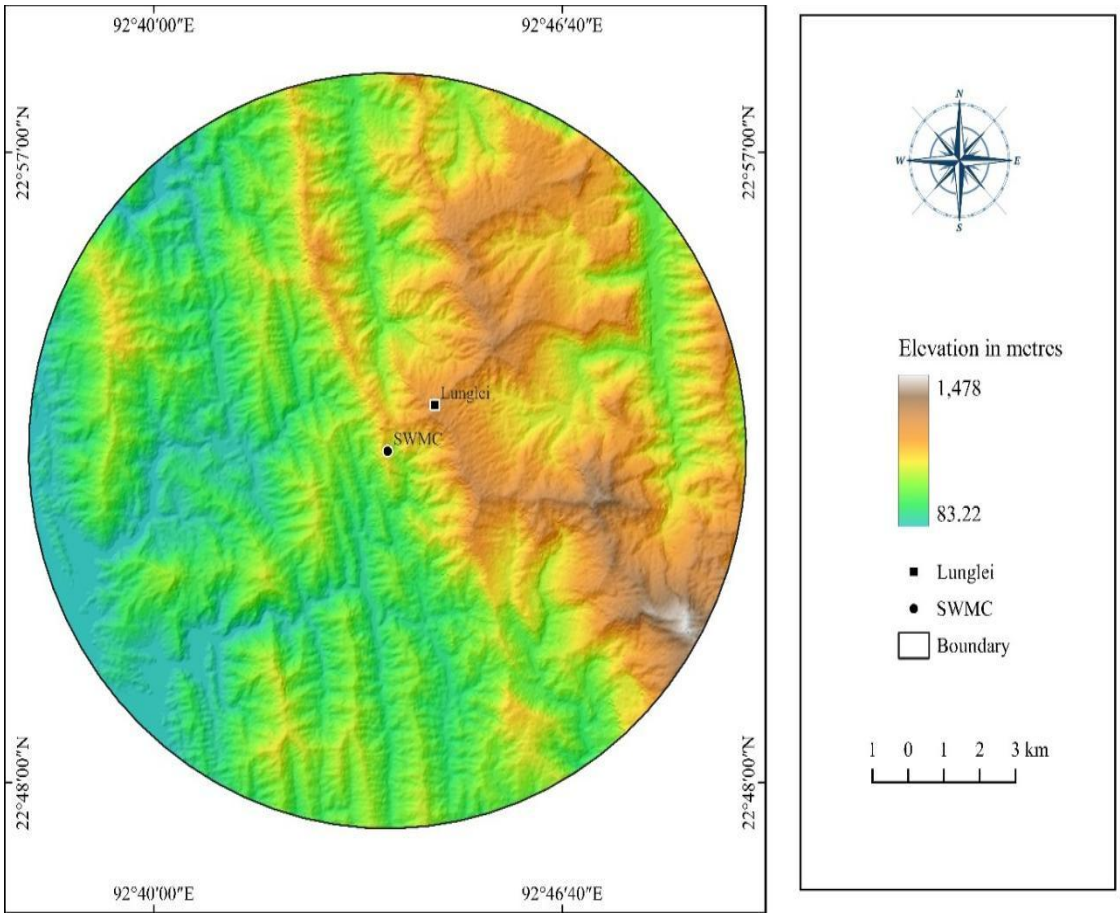


Fig 3.2. Elevation map of 10 km radius of proposed site

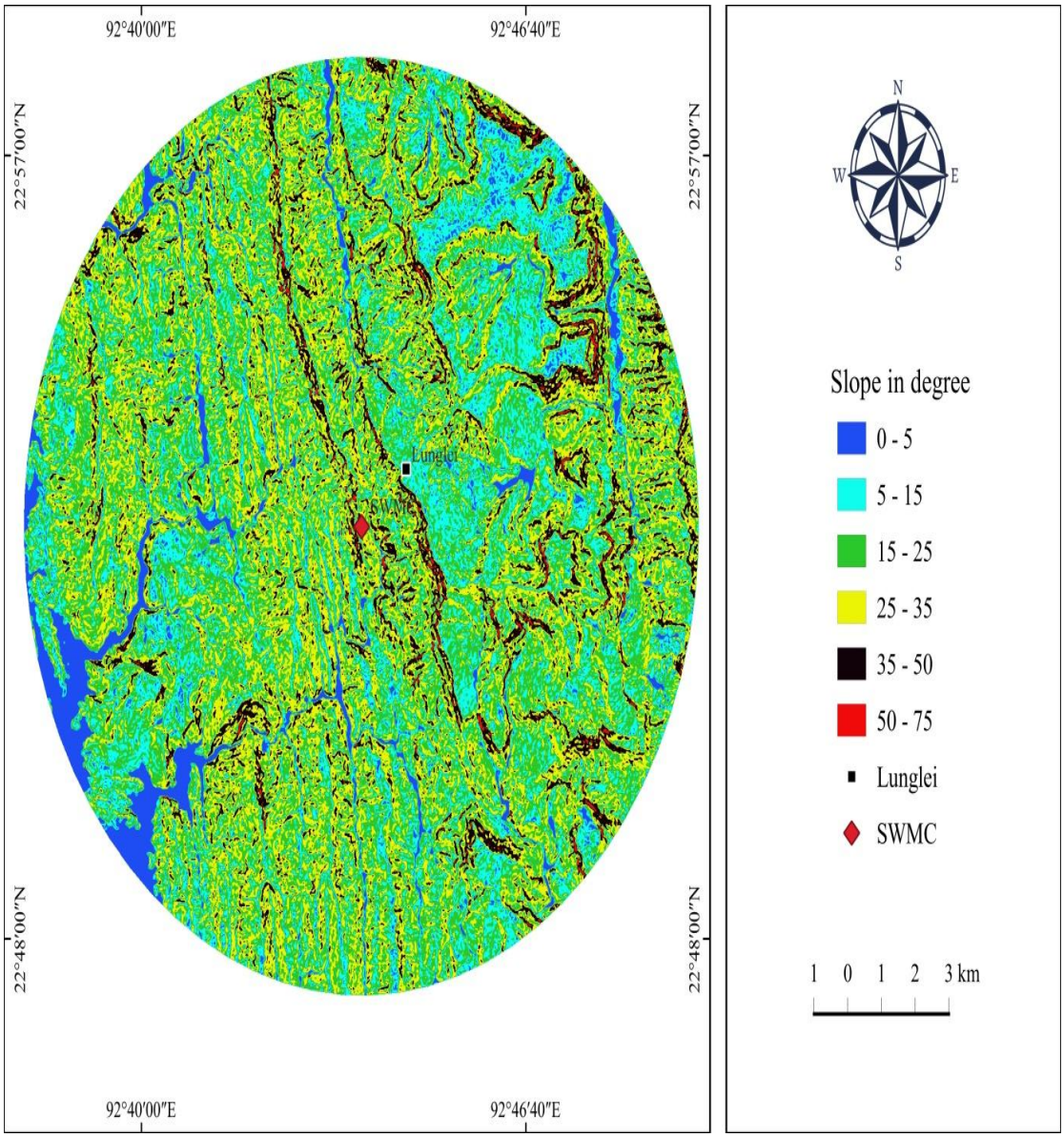


Fig 3.3. Slope degree map of 10 km radius of proposed site

3.4.3 Soil

The soil formation Lunglei falls in the North Eastern Hills (Purvachal) agroclimatic zone with warm and humid climate. About 43% of the total land area is occupied by laterite soil, the remaining land area is equally covered with alluvial soil and forest soil with a rich humus cover (ICAR, 2018). Physiographically, the district consists of parallel to subparallel hill ranges trending in the North to South direction. These hills are steep with narrow gorges and are often separated by rivers and streams. Most of these streams are tributaries to the Kaladan River. Geologically, Lunglei is rich in shale, siltstone, and sandstone of Surma formed during

the Miocene age. The result of soil quality measured at land fill site has been given Table no 5.1.

Table 3.1 Soil quality analysis(Collection Month October 2022):

Sl. No	Parameters	Unit	Project site	Lower side of the project area	500m N from the project side	200m E from the project side	Hauruang	Old dumpsite	Sazaikawn
1	Colour		Reddish yellow	Brown	Brownish Yellow	Brownish Yellow	Brown	Brown	Reddish Brown
2	pH		5.92	6.21	6.24	5.87	5.93	5.99	6.1075
3	Bulk Density	g/cm3	1.91	1.16	1.56	1.14	1.32	1.42	1.3275
4	Moisture Content	%	19.8	23.9	22.7	22.2	23.4	21.6	23.45
5	Water Holding Capacity		1.15	1.45	1.13	1.35	1.48	1.55	1.39
6	Sand	%	86.8	64.8	80.8	77.8	54.5	51.1	67.225
7	Silt	%	5	12	10	10	21.4	21.1	14.5
8	Clay	%	8.2	24.2	10	12.2	24.1	29.8	18.725
9	Texture	Cl	Claye	Sandy	Loamy	Sandy	Sandy	Sandy	Sandy

		as s	y Sand	Clay Loam	Sand	Loam	Clay Loam	Clay Loam	Loam
10	Respiration	mg CO2 mg	145	173	109	138	183	162	142.25
11	Soil organic Carbon	%	5.66	5.65	3.58	5.43	4.87	3.95	4.91
12	Total Nitrogen	mg/ kg	23.65	20.49	21.89	23.43	27.12	21.56	21.8925
13	Available Phosphorus	mg/ kg	18.98	14.21	19.38	20.35	23.21	22.65	19.5275
14	Exchangeable Potassium	mg/ kg	215.97	198.27	201.43	221.01	241.49	236.32	213.5425
15	Sodium (Excheangable)	mg/ kg	27.11	20.49	22.54	21.27	18.29	18.66	22.5375
16	Calcium (Excheangable)	mg/ kg	369.63	281.87	217.94	453.1	108.53	160.02	274.025
17	Magnesium (Excheanga	mg/	276.26	366.89	225.33	315.22	247.69	215.88	277.44

	ble)	**kg**							
18	**Manganee (Excheangable)**	**mg/kg**	**131.9**	**193.11**	**122.6**	**173.3**	**146.1**	**124.57**	**147.7775**
19	**Ammonium**	**mg/g**	**4.2**	**5.8**	**5.1**	**5.6**	**5.1**	**4.6**	**5.35**

3.4.4 Drainage

Lunglei being situated on a hilly terrain with more than 20 % slopes, most of the rainwater flows down as surface run off. The natural drainage system of the loction includes: (i) eastern drainage system; and (ii) western drainage system. Two rivers surround the city along its sides, namely Mat on the eastern side, Tlawng on the northern site and Rangte on the western side. The storm water and the wastewater from Lunglei town mostly get drained out into Tlawng River system.

Though Lunglei has numerous drains crossing the town, the drainage situation has come to a deplorable state with choked, over flowing drains, acting as disposal point for solid waste and sewage. The poor drainage conditions coupled with loose sedimentary soils and unregulated construction activities for developmental purposes have led to a substantial incidence of landslides.

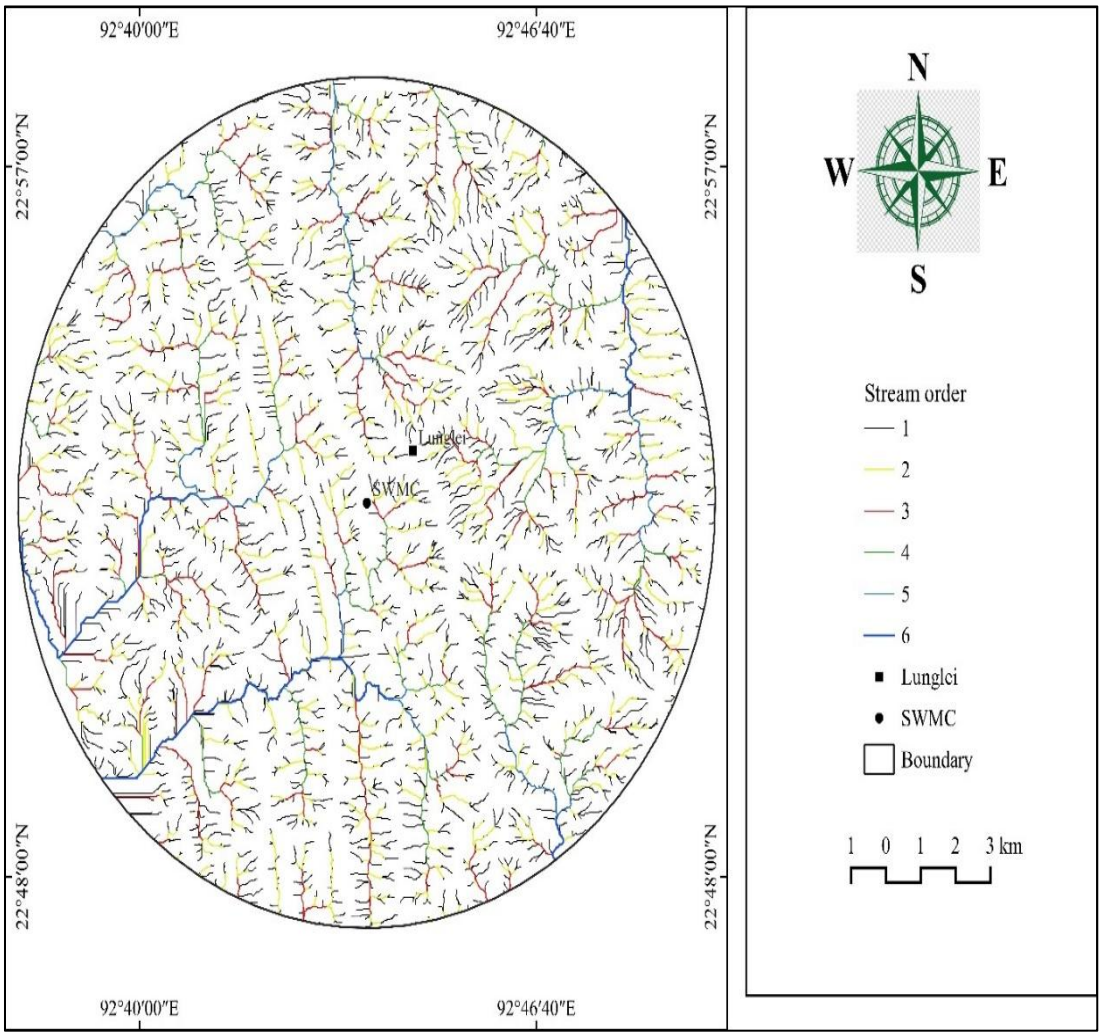


Fig 3.4. Stream order of proposed site

3.4.5 Temperature

The temperature in the region is quite moderate and does not experience any extreme variations both in summer as well as in winter. Winter sets in from around the end of October and lasts till the end of February. The minimum winter temperature varies between 8° C to 24° C. Summer arrives in the middle of May with maximum summer temperature varying between 18° C to 32° C.

The winter season is characterized by cold weather, occasional thunderstorms and frequent fog in the morning. During the summer season, temperature is high with occasional thunder-showers and clear sky in morning times. In monsoon season, the weather is cloudy and humid with low speed wind which blows from different directions. The climate of Lunglei city is characterized by its coolness, relative high humidity nearly all the year round and abundant rainfall. In brief, it enjoys pleasant climate which is neither very hot nor very cold throughout

the year. The year is divided into four seasons. The cold season from December to February is followed by the summer season from last part of February to the last week of May. The months of April, May, and June are usually hot. The south west monsoon season which follows thereafter continues till the first week of October. The rest of October and November constitute the autumn season.

3.4.6 Rainfall

Mizoram state falls under the direct influence of south-west monsoon and receives an adequate amount of rainfall. In monsoon season, the weather is cloudy and humid with low speed wind which blows from different directions. Rainfall is heavy during monsoon and the temperature starts falling with the onset of south-west monsoon during the beginning of June. In post-monsoon season, the rainfall gets reduced drastically followed by clear sky and decrease in temperature and morning fog. The average annual rainfall is 2454.45 between 2001-2020. About 20 percent of the annual rainfall occurs during the pre-monsoon months and is mostly in the form of thunder-showers and about 60 to 70 percent of the annual rainfall occur during the period from May to August. Lunglei generally has mild climate with heavy precipitation throughout the year due to the southwest monsoon winds. The precipitation is much higher in summers than winters. December and January are the driest months. As per the Köppen-Geiger system, the climate is classified as Cwa (Climate Data, n.d.). Highest temperatures are usually recorded in August at about 31°C while January has minimum temperatures falling not below 4°C. Table 5.2 and 5.3 shows the annual rainfall between 2001-2020.

Table 3.2 Annual Rainfall From 2001-2020

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Annual Rainfall (mm)	2343	2436	2331	2850	1863.5	2206.8	3435.5	1877.1	2314	3012.7

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020

Annual Rainfall (mm)	2736.6	2637	2312.6	2367.1	3049.9	2300.7	3021.7	2226	2186.7	1581

Source: Mizoram Statistical Handbook 2021

3.4.7 Relative Humidity

Relative humidity in the dry season is 60 –70 % and in the monsoon period is about 90%. During southwest monsoon, February to April is comparatively dry when humidity is between 60 –70 %.

3.4.8 Natural Hazard

Lunglei town falls under Seismic Zone -IV. It is referred to as the Very High Damage Risk Zone. Generally, the areas having trap or basaltic rock are prone to earthquakes. Landslide is very common to these areas. Figure 5.4 and figure 5.5 shows seismic zone and landslide susceptibility zone respectively.

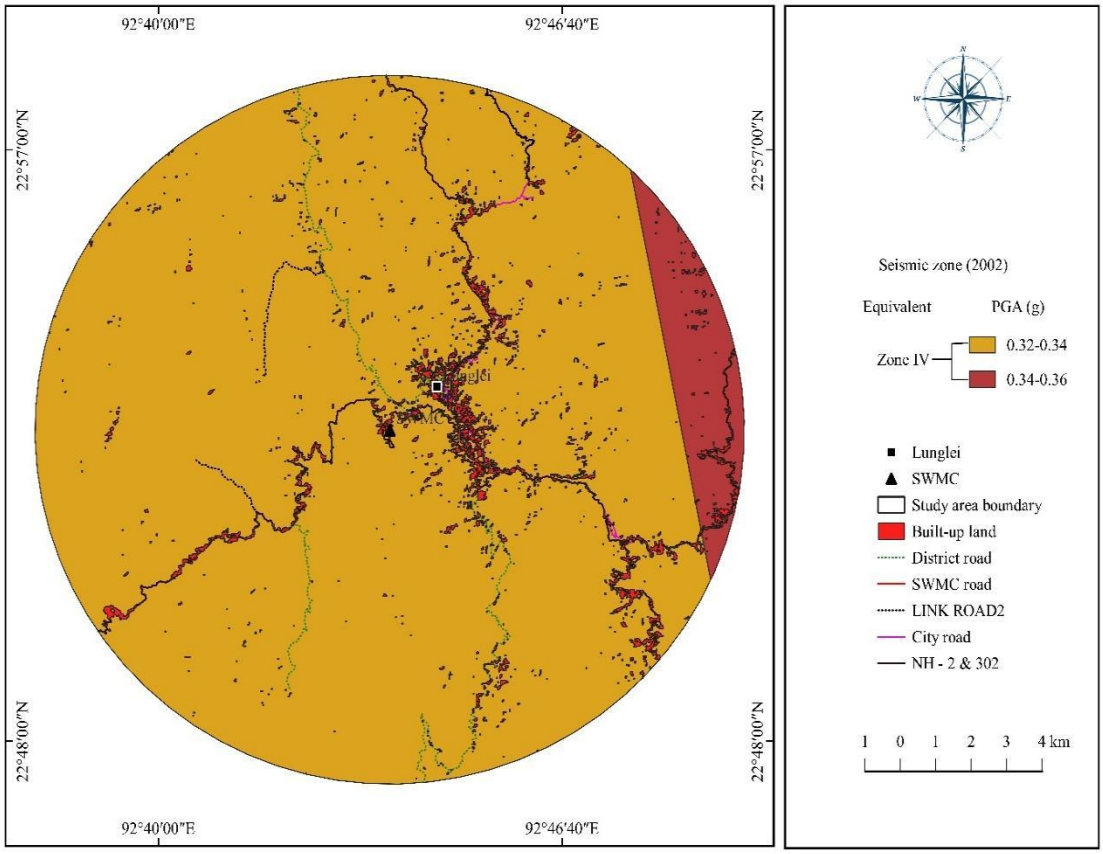


Figure 3.5 Seismic zone map of 10 km radius from proposed SWMC

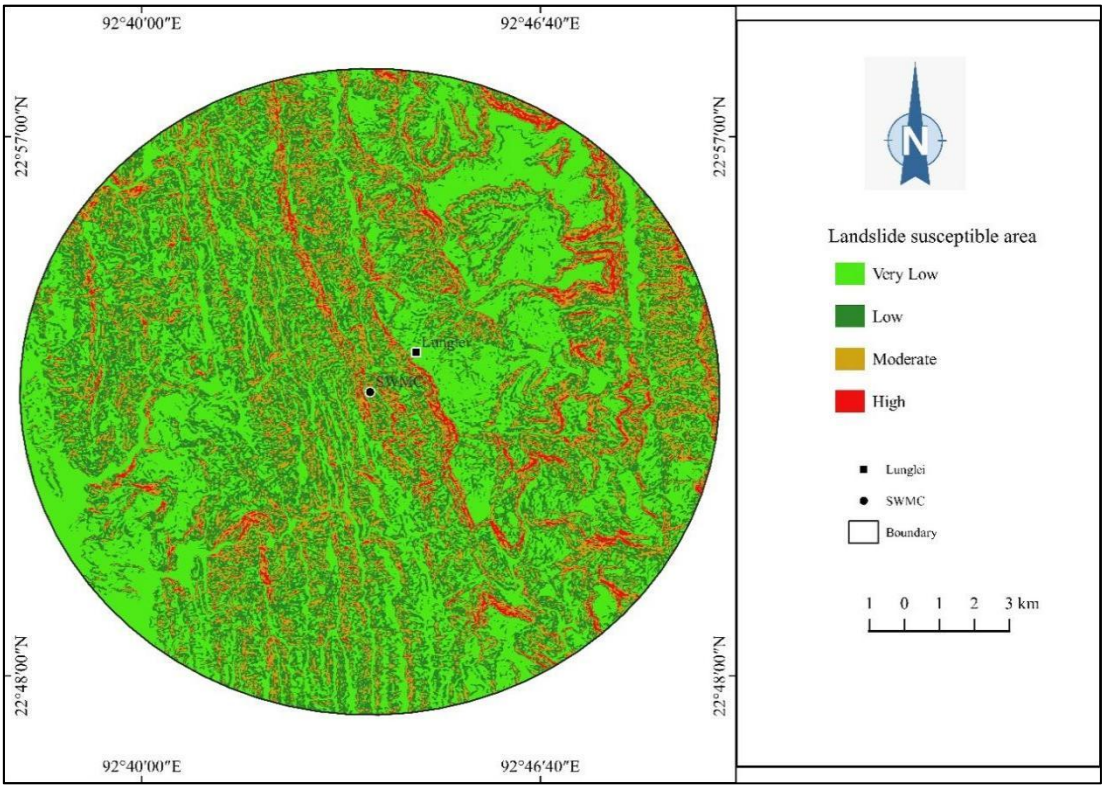


Figure 3.6 Landslide susceptible area map of 10 km radius from proposed SWMC

3.4.9 Air Quality

Ambient air quality monitoring was carried out as per the guidelines of CPCB to establish the air quality of the study area. The main sources of air pollution in the study area are construction debrief, vehicular emission, and burn of agriculture practised. Ambient air sampling result of SPM, **PM** $_{10}$, **PM** $_{2.5}$ Sulfur dioxide (SO2) and Oxides of Nitrogen (NO2), was done on 6 sampling sites which are given in table 5.5.

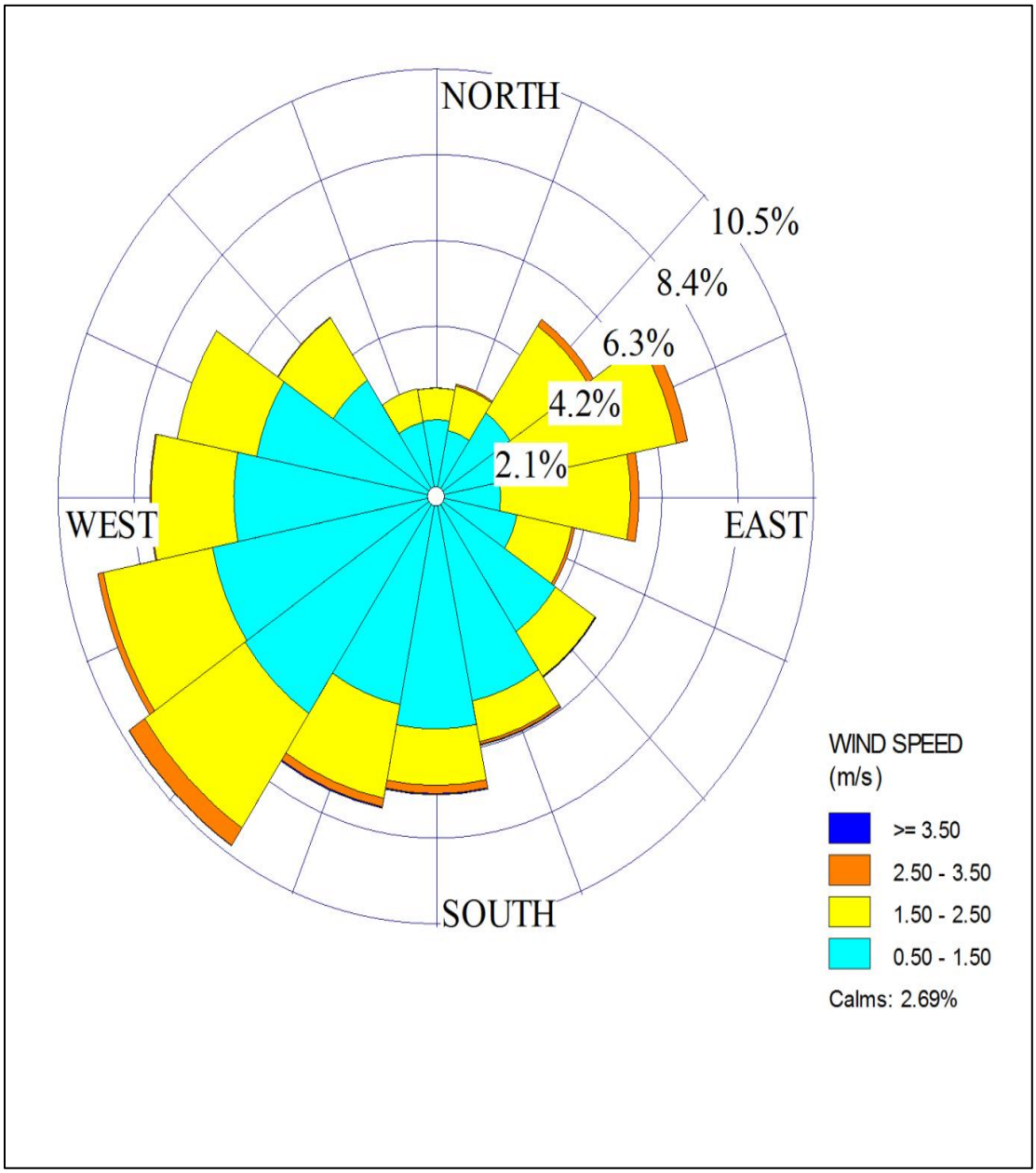


Figure 3.7 Wind rose plot of proposed SWMC

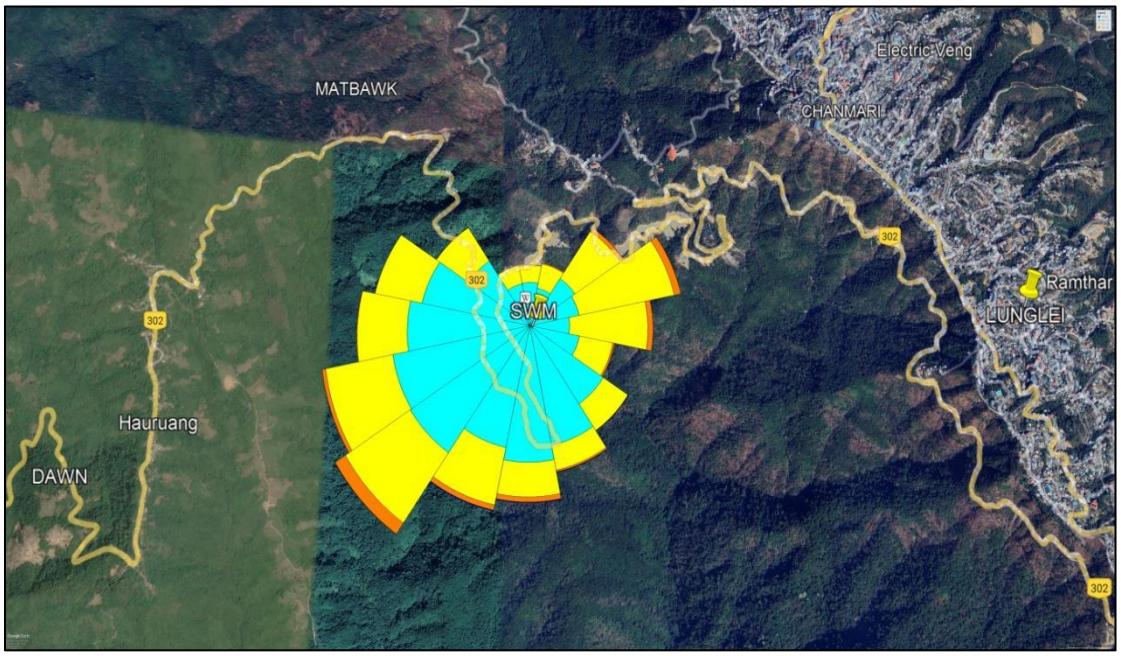


Figure 3.8 Wind rose overlay with proposed SWMC location.

Table 3.3:- Analysis Result of Ambient Air Quality

(Collection Month October 2022)

Serial. No	Name of AAQM location (Distance in km/ Direction from Site)	Pollutant	CPCB Limit (24 hour basis unless mentioned) Concentration in ppm	Readings	Remarks
1	At project site 1 (0.0/base)	PM10	100	40	Within limit
		PM2.5	60	21	Within Limit
		SO2	80	6	Within Limit
		NOX	80	4	Within limit
		CO	0.4	BDL	
2	Site 2 (2 km in SE)	PM10	100	25	Within Limit
		PM2.5	60	1.3	Within Limit
		SO2	80	3.2	Within limit
		NOX	80	1.2	Within Limit
		CO			
3	Site 3 (2 km in	PM10	100	20	Within Limit

	NW direction)	PM2.5	60	2.4	Within limit
		SO2	80	3.8	Within Limit
		NOX	80	1.5	Within Limit
		CO		BDL	
4	Site 4 (2 km in W direction)	PM10	100	15	Within limit
		PM2.5	60	4.3	Within Limit
		SO2	80	3.4	Within Limit
		NOX	80	2.1	Within limit
		CO		BDL	
5	Site 5 (2 km in E direction)	PM10	100	18	Within Limit
		PM2.5	60	3.1	Within Limit
		SO2	80	4.6	Within limit
		NOX	80	3.2	Within Limit
		CO		BDL	
6	Site 6 (2 km in N direction)	PM10	100	12	Within Limit
		PM2.5	60	3.6	Within limit
		SO2	80	3.2	Within Limit
		NOX	80	2.6	Within Limit
		CO		BDL	

3.4.10 Noise Level

Noise after a certain level can have a very disturbing effect on the people and animals exposed to it. Hence, it is important to assess the present noise quality of the area in order to predict the potential impact of future noise levels due to the proposed project. Noise monitoring was carried out at two locations. Noise measurements were done using Envirotech Sound Level Meter SLM 100. Monitoring was carried out both in the day and night time and derived from the monitored data including the peak values. The results of the monitoring are provided in Table 5.6. Monitored levels were compared against Ambient Noise Standards prescribed under Gazette Notification 643 of Ministry of Environment and Forests, Government of India.

Table: - 3.4 Analysis Result of Ambient Noise Quality (Collection Month October 2022)

Serial.No	Name of AAQM location (Distance in km/ Direction from Site)	Readings (in dBA)		NOICE ACT,2000 RECOMMEND VALUE (in dBA)	
		Day	Night	DAY	NIGHT
1	**At Project Site 1 (0.0 / Base)**	46.6	36.8	**55**	**45**
2	**Site 2 (2 km in SE)**	43.7	38.8	**55**	**45**
3	**Site 3(2 km in NW direction)**	45.3	38.3	**55**	**45**
4	**Site 4 (2 km in W direction)**	44.6	36.9	**55**	**45**
5	**Site 5 (2 km in E direction)**	44.8	39.5	**55**	**45**
6	**Site 6(2 km in N direction)**	46.9	37.4	**55**	**45**

Noise level confirms the prescribed limit at both the monitored locations corresponding to its land use category.

3.4.11 Water Quality

The water environment has been described and the effects on it have been evaluated using a set of water quality metrics for water resources located within a 10-kilometer radius of the study region. Studies on the ecosystem's interactions with the water environment are crucial for preparing environmental impact assessment reports, identifying sensitive situations, and taking the necessary steps to maintain ecological balance.

3.4.12 Raw Water availability and Water Quality

To assess the water quality impacts, water resources in the impact area have been grouped into two classes.

1. Surface water resources including streams, tanks, rivers etc.
2. Ground water resources in the deeper strata of the ground.

To determine the baseline data for water resources samples were collected from 4 locations. The details of the sampling locations are given in Table 5.5.(Collection Month October 2022)

Parameters	Standard	Units	Stream 1	Stream 2	Rangte River	Groundwater
Colour	5-15		Clear	Clear	Clear	Clear

Odour			Odourless	Odourless	Odourless	Odourless
Temperature	<40	◦C	23	23.5	21.2	19
Ph	6.5-8.5		6.08	6.06	6.32	5.92
Turbidity	1	NTU	56	29	34	27
Electrical Conductivity	300	µS	33	32	24	164
Total Dissolve Solids	100	Mg/L	12.326	9.322	10.35	23.36
Total Suspended Solids	75	Mg/L	0.01	0.03		0.02
Alkalinity	600	Mg/L	40	30	36	190
Hardness	300	Mg/L	40.2	20	26	138
Calcium	75	Mg/L	6	7.6	5.6	40.8
Magnesium	30	Mg/L	44	57.6	32.8	76.4
Free Carbondioxide		Mg/L	4	2	6	8
Sulphate	200	ppm	11.92	8.19	12.2	12.02
Phosphate	5	ppm	0.019	BDL	0.002	BDL
Nitrate-N	150	ppm	0.027	0.017	0.013	0.025
Ammonia-N	50	ppm	0.736	0.304	0.342	0.255
Chloride	45	Mg/L	39.99	28.97	29.12	34.96
Dissolve Oxygen	4.0-6.0	Mg/L	8.4	8.8	7.9	7
Biological Oxygen Demand	<2	Mg/L	0.7	1.2	1.1	0.6
Chemical	10	Mg/	0.6	0.58	3	0.25

Oxygen Demand		L				

Table: 3.5 Baseline data Water characteristic

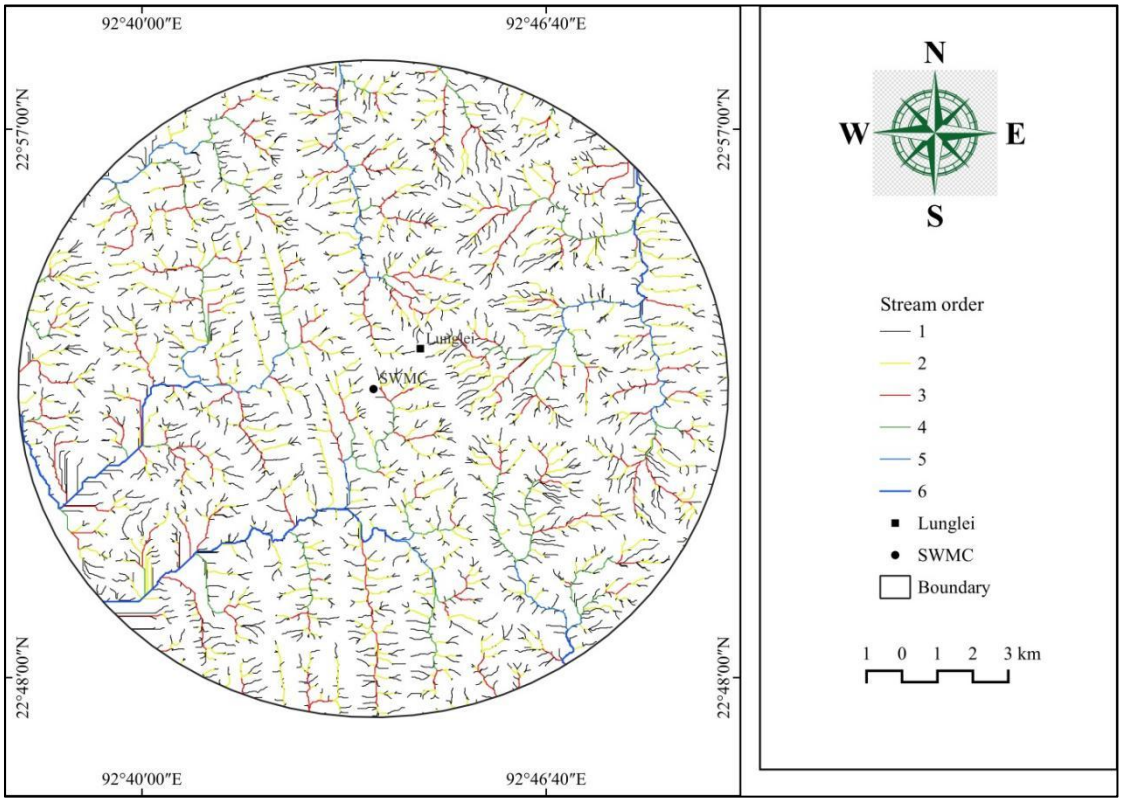


Fig: 3.9 Surface water drainage Pattern

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3.4.13 Surface water

Surface water in the study area are categorized by their drainage into four order based on Strahler stream order. 1st order indicate non-perennial stream, which flows during the monsoon season and dry up in the winter. 2nd order of the stream are flowing less volume of water for the whole season, and are also depend on the rainfall, with effect a large volume of erosion. 3rd order stream also sometimes dry up if droughts are long and rainfall low during the monsoon season. The 4th order of stream is the tributary of Main River and is flowing throughout the year, because this river has at least three small streams of sources. The surface water and drainage patter are shown in Figure 5.6 and water qualities are shown on table 5.7.

3.4.14 Ground Water

i. Potential zone: this zone generally covers valley fill, flood plains and low-lying areas which are located within the proximity of water bodies, where there will be continual recharge. It also includes the intersection of the structural units, such as lineaments

and faults, with valley fill and flood plains. Lithologically, this zone comprises areas where unconsolidated sediments, such as gravels, sand, silt and clayed sand are deposited.

ii. Good: All the remaining geological structures falls under the good potential zone. The lowlying areas including parts of flood plains and valley fills are also included in this zone. Among the rock types exposed in the study area, sandstones are generally capable of storing and transmitting water through their interstices and pore spaces present in between the grains and are considered to be suitable aquifer.

iii. Moderate: This zone mainly comprises areas where the recharge condition and the wateryielding capacity of the underlying materials are neither suitable nor poor. Topographically, it covers gently sloping smooth surface of the hill. The moderate zone falls within the poor water bearing rock formation such as silty shale that are, in turn, characterized by the presence of secondary structures in them.

iv. Poor: The poor zone is mainly distributed in the elevated areas. It is mainly distributed along the ridges and high structural hills. This zone is predominantly high in terms of areal extend and covers large part of the state.

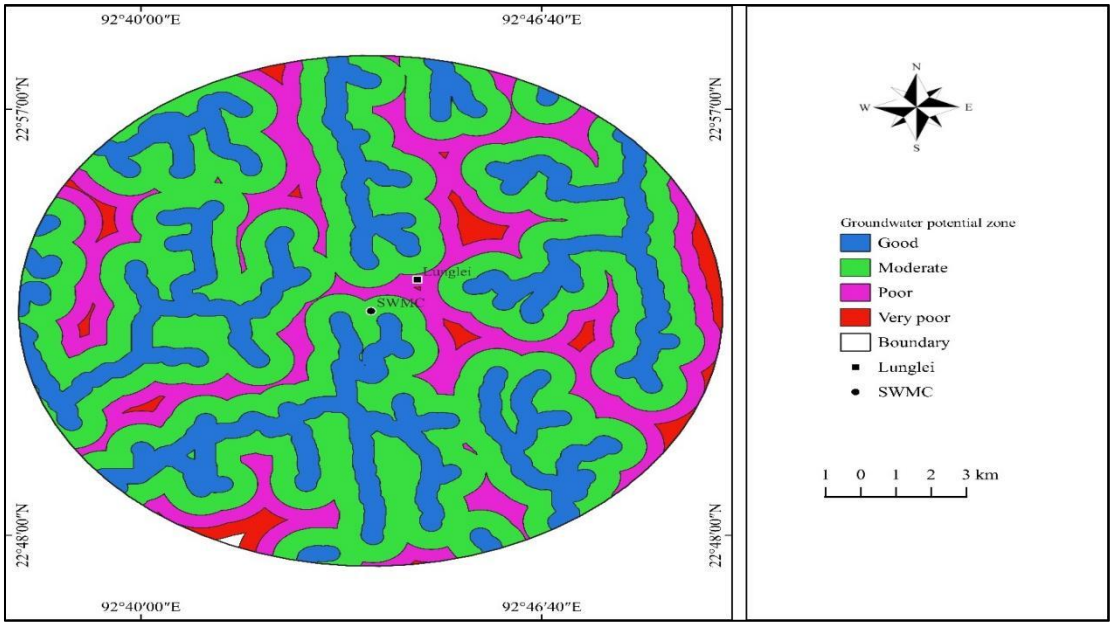


Fig: 3.10 Ground water Potential

3.5 BIOLOGICAL ENVIRONMENT/BIO ASSESSMENT

3.5.1 Study area

Even though Lunglei District (4572.00 sq.km) forests are the most critical natural resource for the people of Lunglei as 88.6 % of the total area of Lunglei is under forest and tree cover (FSI, 2019). The communities have the right to utilise the land and cultivate in the vicinity forests as per the approval accorded by the Village Council. As per the ISFR classification of 2019 (FSI, 2019), 283105 ha. of the forests in Lunglei falls under open forests (70.39%), 119013 ha. (29.59%) under moderately dense forests and 99 ha. (0.02%) under very dense forests.

The Study area include 10 km radius from the proposed SWMC. This includes open Forest cover, fallow land, agriculture land and build up area.

Objectives

The objective of the study was to assess the vegetation types, identify the flora and fauna, rare and endangered species (if any) and assess the impact of the proposed project activities on these biodiversity.

3.5.2 Terrestrial ecology

Forest Resources

The Study Area covers 10 sq. kms. but the Proposed Landfill Site covers only 7.2 hectares. The Study Area is an abandoned jhum land and so the forest is an open forest with no definite forest type. Most of the land in the study area falls under private ownership and had been used mostly abandonned. Due to jhumming, the vegetation of the study area is poor and there is no or little chance of occurring rare and endangered species. The water source is also poor with three small streams or nallahs with scanty of water during dry season.

Flora Analysis

The Study was conducted by the following method:

Quadrats Method: In the Study Area (10 km radius), 20 quadrats of 10m2 were laid randomly for trees, 30 quadrats of 5m2 were laid randomly for grasses and 30 quadrats of 1m2 were laid randomly for herbs and shrubs. In the Proposed Project Site (20 Ha), 10 quadrats of 10m2 were laid randomly for trees, 5 quadrats of 5m2 were laid randomly for grasses and 10 quadrats of 1m2 were laid randomly for herbs and shrubs. All the plant species inside the quadrats were recorded, including climbers and epiphytes (Photo 4&5). The field data were taken for determining important quantitative analysis such as frequency, abundance and density of plant species.

The floral diversity assessment recorded 13 species of trees, 15 species of herbs and 33 shrubs in the Proposed Project Site. The inventory of floral diversity in the two sites is given in Table 5.8.

Diversity indices: In order to study the plant diversity in the study area, three diversity indices have been adopted which are as follows:

i). Margalef's Index of species richness:

Margalef's index of species richness was calculated by using the formula

$D_{mg} = (S-1)/\ln N$

Or, $D_{mg} = \frac{(S-1)}{\text{Log } N}$

Where, D_{mg} = Margalef's Index of species richness

S = Number of species;

N= Number of the individuals.

ii). Menhinick's Diversity Index

$$D = \frac{S}{\sqrt{N}}$$

Where D = Menhinick's Diversity Index,

S = Number of species

N = Total number of individuals.

iii). Shannon-Wiener Diversity Index

$$H = -\sum pi \ln pi$$

Where, H = Shannon-Wiener Diversity Index

pi= ni/N (ni= number of individuals of the i^{th} species)

N= Total number of all individuals of all the species.

The computed data from quantitative analysis was taken into consideration for calculating the above Diversity Indices. The overall diversity indices for trees, herbs, shurbs, climbers and epiphytes and grasses of the two sites are given in the Table 5.8 below:

Table 3.6 Overall biodiversity indices of plants in both the Study Sites of the Study Area

Study Site	Categories	Number of Species	Total Number of individual of all species	Overall Margalef's index of species richness	Overall Menhinick's index	Overall Shannon-Wiener index
Study Area	Trees	13	70	6.50371944	1.553797192	
	Herbs	15	127	6.65461319	1.331034764	2.49
	Shrubs	33	293	12.9719162	1.927880585	1.95

Rare and Endangered Species

With reference to the biodiversity survey, no endemic, rare and endangered species has been located in the Study Area.

Table 3.7 Ecological Analysis of Plants in the Projects Site (10 sq.km)

Sl. No	Scientific Name	Local Name	Number of Individual (Q)	Number of Quadrats (Y)	Occurrence (X)	% Frequency Z= X/Y x 100	Density (Q/Y)	Abundance (Q/X)
Trees								
1	*Albizia chinensis*	Vang	8	10	6	60	1.333	0.8
2	*Anogeissus acuminate*	Zai-rum	7	10	2	20	3.5	0.7
3	*Duabanga grandiflora*	Zuang	8	10	5	50	1.6	0.8
4	*Erythrina stricta*	Far-tuah	3	10	3	30	1	0.3
5	*Ficus hirta*	Sa-zu-thei-pui	3	10	1	10	3	0.3
6	*Ficus prostrata*	Thei-tit	2	10	1	10	2	0.2

7	*Ficus semicordata*	Thei-pui	4	10	1	10	4	0.4
8	*Gmelina arborea*	Thlan-vawng	5	10	2	20	2.5	0.5
9	*Lannea coromanselica*	Zawng-tawi-taw	2	10	1	10	2	0.2
10	*Macaranga indica*	Hnah-kiah	4	10	1	10	4	0.4
11	*Melocanna baccifera*	Mau	2	10	1	10	2	0.2
12	*Toxicodendron succedaneum*	Chhim-hruk	3	10	1	10	3	0.3
13	*Trema orientalis*	Bel-phuar	19	10	7	70	2.714	1.9

Shurbs

14	*Mimosa pudica*	Hlo-nuar	8	10	4	40	0.8	0.08
15	*Triumfetta bogotensis*	Se-mei-bawm	4	10	4	40	0.4	0.04
16	*Sida acuta*	Khing-khih	7	10	4	40	0.7	0.07
17	*Ludwigia hexapetala*	Tui-kum-tluang	2	10	2	20	0.2	0.02
18	*Urena lobata*	Se-hnap	5	10	2	20	0.5	0.05
19	*Giardinia palmata*	Kang-thai	4	10	3	30	0.4	0.04
20	*Solanum torvum*	Tawk-pui	3	10	3	30	0.3	0.03

Herbs

21	*Azeratum conyzoides*	Vai-len-hlo	12	10	2	20	1.2	0.12
22	*Cheilocostus speciosus*	Sum-bul	17	10	3	30	1.7	0.17
23	*Chromaloena odorata*	Tlang-sam	5	10	3	30	0.5	0.05
24	*Conyza bonariensis*	Buar-zen	12	10	4	40	1.2	0.12
25	*Dioscorea alata*	Ba-chim	4	10	2	20	0.4	0.04
26	*Eulalia trispicata*	Thang	14	10	2	20	1.4	0.14
27	*Innula cappa*	Buar	15	10	4	40	1.5	0.15

28	*Mikania micrantha*	Japan-hlo	6	10	4	40	0.6	0.06
29	*Mucuna bracteata*	Hrui-duk	4	10	2	20	0.4	0.04
30	*Musa sylvestris*	Chang-el	3	10	2	20	0.3	0.03
31	*Piper peepuloides*	Ram-pan-hnah	8	10	2	20	0.8	0.08
32	*Polygonum chinensis*	Ta-ham	6	10	4	40	0.6	0.06
33	*Saccharum longisetosum*	Luang	14	10	5	50	1.4	0.14
34	*Scleria levis*	Thip	3	10	1	10	0.3	0.03
35	*Thysanolaena latifolia*	Hmun-phiah	4	10	5	50	0.4	0.04

Fauna Analysis

Fauna includes all animals that can be found in the study area. In this study IUCN Red List criteria is used to describe the condition of the fauna found in the area. Most of the data are secondary in nature due to the lack of time for adequate fauna study. Fauna are categorise into Mammals, Birds, Amphibians, Reptiles and Fish and are represented in table 5.10, 5.11, 5.12, 5.13 and 5.14 respectively. The IUCN Status are given as Not Evaluated (NE), Data Deficient (DD), Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CE), Extinct in the Wild (EW) and Extinct (EX).

Table 3.8:List of Mammals

Sl. No	*Scientific name*	Common Name	Local Name	Family	IUCN status	Status as per 1972
1	*Euroscaptor micrura*	Himalayan mole	Bui-ke-lek	Talpidae	LC	NA
2	*Suncus murinus*	Asian House Shrew	Chhim-tir	Soricidae	LC	NA
3	*Tupaia belangeri*	Northern Tree Shrew	Che-pa	Tupaiidae	LC	NA
4	*Eonyteris spelaea*	Dawn Bat	Bak	Pteropodidae	LC	NA

5	*Canis aureus*	Common Jackal	Si-hal	Canidae	LC	I
6	*Prionailurus bengalensis*	Leopard Cat	Sa-nghar	Felidea	LC	I
7	*Muntiacus vaginalis*	Northern Red Muntjack	Sa-khi	Cervidea	LC	I
8	*Capricornis rubidus*	Red Serow	Sa-za	Bovidae	NT	NA
9	*Callosciurus erythraeus*	Red Bellied Pallas Squirrel	Hlei-kap-sen	Scuiridea	LC	NA
10	*Tamiops macclellandi*	Himalayan striped Squirrel	Hlei-mual-rang	Scuiridea	LC	NA
11	*Beryl's bowers*	Bower's Rat	Sa-zu	Muridea	LC	NA
12	*Cannomys badius*	Lesser Bamboo Rat	Bui-sen	Muridea	LC	NA
13	*Mus musculus*	House mouse	Chai-te	Muridea	LC	NA
14	*Rattus rattus*	House Rat	Zu-in	Muridea	LC	NA
15	*Niviventer niviventer*	White Bellied Rat	Zu-pawl	Muridea	LC	NA

Table 3.9:List of Birds

Sl. No	*Scientific name*	Common Name	Local Name	Family	IUCN status	Status as per 1972
1	*Accipiter nisus*	Eurasian Sparrowhawk	Mu-te	Accipitridae	LC	I
2	*Accipiter trivirgatus*	Crested Goshawk	Mu-ar-la	Accipitridae	LC	I
3	*Buteo burmanicus*	Himalayan Buzzard	Mu	Accipitridae	LC	NA
4	*Spilornis cheela*	Crested Serpent Eagle	Mu-van-lai	Accipitridae	LC	NA
5	*Arborophila*	Rufous/Throated	Va-rung	Phasianidae	LC	II

	torqueola	patridge				
6	*Gallus gallus*	Red Junglefowl	Ram-ar	Phasianidae	LC	II
7	*Lophura leucomelanos*	Kalij Pheasant	Va-hrit	Phasianidae	LC	I
8	*Turnix sylvatica*	Small Buttonquail	Va-hmim	Turnicidae	LC	NA
9	*Chalcophaps indica*	Emerald Dove	Ram-par-va	Columbidae	LC	II
10	*Streptopelia chinensis*	Spotted Dove	Thu-ro	Columbidae	NE	II
11	*Cacomantis sonneratii*	Bended Baycuckoo	Thang-fen-pa-bawp	Cuckooladae	LC	II
12	*Centropus bengalensis*	Lesser Coucal	Lal-ruanga-se-hnawt	Cuckooladae	LC	II
13	*Cuculus poliocephalus*	Small cuckoo	Ka-kut	Cuckooladae	LC	II
14	*Hierococcyx sparverioides*	Large Hawk cuckoo	Biak-bai-rawk	Cuckooladae	LC	II
15	*Harpactes erythrocephalus*	Red-Headed Trogon	Va-ral-thi	Trogonidae	LC	II
16	*Apus acauticauda*	Dark-rimped Swift	Va-mur	Apodidae	VN	NA
17	*Upupa epops*	Common Hoopoe	Chhuang-tuar	Upupidae	LC	II
18	*Megalaima asiatica*	Blue throated Barbet	Tuk-lo	Bucerotidae	LC	NA
19	*Megalaima australis*	Blue ear Barbet	Tuk-lo-bengngawng	Bucerotidae	LC	NA
20	*Megalaima franklinii*	Golden Throat barbet	Zo-tuk-lo	Bucerotidae	LC	NA
21	*Megalaima lineata*	Lineated Barbet	Phai-tawl-lawt	Bucerotidae	LC	NA
22	*Megalaima virens*	Great Barbet	Zo-tawl-	Bucerotidae	LC	NA

			lawt			
23	*Chrysocolaptes lucidus*	Greater Golden-backed Woodpecker	Thloh-pui	Picidae	LC	NA
24	*Dinopium javanese*	Indian Golden-Backed Woodpecker	Thloh	Picidae	LC	NA
25	*Psarisomus dalhousiae*	Longtailed Broadbill	Khawmual-thi-zil	Eurylaimidae	LC	II
26	*Pitta cyaneae*	Blue Pitta	Vai-buar-chawm	Pitidae	LC	NA
27	*Pitta nipalensis*	Blue-naped Pitta	Zo-buar-chawm	Pitidae	LC	NA
28	*Lanius colllurioides*	Burmese Shrike	Chhem-hur	Laniidae	LC	NA
29	*Oriolus tenuirostris*	Slender-billed Oriole	Vamai-tai	Oriolidae	LC	II
30	*Oriolus trailii*	Maroon Oriole	Chang-sen	Oriolidae	LC	
31	*Dicrurus macrocercus albirectus*	Black Drongo	Chang-kak	Dicruridae	LC	NA
32	*Dicrurus aenus*	Bronze Drongo	Thlan-thla	Dicruridae	LC	NA
33	*Dicrurus paradiseus*	Greater Racket-tailed Drongo	Va-kul	Dicruridae	LC	II
34	*Dicrurus remifer*	Lesser Racket-tailed Drongo	Chang-hlawi	Dicruridae	LC	NA
35	*Artamus fuscus*	Ashy-Wood swallow	Leng-derh	Artamidae	LC	II
36	*Acridotheres fuscus*	Jungle Myna	Ram-Vai-va	Sturnidae	LC	II
37	*Corvus macrorhynchos*	Jungle Crow	Cho-ak	Corvidae	LC	II
38	*Dendrocitta formosae*	Grey Treepie	Bem-kawng	Corvidae	LC	II

39	*Coracina macei*	Large Cuckoo-shrike	Ir-liak	Campephagidae	LC	II
40	*Coracina melachistos*	Black-winged Cuckooshrike	Kil-thei-hrawk	Campephagidae	LC	II
41	*Pericrocotus flammeus*	Scarlet minivet	Bawng	Campephagidae	LC	II
42	*Chloropsis aurifrons*	Golden-fronted Leafbird	Chhawl-hring	Irenidae	LC	II
43	*Hemixoz flavala*	Brown-eared Bulbul	Pi-kawl-rit	Pycnonotidae	LC	NA
44	*Pycnonotus artriceps*	Black-headed Bulbul	Tukhum-vi-lik	Pycnonotidae	LC	NA
45	*Pycnonotus cafer*	Red-vented Bulbul	Tlai-berh	Pycnonotidae	LC	II
46	*Alcippe nipalensis*	Nepal Fulvetta	Mit-val	Timaliidae	LC	II
47	*Garrulax leucolophus*	White-crested Laughingthrush	Ko-ro	Timaliidae	LC	II
48	*Garrulax pectoralis*	Greater Necklaced Laughingthrush	Va-zar	Timaliidae	LC	NA
49	*Napothera brevicaudata*	Streaked Wren Babbler	Va-lei-sawt	Timaliidae	LC	NA
50	*Timalia piliata*	Redcapped Babbler	Tek-tek	Timaliidae	LC	NA
51	*Anthus hodgesoni*	Olive-baked Pipit	Chip	Motacillidae	LC	NA
52	*Nectarinia asiatica*	Purple Sunbird	Lawi-zit	Nectariniidae	LC	NA

Table 3.10: List of Amphibians

Sl.No	*Scientific name*	Common Name	Local Name	Family	IUCN status	Status as per 1972
1	*Bufo stomaticus*	Marbled Toad	U-tawk-phar	Bufonidae	LC	NA
2	*Pedostibes cempi*	Garo Hills Tree	Chung-u	Bufonidae	DD	NA

		Toad				
3	*Microhyla butleri*		Chung-u	Microhylidae	LC	NA
4	*Xenophrys parva*	Mountain horned Frog	Chung-u	Megophryidae	LC	NA
5	*Kaloula pulchra*	Painted Baloon Frog	U-tum	Microhylidae	LC	NA
6	*Fejervarya limnocharis*	Indian Cricket Frog	Uchangte	Dicroglossidae	LC	NA
7	*Fejervarya nepalensis*	Nepal Cricket Frog	Uchangte-hnugnrang	Dicroglossidae	LC	NA
8	*Clinotarsus alticola*	Point-nosed Frog	U-lawng	Ranidae	LC	II
9	*Euphyctis cyanophylctis*	Indian Skipper Frog	Uchang	Ranidae	LC	NA
10	*Hylarana nicobariensis*		Uchang	Ranidae	LC	NA
11	*Hylarana tytleri*	Leaf Frog	-	Ranidae	LC	NA
12	*Odorrana chloronota*	Green-backed Stream Frog	U-chang-hnugn-hring	Ranidae	LC	NA
13	*Pterorana khare*	Khare's Stream Frog	-	Ranidae	LC	II
14	*Sylvirana leptoglossa*	Assam Forest Frog	Uchang	Ranidae	LC	NA
15	*Philautus parvulus*	Dwarf Bush Frog	Dawng-thlek-te	Rhacophoridae	LC	NA
16	*Rhacophorus bipunctatus*	Twin-spotted Tree Frog	Uchang	Rhacophoridae	LC	II
17	*Rhacophorus maximus*	Large tree Frog	U-chhawl-hring	Rhacophoridae	LC	NA

Table 3.11: List of Reptiles

Sl. No	*Scientific name*	Common Name	Local Name	Family	IUCN status	Status as per 1972
1	*Indotestudo elongata*	Yellow Tortoise	Tel-rang	Testudinidae	EN	NA
2	*Manouria emys*	Asian Brown Tortoise	Tel-pui	Testudinidae	EN	I
4	*Cyclemys gemeli*	Indian Leaf Turtle	Tel-bial	Geomydidae	NT	II
5	*Calotes emma*	Spiny headed Forest Lizard	Laiking	Agamidae	LC	NA
6	*Calotes jerdoni*	Jerdon's Forest Lizard	Laiking hring	Agamidae	NE	NA
7	*Calotes versicolor*	Commone Garden Lizard	Lai-king	Agamidae	LC	NA
8	*Draco norvilii*	Norvil's Flying Lizard	U-leuh-thla-sen	Agamidae	NT	NA
9	*Japalura otai*	Otai's Mountain Lizard	Zo-lai-king	Agamidae	LC	NA
10	*Ptyctolaemus gularis*	Blue-throated Lizard	Lai-king	Agamidae	LC	NA
11	*Ophisaurus gracilis*	Asian Glass Lizard	Lai-tel-rul	Anguidae	LC	NA
12	*Gekko gecko*	Tokay Gecko	Awk-e/Chawk-e	Gekkonidae	LC	I
13	*Hemidactylus brookii*	Brook's House Gecko	Dai-dep-in-nghak	Gekkonidae	LC	NA
14	*Hemidactylus platyurus*	Flat-tailed Gecko	In-kang-veng	Gekkonidae	LC	NA
15	*Takydromus*	Asian Long-tailed	Lai-tel-mei-sei	Lacertidae	LC	NA

	sexlineatus	Lizard				
16	*Eutropis multifasciata*	Many lined Grass Shrink	Kawlchawr	Scincidae	NE	NA
17	*Varanus salvator*	Water Monitor	Tui-pui-sa-tang	Varanidae	LC	I
18	*Typhlops diardii*	Diard's Blind Snake	Chhawk-nghawl	Typhlopidae	LC	NA
19	*Typhlops jerdoni*	Jerdon's Blind Snake	Rulmitdel	Typhlopidae	LC	NA
20	*Python bivittatus*	Burmese Rock Python	Sa-phai	Boidae	VU	NA
21	*Ahaeltulla prasina*	Short nosed Vine Snake	Rul-Van-kai	Colubridae	LC	NA
22	*Amphiesma venningi*	Chin Hills Keelback	-	Colubridae	LC	NA
23	*Boiga cyanea*	Green Cat Snake	Rul-rial	Colubridae	LC	NA
24	*Boiga ochracea*	Tawny Cat Snake	Rul-sakhi	Colubridae	EN	NA
25	*Oreocryptophis porphyracea*	Black-banded-Trinket Snake	Rul-hlai-te	Colubridae	LC	NA
26	*Ptyas korros*	Indo-Chinese Rat Snake	Hlai-dum	Colubridae	NT	NA
27	*Rhabdophis himalayanus*	Himalayan Keelback	Rul-nghawng-sen-chi-khat	Colubridae	LC	NA
28	*Rhabdophis subminiatus*	Red-necked Keelback	Rul-nghawng-sen-chi-khat	Colubridae	LC	NA
29	*Xenopchrophis piscator*	Checkered Keelback	Tui-rul	Colubridae	NE	NA
30	*Bungarus fasciatus*	Banded krait	Chawnglei	Elapidae	LC	NA
31	*Bungarus niger*	Greater Black Krait	Khua-vang-rul	Elapidae	LC	NA
31	*Naja kaouthia*	Monocled Cobra	Chawng-kawr	Elapidae	LC	NA

32	*Ophiophagus hannah*	King cobra	Rul-ngan	Elapidae	VU	
33	*Cryptelytrops erythrurus*	Spot-tailed Pit Viper	Rul-tu-ha	Viperidae	LC	NA
34	*Ovophis monticola*	Mountain Pit Viper	Rul-muk	Viperidae	LC	NA
35	*Popeia popeiorum*	Pope's Pit Viper	Rul-tu-ha-chi-khat	Viperidae	LC	NA

Table 3.12: List of Fish

Sl.No	*Scientific name*	Common Name	Local Name	Family	IUCN status	
1	*Anguilla bengalensis*	Indian longfin eel	Ngha-rul	Anguillidae	NT	NA
2	*Amblypharyngodon mola*	Mola carpet	Ngha-dawl	Cyprinidae	LC	NA
3	*Barilius barila*	Barred baril	Leng-phar	Cyprinidae	LC	NA
4	*Chela cachius*	Neon hatchet fish	Ngha-dawl	Cyprinidae	LC	NA
5	*Devario naganensis*	Naga danio	Nghadarthlalang	Cyprinidae	VU	NA
6	*Garra annandalei*	Annandale garra	Ngha-lim	Cyprinidae	LC	NA
7	*Garra lamta*	Lamta garra	Ngha-kha	Cyprinidae	LC	NA
8	*Garra lissorhynchus*	Khasi garra	Ngha-zawng-ek	Cyprinidae	LC	NA
9	*Labeo bata*	Bata labeo	Ngha-tun	Cyprinidae	LC	NA
10	*Puntius chola*	Swamp barb	Ngha-mei-dum	Cyprinidae	LC	NA
11	*Acanthocobitis botio*	Mottled loach	Dawn-tial	Balitoridae	LC	NA
12	*Batasio batasio*	Tista batasio	Ngha-sa-nghal	Bagridae	LC	NA
13	*Sperata aor*	Long-whiskered	Ngha-lu-kawr-	Bagridae	LC	NA

		catfish	sei			
14	*Bagarius bagarius*	Gangetic goonch	Thai-chhawni-nu	Sisoridae	VU	NA
15	*Clarius batrachus*	Magur	Ma-kur	Clariidae	LC	NA
16	*Xenentodon cancila*	Freshwater garfield	Ngha-fung-lawe	Belonidae	NE	NA
17	*Channa gachua*	Dwarf Snakehead	Ngha-Vawk	Channidae	NE	NA
18	*Channa punctata*	Spotted snakehead	Ngha-khing	Channidae	LC	NA
19	*Mastacembelus armatus*	Spiny eel	Ngha-lerh	Mastacembelidae	NE	NA
20	*Monoterus albus*	Swamp eel	Dum-ngha-rul	Synbranchidae	NE	NA

3.6 CULTURAL AND HERITAGE ENVIRONMENT

The meaning of Lunglei is “a bridge of rock”. Lunglei also called ‘Letlangpui’ as a town does not have a distinct past specifically. Lunglei was the Capital of South Lushai Hill Districts for 10 years from 1888, as was Aizawl for the North Hill Districts. The two were united in 1898. Lunglei is the second-largest town in Mizoram and was an important town until the partition of India as it had direct access to Chittagong, a big city in Bangladesh which made Lunglei the commercial and education center. As of 1912, there were only 2 shops in Lunglei 1922 which increased to 4 shops in 1922. The first Jeep able road to Lunglei was made only in the 1950s. The whole state of Mizoram was a part of Assam until 1972 when it was made a union territory until 1987; there was insurgency problem in the region. When Mizoram was declared as state, all problems of terrorism and demands for freedom subsided.

The tiny hill state tucked at the North Eastern tip of India, invites you to relax in its picturesque hills and dales, enjoy its salubrious climate and meet its simple and cordial people bubbling with their glorious heritage of arts and crafts and colourful festivals that reflect their ancient faith in the inexorable power of nature. Contoured by thickly forested hills aflush with a variety of exotic orchids, Mizoram is flanked by Bangladesh in the west and Myanmar in the east and south, sharing around 722 km with these foreign countries.

Offering a perfect habitat to nature, Mizoram offers a newer secret to reveal in every corner of

its mist clad hills. Relish a mug of fresh herbal tea with the denizens, known locally as 'Mizo', or the Man of the Hills (Mi:man, Zo: hills).

3.7 SOCIO-ECONOMIC ENVIRONMENT

Mizoram is a vibrant, exotic state where tradition and royal glory meet in a riot of colors. The land is endowed, rich culture and heritage, beauty and natural resources. The festivals of Mizoram mirror the people, their culture, their artistic genius and skill in music and dance which is a vital element in the life of every tribe

The state of Mizoram has an area of 21081 sq.km. As per details from Census 2011, Mizoram has population of 10.97 Lakhs, an increase from figure of 8.89 Lakh in 2001 census. Total population of Mizoram as per lastest census data is 1,097,206 of which male and female are 555,339 and 541,867 respectively. The State has population density of 42per sq. km. (as against the national average of 312). The decadal growth rate of the state is 29.18% (against 21.54% for the country) and the population of the state continues to grow at a much faster rate than the national rate. Major demographic indicators are shown

Table 3.13 Demographic Feature of Mizoram

S. No.	**Item**	Mizoram	India
1	Total population (census 2011) (In million)	0.09	1,210.9
2	Sex Ratio (Census 2001)	976	940
3	Total Geographical Area	21081 sq.km	3,287,240 Sq. Km

Source: Mizoram Statistical Handbook 2021

General Statistic of the district

AREA	SQ.KM.	4,536 km2
LONGITUDE	DEGREE	22.8831° N
LATITUDE	DEGREE	92.6984° E
ALTITUDE	METRES	1222

Source: Mizoram Statistical Handbook 2021

3.8 LAND USE

Land use land cover rate is differing from time to time as well as cultural practices. In the study area we found five different types of land use and land cover. Due to the population ever increase which degrade and exhaust for human wants and satisfaction and livelihood. The built-up land comprises 9.87% which includes town area and road, Agriculture 20.13%. Open forest make up majority of the study area and account for 55.25% of the land use while 14.75% of the area are cover by dense forest. The figure 5.10 shows that the land use pattern, the vegetation cover areas were found in the southern part of the dump site, while built-up land were found in the eastern site surrounded by cropped land around the build-up area.

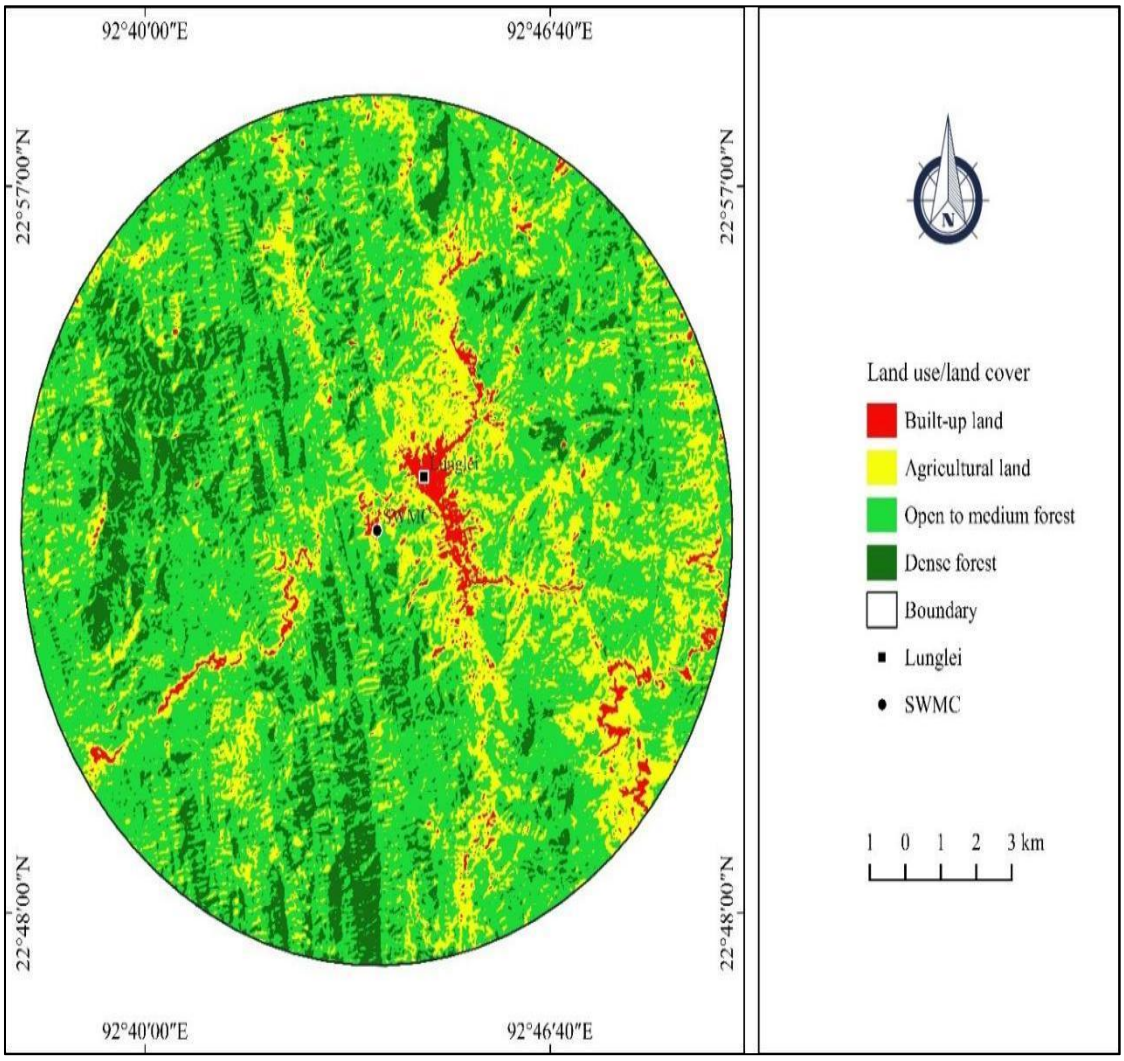


Fig: 3.11 Land use Pattern

3.9 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.9.1 Country's Policy Framework

The National policy framework has been developed to complement the legislative provisions. There are a number of environmental, social, sanitation, Health and Hygiene sector policies in the country. Only most relevant national environmental and social policy which is applicable to the project has been captured in the section as listed in **Table 3.1.**

Table 3.14 Relevant National Environmental and Social Policy Framework

S.No	Policy	Coordinating Agency	Principal Focus of the Policy
1	National Environment Policy (NEP) 2004	MoEF	Conservation of Critical Environmental Resources, Intra-generational Equity: Livelihood Security for the Poor, Inter-generational Equity, Integration of Environmental Concerns in Economic and Social Development.
2	National Water Policy, 2002	National Water Board	To develop, conserve, utilize and manage Water Resources of the Country in sustainable manner,
3	National Forest Policy, 1988	MoEF	Increase productivity &quality of forests and bring all degraded and denuded lands under afforestation programs.
4	Policy Statement for abatement of Pollution 1992	MoEF	Integrates environmental considerations into decision making. Protection on critically polluted areas and river stretches; and involve the community in decision-making.
6	Environment Action Program in 1993.	MoEF	The program aims at improving the environmental services in India and facilitating integration of environmental considerations in developmental programs across different sectors.
7	Wild Life conservation	MoEF	Assigns priority sector to wildlife and forests and outlines measures for protecting wild life

S.No	Policy	Coordinating Agency	Principal Focus of the Policy
	strategy 2002		and enhancing the quality of forest areas in the country
8	The National Conservation Strategy and Policy Statement on Environment and Development	MoEF	Includes guidelines for integrating environmental considerations into India's process of development. Stipulates that projects of certain category must be implemented after prior environmental clearance.

3.9.2 Country's Legal Framework and Regulatory Requirements

The legal framework of the country consists of several acts, notifications, rules and regulations to protevct environment and wildlife. Review of Indian legal system has been critically reviewed to identify its applicability to the project. A list of all required clearances/ permissions related to environment has been summarised in Table 3.2.

Table 3.15: Permissions/Clearances Required for the Sub-Project

S.No.	Clearances	Acts/Rules/Notifications/ Guidelines	Concerned Agency	Responsibility
A. Pre-construction Stage				
1	Consent to Establish / No Objection Certificate	Under section 25/26 of The Water (Prevention & Pollution) Act, 1974 and Section 21 of the Air (Prevention & Control of Pollution) Act, 1981	Mizoram Pollution Control Board	MPCB/DSMC
	Application for obtaining authorization	MSW(MH) rules-2000 [see rules 4(2) & 6(2)]	Mizoram Pollution Control Board	MPCB/DSMC

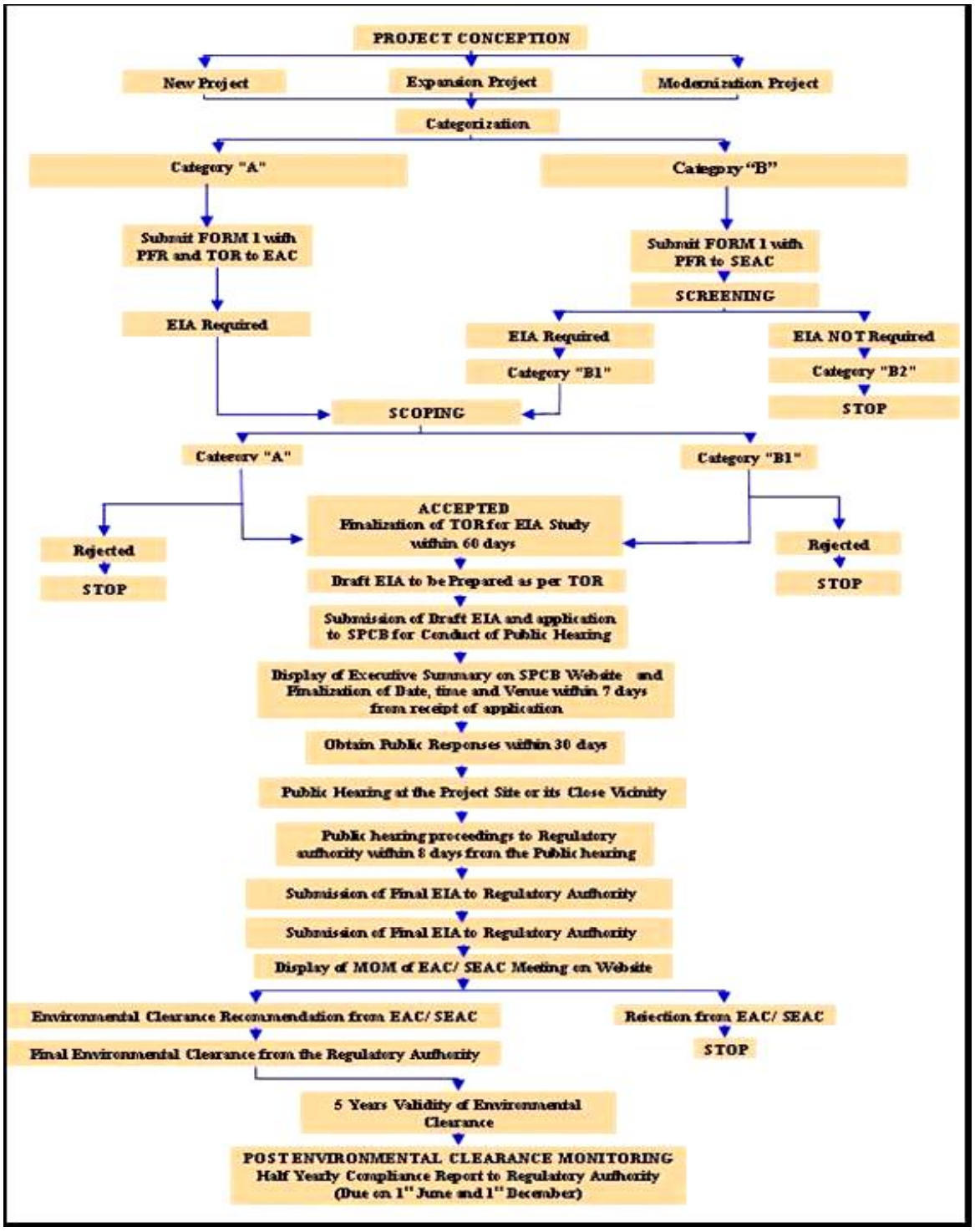
S.No.	Clearances	Acts/Rules/Notifications/ Guidelines	Concerned Agency	Responsibility
2	**Environmental Clearance**	EIA Notification, 2006 and as amended uptodate promulgated under Environment Protection Act 1986	**MoEF New Delhi** as State Environmental Impact Assessment Authority (SEIAA) is not constituted.	DUDO Lunglei
B. Implementation Stage				
4	Permission for Withdrawal of Ground Water	Environment Protection Act 1986	Central Ground Water Authority	Contractor
5	Permission for Withdrawal of Surface Water from River/ Irrigation Canals	-----	Irrigation Authorities for use of water from Irrigation Canal. River Board / Authorities for withdrawal of water from Rivers	Contractor 1. To the Extent Possible Ground Water will be used.
6	Permission for Sand Mining from river bed	Mines and Minerals (Regulation and Development) Act, 1957 as amended in 1972	River Board Authorities/ Department of Mining Govt. of Jharkhand	Contractor
7	Permission for Opening of New Quarry		Department of Mining Govt. of Mizoram / Mizoram Pollution Control Board	Contractor
8	Hot mix plant, Crushers, Batching Plant	Air (Prevention and Control of Pollution) Act 1981	Mizoram Pollution Control Board	Contractor

S.No.	Clearances	Acts/Rules/Notifications/ Guidelines	Concerned Agency	Responsibility
9	Storage of Hazardous Chemicals	Hazardous Waste (Management and Handling) Rules 1989 and Manufacturing Storage and Import of Hazardous Chemicals Rules 1989	Mizoram Pollution Control Board	Contractor
10	Disposal of Hazardous Waste	Hazardous Waste (Management and Handling) Rules 1989	Mizoram Pollution Control Board	Contractor
11	Disposal of Construction Waste & liquid effluent from Labour camps	Water (Prevention and Control of Pollution) Act 1974	Mizoram Pollution Control Board	Contractor
13	Pollution Under Control Certificate	Central Motor and Vehicle Act 1988	Department of Transport, Govt. of Mizoram	Contractor
14	Employing Labour/workers	The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996,	District Labour Commissioner	Contractor

3.10 ENVIRONMENTAL CLEARANCE PROCESS

The procedure for obtaining environmental clearance has been depicted as figure 3.12

Figure 3.12 Environmental Clearance Process



Cross Sectoral Coordination and Other Permissions

In addition to above permissions and clearances, the cross sectoral coordination with various departments need to be taken up prior to actual implementation of the project and obtain necessary permissions/clearances from:

- Electricity Board and Telephone Department

- Other utility organizations e.g. oil pipelines etc.

Relevant Guidelines/Specifications

- Technical Guidance EIA Manual for Common Municipal Solid Waste Management Facility prepared by IL&FS for MoEF.
- Municipal Solid Wastes (Management & Handling) Rules, 2000 (MSW Rules 2000) of Central Pollution Control Board.
- The factories act 1956 for hygiene and safety requirements of construction workers
- Other relevant codes of Bureau of Indian Standard (BIS) and National Building Codes

3.10.1 Administrative Structure and the Interactive framework

The Government through specific legislations regulates the environmental management system in India. The MoEF and the pollution control boards (CPCB i.e. Central Pollution Control Board and SPCBs i.e. State Pollution Control Boards) together form the regulatory and administrative framework. Other Ministries/Statutory Bodies/departments are also responsible for ensuring environmental compliance and granting various clearances.

3.10.2 Ministry of Environment and Forests (MOEF)

The primary responsibility for administration and implementation of the Government of India's policy with respect to environmental management, conservation, ecologically sustainable development and pollution control rests with the Ministry of Environment and Forests (MoEF). Established in 1983, MoEF is the agency primarily responsible for the review and approval of EIA pursuant to GOI legislation.

3.10.3 MOEF Regional Offices

The Ministry of Environment and Forests has set up regional offices, in the six regions of the country. The regional office for the present project is located at Bhopal. This office is responsible for collection and furnishing of state information relating to EIA of projects, pollution control measures, status of compliance of various conditions in projects cleared by MoEF, legal and enforcement measures and environmental protection in special conservation areas such as wetlands, and other biological reserves.

3.10.4 Central Pollution Control Board (CPCB)

CPCB is a statutory authority attached to the MoEF and located in New Delhi. The main responsibilities of CPCB include inter alia the following

- Plan and implement water and air pollution monitoring programs;
- Advise the Central Government on water and air pollution monitoring programs;
- Set air and water standards; and
- Co-ordinate with the State Pollution Control Boards.

3.10.5 State Pollution Control Boards (SPCB)

The Mizoram Pollution Control Board (MPCB) will be the government agency responsible for ensuring the compliance with the relevant standards related to discharge of pollutant into the environment. The following activities of the MPCB will be relevant to the project.

- Planning and executing state level air and water quality initiatives;
- Advising state government on air, water and industry issues;
- Establishing standards based on National Minimum standards;
- Enforcing monitoring of all activities within the state under The Air Act, The Water Act and the Cess Act etc.; and
- Issuing No Objection Certificate (NOC) for various developmental projects.

3.10.6 Department of Forest (DoF) Government of Mizoram

The department of forests, Govt. of Mizoram is responsible for the management and administration of forest resource in the state. The project site is not located on Govt. forest land and within 10 km of radius no reserve forest or any protected forest. The proposed project site is partly on private forest land and permission for removal of tree is required from forest department.

CHAPTER 4:ANTICIPATED ENVIRONMENTAL IMPACTS AND ITS MITIGATION MEASURES

4.1 INTRODUCTION

It is expected that there will be certain changes in the overall environmental matrix of the study area. The baseline data of the existing environment, in the absence of the proposed activity, provides the status of the natural environment and with the proposed activity, it further provides a mechanism for prediction of the changes that are likely to occur. In the present study, evaluation of land, water, air, noise, flora, fauna and socio-economics was undertaken to understand the baseline environmental status of the area and estimations were made as to how this will change with the commencement of the proposed activities. Anticipating the quantum of change, efforts were also made to analyze the degree of alternations and strategies for suitable management to ameliorate the negative impacts project activities. This exercise has provided a sound basis for formulation of different management plans, which are presented in the EMP document of the project.

Impact on various environment parameters can be broadly categorized into phases, namely:

Construction Phase: Impact during this phase may be regarded as temporary or short term;

Operation Phase: Impact during this phase shall have long-term effects.

Various impacts during these two phases have been envisaged and are discussed in the subsequent sections. In the light of the predicted impacts, various mitigation measures are suggested emphasizing to avoid/ minimize the negative impacts. The quantum and magnitude of an impact is assessed on the basis of its nature, viz. positive/ negative, reversible/ irreversible, short term (confined to construction phase)/ long term (remains in operational phase), local/ strategic, adverse/ beneficial and significant/ insignificant.

4.2 IDENTIFICATION, PREDICTION AND EVALUATION OF IMPACTS

Environmental impacts have been assessed considering present environmental setting of the project area, nature and extent of the proposed activities. Suitable approach and methodology was adopted to ascertain likely impacts both during design & construction and operation stage. Valued environmental components (VECs) were identified during initial site visit followed by its detailed investigation during later stage of the study.

Various operations involved in the Municipal Solid Waste Management Facility have been studied in detail to identify, predict and evaluate impacts on various environmental components. This chapter discusses the various pollution loads and stressors that could impact the environment and the incremental environmental impacts on the environmental

parameters during the operation phase of the project. The identified impacts are quantified using mathematical models to a possible extent so as to estimate the future environmental scenario.

Prediction of environmental impacts is the most important component in the impact assessment study as it provides quantitative information related to projection of impacts from the proposed project based on the estimated pollution loads during the operation phase of the plant. Several mathematical/statistical techniques and methodologies are available for predicting impacts due to proposed project on physico-chemical, ecological and socioeconomic components of environment. The results obtained from the predictions will be superimposed over the baseline status (pre-project) of environmental quality to derive the ultimate (post-project) scenario of environmental quality status in the impact zone around the plant site. The quantitative impacts derived from predictions are also essential to delineate pragmatic environmental management plan, especially pollution mitigation measures for implementation in detailed engineering stage and thus during operation phases of the proposed project for minimizing the adverse impacts on the surrounding environment.

Impact on Different Components of Environment

The impacts has been identified and predicted for the environmental components like:-

- Air
- Water
- Noise
- Soil
- Ecology
- Socio-economic environment
- Culture and heritage

During construction phase source of the air pollution will be fugitive emission from construction activities and transportation and during the operational phase, the main sources of air pollution will be emissions from, fugitive dust and odour from waste handling and processing.

During construction phase, sewage from construction/ worker camp will be the only source of water pollution and significant water demand will be required for construction purpose. During operation phase, leakage from the drainage systems, composting and landfilling may cause leachate production which can contaminate the ground water aquifers.

During construction phase, major sources of noise pollution will be vehicular traffic, operation of machinery etc. and during operation phase, the source of noise will be due to the operation of machineries and transportation.

4.3 SOURCE OF AIR POLLUTION AND MITIGATION

4.3.1 During Construction Phase

During the construction phase, SPM is expected to be the main pollutant associated with on-site approach roads (paved and unpaved), and material handling. The proposed activities during construction phase would primarily involve development of site (i.e. excavation etc) and construction of landfill and its associated facilities.

During the construction phase, pollution emission sources shall be distributed throughout the project site and shall fall under the category of area source. The project area is slope, so extensive formation work is not expected during this phase. In addition, due to the confined nature of heavy construction activity during this limited period, tailpipe emissions from construction equipment are assumed to be negligible.

IMPACT	MITIGATION
• During construction phase, operation of construction equipments and vehicular emissions will be the main source of pollution.	• A dust control plan will be implemented and regular maintenance of vehicles and equipment will be carried out. • Regular sprinkling on haul roads will be carried out to moisten the air borne fugitive emissions. • The construction area will be shielded with the help of tarpaulin to contain the air emissions within the premises. • Pollution control checks & optimum use of the vehicles. • PUC certified vehicles will be used. • All transportation vehicles will be suitably covered with tarpaulin & overloading of the vehicles will be avoided.

4.3.2 During Operation Phase

The vehicular traffic generated due to the proposed project is negligible as compared to the total traffic Lunglei road, hence the contribution due to proposed project can be considered as insignificant. Modelling therefore has not been done for the tailpipe emissions (i.e. CO, NOx and SPM) for vehicles travelling along this road. Proposal of green belt development along the periphery of the plant will also reduce the tailpipe emissions as well as the emissions from the site. Since the Solid Waste Management Facility will involve a compost plant as well as the landfill site, hence the probability of emissions will also be reduced.

IMPACT	MITIGATION
• During the operational phase, the main sources of air pollution will be emissions from fugitive dust and odour from waste handling and processing. • Tail pipe emissions from the vehicles involved in material handling.	• Emissions from waste handling will be controlled by provision of covered areas, proper ventilation • Composting will be done using windrow technology using accelerated aerobic bioconversion which will not create odour problems. Regular sprinkling on the wind rows will be done to avoid fugitive emissions from dust arising from the source. • Ambient air quality monitoring will be regularly carried out particularly for checking odour nuisance at down wind direction on the boundary of the processing plant. • PUC certified vehicles will be used.

4.4 SOURCE OF WASTE WATER AND MITIGATION

This section describes the potential impacts on the water resource due to the proposed project.

4.4.1 During Construction Phase

Construction activities for the proposed development can have minor impact on hydrology and water quality of the area as the construction waste will not be leached into ground water

or any surface water body. Potential impacts on the hydrology and water quality have been discussed as under.

- Soil runoff from the site leading to off-site contamination (particularly during rainy season).
- Improper disposal of construction debris leading to off-site contamination of water resources.
- Unaccounted disposal of domestic wastewater from temporary labour camps.
- Storm water run-off during rainy season.

IMPACT	MITIGATION
• Sewage will be the only source of water pollution. • Significant water demand for construction. • Improper disposal of construction debris leading to off-site contamination of water resources. • Unaccounted disposal of domestic wastewater from temporary labour camps. • Spillage of oil and grease from the vehicles and wastewater stream generated from onsite activities such as vehicles washing, workshop etc. • Storm water runoff during rainy season.	• The waste water generated will be treated in a septic tank followed by soak pit. • Curing water will be sprayed and after liberal curing, all concrete structures will be covered with gunny bags which will conserve water. There will be provision of using Polymer dispersion and air entraining agents as well. • Local labours will be employed hence the problem of unaccounted disposal of domestic wastewater will not be a problem. • Spillage of oil and grease will be minimized as much as possible by segregating the vehicle washing area etc from that of the processing areas. • Proper measures to minimize storm water run-off during rainy will be implemented.

4.4.2 During Operation Phase

During the operation phase of the project, water would be required for the following activities:

- Domestic consumption and service requirement.
- In compost Plant, dust washers, etc

IMPACT	MITIGATION
• The daily water demand of water will be provided from nearby surface water. • Uncontrolled discharge of storm water may cause flooding of the area. • Leakage from the drainage systems. • Composting may cause leachate production which can cause contamination of ground water aquifers. • Land filling may cause leachate production.	• The Solid waste management facilities will not have considerable impact on water consumption in the area • The storm water drains have been designed in line with the peak intensity of rainfall which will help in minimizing the problem of flooding. • The storm water drains will be cleaned regularly to avoid water logging in the area. • Single stage leachate treatment system will be used to prevent accumulation of leachate which contaminates the soil and water.

4.4.3 Rain Water Harvesting Scheme

The Rain water harvesting scheme has not been proposed due its topography (hilly/mountainous).

4.5 IMPACT ON LAND ENVIRONMENT AND MITIGATION

4.5.1 During Construction Phase

The proposed project will be developed on the land of UD&PA department. With the development of the proposed plant, green belt would be developed and other aesthetic changes would be made to the Municipal Solid Waste Management Facility site, thereby creating overall positive impact on the aesthetics of the site.

IMPACT	MITIGATION
• The land had trees, shrubs and weeds type of wild vegetation which grows during the rainy season. • Waste will be generated from the various construction activities.	• There will be permanent change in the land use pattern. Minimum removal of vegetation is advice. • With the site development for the proposed plant, green belt will be developed and other aesthetic changes will be made at the plant site; thereby creating positive impact on the aesthetics of the site. • The construction waste will be segregated into recyclable waste and inert waste. • Recyclable waste will be sold to the vendors and inert waste will be used for construction of road and paved areas.

4.5.2 During Operation Phase

IMPACT	MITIGATION
• The proposed project is 15 M • • TPD Municipal Solid Waste Management waste facility.	• The solid waste will be segregated and treated as per their nature: • Mechanical segregation as pre-processing step. • Bio-composting of short term biodegradable. • Recovery of plastic and recyclables. • Proper sanitization of the windrows will be done using natural herbicides such as BIOKLEEN, ECOKLEEN, etc. so that there are no waste borne pathogens and disease vectors.

	• Development of a green belt has been proposed which will help to improve the soil quality and texture (since composting involves the usage of enriched as well as will add to the fertility of the soil) • The left over material would then be send to the nearby landfill site.

4.6 IMPACT OF NOISE ENVIRONMENT AND MITIGATION

The assessment of the impacts of noise on the surrounding community depends upon:

- Characteristics of noise source (instantaneous, intermittent, or continuous in nature, with the latter contributing the least to noise pollution);
- Time of day at which noise occurs; and
- Location of noise source with respect to noise sensitive receptor.

For the purposes of predicting noise emissions impacts from the site, the noise emission sources were examined during construction and operational phases.

4.6.1 During Construction Phase

Sources of noise emissions are expected from various construction machineries / equipments. General noise levels generated from the operation of equipment and machinery are provided in following table 5.1:

Name of Source	Noise Level at 16 m (50 ft) from Source in dB (A)	Noise Level at 1m from source (calculated) in dB(A)
Air Compressor	87	111
Back Hoe/Loader	81	105
Concrete Mixer Truck	85	109
Concrete Pumper	70	94
Concrete Vibrators	77	101
Cranes - mobile	81	105
Dump Truck	83	107
Generator	Not considered	75 (as prescribed by CPCB)
Hammering	86	110

Name of Source	Noise Level at 16 m (50 ft) from Source in dB (A)	Noise Level at 1m from source (calculated) in dB(A)
Jack Hammer	88	112
Pile Driver	100	124
Radial Arm Saw	80	104

Since the site is far away from settlement area hence the noise generated from the construction phase is expected to imply a minor impact on the nature, hence the possibility of all the equipments working together is ruled out. Hence, the noise generated is not anticipated to be high.

Impact	Mitigation
• Major sources of noise pollution are vehicular traffic, operation of excavation and trucks.	• Vehicular movement carrying raw materials will be avoided during night time. • The construction area will be shielded with the help of tarpaulin. • The vehicles will be regularly maintained and optimum use of the same will be made. • The machinery used will be environmentally acceptable with minimum noise. • Ear plugs will be recomended to the workers.

4.6.2 During Operation Phase

During the operational phase, the major sources of noise are:

- Noise from blowers, shredders of compost plant
- Noise from generator
- Noise generated from compactor and other rotating equipment's of the power plant
- Noise due to vehicular movement inside the plant premises and on Tlabung road.

All the noise producing equipments such as blowers, shredders and generator would be housed in an acoustic enclosure; hence the ambient noise is not anticipated to be very high. The noise level outside the acoustic enclosure for different equipments would not exceed the prescribed standards (75 dB (A) at 1 m distance from the equipment). Equipment will be statically and dynamically balanced to eliminate any vibration that can lead to noise

generation. Blow off valves; discharge pipes, relief valves and other noise producing static equipment will be equipped with silencers. Pipelines will be suitably sized to avoid excess velocities that can lead to noise generation. Wherever necessary, insulation will be provided for reducing noise pollution. The above abatement measures will ensure that noise levels are kept below standards for the rotating equipment. To reduce the occupational impact on the employees working in the close vicinity of the equipments, suitable ear protection devices would be provided. Hence, the overall noise impact because of project activities would not be very high.

Impact	Mitigation
• The source of noise in the post construction phase will be due to the operation of machineries, and transportation.	• Abatement measures will ensure that noise levels are kept below 75 db (A) in the ambient air of the plant and nearby areas. • Plantation will be done at the periphery so that it can act as a sound barrier. • The area will cover 33% of the area under landscape which will help to absorb noise. • Ear plugs will be recomended to the workers.

4.7 IMPACT OF SOIL ON ENVIRONMENT AND MITIGATION

4.7.1 Construction Phase

Impact on soil owing to the project construction activity includes soil erosion, compaction, physical and chemical desegregations and pollution of soil in case of waste discharge on land.

Impact	Mitigation
• The source of soil disturbance in the construction phase will be soil erosion, physical and chemical desegregations etc.	• A green belt area around the periphery will help soil erosion. • It would be kept in mind that the chemicals like paints, oil etc do not come in direct contact of the soil.

4.7.2 Operation Phase

No significant impact is expected on the soils on and around the site; however as a precautionary measure following management procedure will be implemented

- All solid wastes and hazardous wastes from the plant complex will be collected properly, stored and disposed.
- The entire plant site area is well drained and thus there is no leaching of any substances in case of spills, which are well confined and decontaminated.
- Reject Treatment

Impact	Mitigation
• The domestic and the hazardous waste can contaminate the soil. • Due to uneven area there can be a problem of water logged pockets which in turn can contaminate the soil.	• Solid wastes and hazardous wastes from the plant complex will be collected properly, stored and disposed. • The chances of water logged pockets will be minimized by maintaining a constant level of ground.

4.8 IMPACTS ON ECOLOGICAL ENVIRONMENT

4.8.1 Construction Phase

The possible impacts on the biological environment of the Study Area that may arise due to the Proposed Project are discussed as follows:

TERRESTRIAL ECOLOGY

Impact on Flora:

Construction and excavation works at the Proposed Project Site would result in removal of vegetation cover and felling of trees which will results in loss of vegetation cover and felling of about 1500 matured trees. However, the Proposed Project Site is located proximity to Lunglei town and surrounding area are private owned land or garden and does not provide significant functional value for wildlife due to its close proximity to human activities and development. The removed vegetation would be replaced by vegetative cover once the proposed landfill are filled and capped. Regardless, vegetation is not a significant component of those areas at this time, and impacts would be considered temporary and minimal. Besides,

an existing dumping ground is situated near the Proposed Project Site where municipal wastes are dumped and burnt which already have adverse impacts on the flora and fauna of the study area for a long period of time.

Impact on Habitat and Fauna

The biodiversity survey report a number of mammals and birds in the Study Area, but the study shows that there is no demarcated or suitable habitat for wildlife due to anthropogenic activities. Most of the wildlife associated with the study area is sparse populations of transient birds and mammals that are sporadic in their local distribution. All the fauna recorded during the survey are common in other places and would probably move to adjacent properties. Therefore, there is no scope of habitat fragmentation will occur during the site development.

AQUATIC ECOLOGY

Impact on Flora

The survey indicated that there is no major river except a small streams or nallahs in the Study Area with scanty of water during dry seasons. There is no aquatic floral habitat in these streams. Green algae (Chlorophyta) like Ulothrix spp., Cardenthera diformis, Hydrilla ventricillata and Ipomea aquatica are found. However, these streams do not flow into the Proposed Project Site and so the proposed project may have no significant adverse affect on the aquatic ecology provided the sand excavated during the construction of Landfill are dump into a well and prepared dumping ground.

Impact on Fauna

The survey indicated that there are no significant fish population from the streams of the study area as the stream dry up in summer. Due to the proximity with human habitation the impact on fauna is consider to minimal.

Impact on Endangered / Threatened Flora and Fauna

Biological survey did not reveal the presence of any endangered or rare species of flora and fauna in the Study Area (including Proposed Project Site). Therefore, endangered or rare species would not be impacted by the activity of this project.

Noise, Air Pollution and other Disturbances:

Air, noise and visual disturbance may be generated during the site development that can affect the behaviour of fauna (especially bird, butterflies and other insects, reptiles and very small mammalian species) of the adjacent habitats. However, alternative habitats are available in nearby areas, and disturbance is going to confine to the construction period only. Besides, these activities and the resulting impact on the existing ecology would be suitably compensated and mitigated adopting comprehensive EMP. Hence; the potential impacts to faunal groups from this source are ranked negligible.

4.8.2 Operation Phase

This section of the report considers the potential impacts of project during the operation on terrestrial ecology and potential sources of impact include air, noise pollution, wastewater and other disturbances.

Potential impacts of project operation on terrestrial ecology include long-term air and noise pollution and disturbance generated by area lighting and traffic. Based on the limited fauna community and flora community observed in the zone and the existing land use pattern of the surroundings, potential impacts to fauna and flora from this source are ranked as minimal.

Since most terrestrial fauna recorded or reported to occur in the study area are disturbance tolerant and some are dwellers of typical rural setting hence, operational impacts are ranked as minimal. In addition, a green belt will be included in the development plan. This will provide habitats for a few faunal groups. No impact on the local ecology is expected from the background sources during the operational stage.

Management of Construction Debris/Waste

Debris will be generated due to dismantling of pavement in some sections wherever existing pavement cannot be utilised as determined by the Contractor and approved by the DSMC. Quarry dust and waste iron bars or damaged support structure constitutes significant debris. Mitigation for solid waste management from construction camp has been given in construction camp section.

Mitigation measures

All excavated materials from approach road/internal road, shoulders, verges, drains, and others will be will be used for filling pits, and landscaping.

Unusable debris material shall be suitably disposed off at pre-designated disposal locations, with approval of the concerned authority. The bituminous wastes shall be disposed in secure landfill sites only in environmentally accepted manner

- Unusable and surplus materials, as determined by the Project Engineer, will be removed and disposed off-site.
- The locations of dumping sites should be selected with following considerations.
- Unproductive/wastelands shall be selected for dumping sites.
- Away from residential areas and located at least 1,000 m downwind side of these locations,
- Dumping sites do not contaminate any water sources, rivers etc, and
- Dumping sites have adequate capacity equal to the amount of debris generated.

Public perception and consent from the village Panchayats about the location of debris disposal site has to be obtained before finalizing the location.

4.9 SOCIO-ECONOMIC IMPACT

Positive Impacts

- The project is a mandatory project for the wellbeing of the people of Lunglei so that the litter waste cannot act as receptors for disease vectors. The scientific waste treatment would leave the city neat and clean and free from any epidemics like dengue, plague etc. Also the proposed project will lead to employment generation and will have a positive impact on the socio economic environment. Preference to local population will be given in employment opportunities.
- The proposed Municipal Solid Waste Facility will have a positive impact on the socio economic status, which will contribute to the growing prosperity of the project city.
- The proposed project will help in creating pollution free clean environment and will generate source of income from otherwise considered waste. This will help in improving the economic conditions of the people.
- The project will involve the treatment of municipal solid waste in a scientific way without causing environmental problems such as mal odour, health hazard, etc.

- The transportation of the waste to the desired destination will be carried out by using trucks as the source of transportation, thus creating indirect employment opportunities to the people.
- There is no alteration in transport routes and there is no displacement of habitation.
- Local people will be employed during construction hence; there will be no strain on the community infrastructure. At the same time the project will not create any social stress due to changing patterns of social interaction.
- Due to proposed project the surrounding environment will not face any problem related to pollution because appropriate pollution control measures will be followed.

4.10 IMPACTS DUE TO CONSTRUCTION CAMP AND IMMIGRATION OF WORKERS

Design and Construction Stage

Poor sitting and improper management of construction camp may lead to several adverse impacts on environment viz. (i) loss of vegetation due to use of wood as fuel source for cooking (ii) deterioration in nearby surface water bodies' quality (iii) compaction and contamination of soil due to uncontrolled disposal of solid waste (iv) poor sanitation may result to transmission of communicable diseases among the workers and the host communities. This include the possible spread of sexually transmitted disease, diseases from improper handling and supply of foodstuffs, poor water supply, insect-borne diseases, and alcoholic and drug.

Mitigation measures

- Construction camp shall be sited at such locations so as to utilise the existing infrastructure. No productive land should be utilised for construction camp. All sites must be graded, ditched and rendered free from depressions to avoid water stagnation. Accommodation and ancillary facilities including recreational facility for workers shall be erected and maintained to standards and scales approved by the resident engineer. All camps should maintain minimum distance of 500 m from habitation and water bodies.
- All construction camps shall be provided sanitary latrines and urinals with provision of septic tanks attached with soak pits. Storm water drains shall be provided for the flow of used water outside the camp. Drains and ditches shall be treated with

bleaching powder on a regular basis. Garbage bins must be provided in the camp and regularly emptied and disposed off in a hygienic manner. LPG cylinders shall be provided as fuel source for cooking to avoid any tree cutting.

- At every workplace, the Contractor will ensure, in collaboration with local health authorities that a readily available first-aid unit including an adequate supply of sterilized dressing materials and appliances shall be provided.
- The Contractor will ensure the good health and hygiene of all workers to prevent sickness and epidemics. These include the HIV/AIDS prevention program to reduce the risk and transfer of HIV virus between and among the workers and community, promote early diagnosis and assist affected individuals. Activities under the program includes monthly information, education, and consultation communication campaigns to workers, drivers, delivery crew, and communities on the risk, dangers, and impacts of STD and HIV/AIDS
- The Contractor will ensure that sufficient supply of suitable and hygienically prepared food at reasonable price is available to the workers.
- The Contractor will provide adequate and safe water supply for the use of the workers.
- The Contractor will ensure that all precautions to protect the workers from insect and pest to reduce the risk to health. This includes the use of insecticides which should comply with local regulations.
- No alcoholic liquor or prohibited drugs will be imported to, sell, give, and barter to the workers of host community.
- Migrant workers may be the potential carriers of various diseases. Local community may get exposed to the diseases carried by migrant workers. Regular health check-up and immunization camps shall also be organized for the workers and nearby population.

Safety of Construction Workers and Health and Safety Risks to Local Community

Design and Construction Stage

The following safety aspects viz. (i) safety of construction workers, (ii) safety of local community (iii) unsafe/ hazardous traffic conditions due to construction vehicle movement need to be considered during design and construction stage, and (iv) conduct of safety audit.

Children are one of the most vulnerable to injury from collisions with transport carrying vehicles due to their lack of understanding of traffic hazards, behaviour while at play, and their small size makes it difficult for the motorist to see.

Mitigation measures

- During the construction phase, contractors shall be required to adopt and maintain safe working practices. Internationally accepted and widely used safety procedures should be followed during (i) construction works (ii) handling of large construction equipments and machineries, (iii) handling of chemicals and hazardous materials and inflammable substances (iii) welding (iv) electrical works etc. A set of mitigation measures for construction workers have been provided in EMP matrix table.
- Contractor shall arrange all PPEs for workers, first aid and fire fighting equipments at construction sites. An emergency plan shall be prepared duly approved by the engineer in charge to respond to any instance of safety hazard. The contractor will be required to appoint an Accident Prevention Officer (APO) who will conduct regular safety inspections at construction sites. The APO will have the authority to issue instructions and take protective measures to prevent accidents..
- Provision of temporary or permanent barriers like fence or plants to avoid pedestrian crossing except at designated crossing points in approach road to landfill site.
- Installation of speed bumps to control speed near designated pedestrian crossing areas in approach road to landfill site. .
- Conduct of regular safety audit on safety measures adopted during construction. The audit will cover manpower and their safety, machinery, temporary works, equipment and vehicles, materials storage and handling, construction procedures, environment, site safety guidelines, and miscellaneous services.

Operation phase

The provision made during design stage will help to avoid/minimise health and safety risks. Other issues related during operational phase are monitoring of emergencies and establishing procedures to carry out rescues during any emergency and accidents.

Transports and Storage of Materials

The construction material primarily will consist of aggregate, sand, cement, bitumen, lubricating oil and fuel for vehicle and construction equipment's. These will be primarily stored temporarily at construction camps. The oils, fuels and chemicals will be stored on concreted platform with spills collection pits. The cement will be stored under cover. All these temporary storage areas will be located at least 150 m away from the habitat (workers). The likely impacts due to transportation and storage including fugitive emission have already been covered under different section above.

4.11 IMPACT ON COMMON PROPERTY RESOURCES

The impact on common properties is not anticipated as project site is located on open land own by partly private owner and partly by government.

4.12 IMPACT ON ACCESSING UTILITIES:

Utilities include the supply of water, electricity and sewage facilities. Residents in the neighborhood would not face bottlenecks in accessing utility services such water supply, electricity or sewage facilities due to proposed project in the area. Impact on existing utilities due to construction and operation of the proposed waste management facility has been considered as "no impact" as site is away from these utilities.

4.13 IMPACT ON HISTORICAL, ARCHEOLOGICAL AND ARCHITECTURAL SITES

There are no historical or archaeological monuments of significance within the study area and hence no negative impact in this regard is anticipated.

4.14 CONTROL OF PATHOGENS

This is one of the vital aspects for handling of waste at various stages right from the source of generation to processing treatment. Safety of the workers along with safety of the neighborhood and other citizens is a matter of concern. For minimizing the adverse effects, following measures will be taken.

- Spray treatment of sanitizers on waste heap using herbal and biological preparations.
- Sanitization of vehicles before and after loading will be ensured.
- Control of bio aerosols and dust control would be done through protective mechanisms, and good house keeping measures.

- Use of chemical disinfectants, polyphenols etc. will be prohibited as these chemical interfere with the natural decomposition process of MSW.

Arrangements for pressurized spray vehicles sanitization spray tower, vehicle washing facilities will be some of the essential parts of SWM facilities. If these aspects are neglected, it can lead to severe protest from citizens and even force facility shifting or closure.

4.15 CONTROL OF MAL-ODORS

Incidences of mal-odor generation have been most common phenomenon all over the world leading to public protests and ultimately settlement of issue with better facility management and installation of odor control systems.

- Mal- odour is generally released when the windrows are not properly turned for aeration purpose. This process needs to be done every 5-7 days till the complete organic matter has broken down. The same will be followed.
- Excessive waste stalking height leads to dead pockets. Therefore the windrows height would be restrict to 2.0 m only.
- Excess water content through rain or by moistening process will be avoided.
- Proper moisture maintenance would be ensured as the thermophilic temperatures are reached quickly.
- Proper spraying of odor-neutralizers would be ensured.
- Disposal of dead animals along with MSW would be strictly prohibited.

Sufficient provisions will be taken with respect to platform management, monsoon shed, waste congestion, pre-processing steps and installation of odor neutralization system. Accumulation of leachates also leads to stinks. This will be tackled through double or triple stage leachate treatment system.

4.16 OPERATION AND MAINTAINANCE PLAN

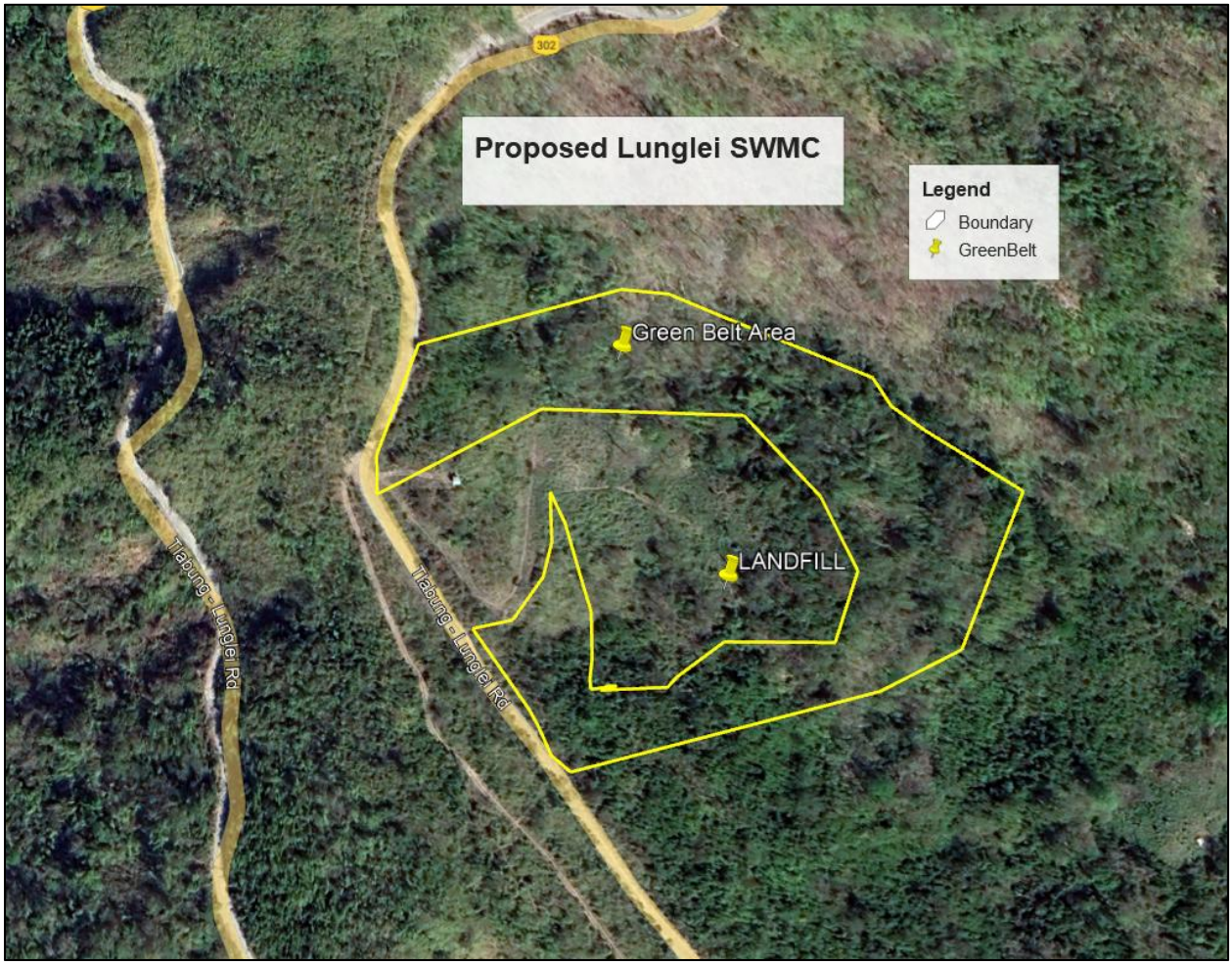
- Minimum working hour per shift or per day would be 8 hours.
- Routine maintenance shutdown period and its frequency: once in a week (8 hours per shift per day)
- Contingency plan for handling the waste during shutdown period

During shutdown period MSW will be stored in windrows. Moisture content of the waste would be analyzed depending on which apt levels between 45-50 % at any time would be

maintained. Windrow turning process is carried out mechanically, if required. The waste collected during the shutdown period will be processed during the next working day.

4.17 GREEN BELT DEVELOPMENT

Green belt will be developed at every possible place. The treated water will be reused for green belt development within the plant premises and the periphery of the plant. The plantation will be done in a proper manner. It helps in reduction of air pollution levels and increase in the quality of nature besides helping in conservation of top soil and maintenance of the ecological balance.



-Proposed Green Belt Area-

CHAPTER 5: ANALYSIS OF ALTERNATIVES

6.1 INTRODUCTION

This chapter below presents the project site evaluation with respect to siting guidelines prescribed by Ministry of Urban Development & SWM rule 2020 and its subsequent amendments for setting up waste management facilities, rationale for sizing of the proposed facility, and selection of the waste treatment technology. It has been planned to adopt composting technology for treatment of biodegradable organic fraction of the waste. Recyclables will be segregated and sent for further processing while the inert waste will be stored separately. The project has been planned in such a manner that the emphasis shall be laid on maximizing resource efficiency and for promoting 4R's-Reduce, Reuse, Recycle, and Recover. The proposed Integrated Municipal Solid Waste Management facility to be developed at Lunglei, Mizoram in an environmentally sustainable manner with an emphasis on maximizing resource use efficiency. The facility will make a significant contribution in diverting the municipal waste reaching the landfill sites and also reducing the load on the existing waste management/processing facilities in the Lunglei Town.

6.2 SITE EVALUATION

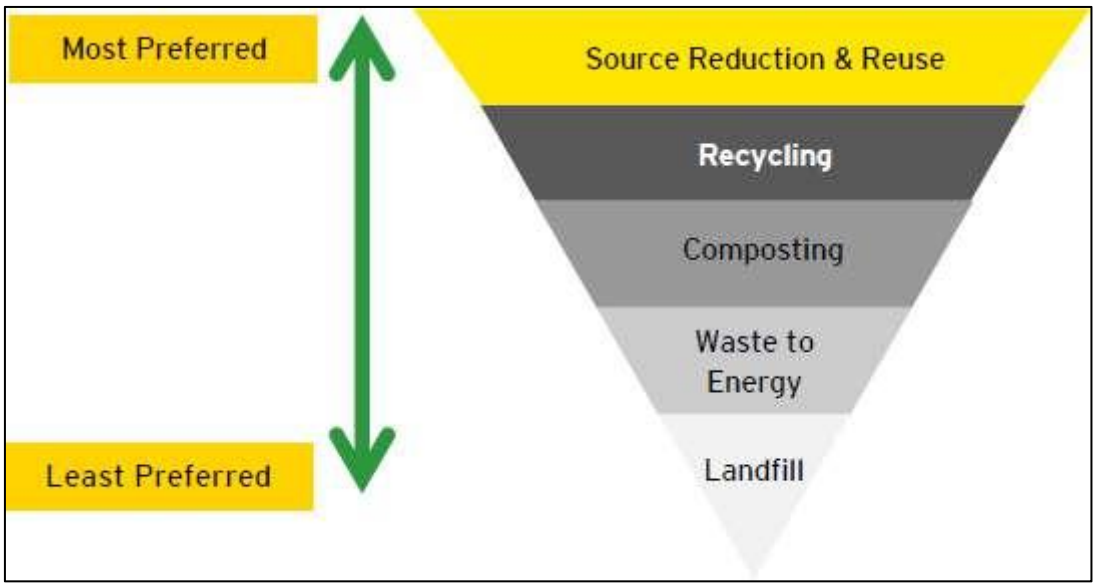
While studying the suitability of various alternative sites within Lunglei, the consultant reviewed land availability in the zone, and identified each possible site for an alternative site. The most possible alternative site is an existing dumpsite near the the town of Lunglei which is found to be relatively small in size compared to the new proposed site. And the location is very closed to habitational zone which is not recommended.

There are no Biological Sensitive Area or Sensitive/Incompatible Land area near the selected site.

6.3 ASSESSMENT OF ALTERNATIVE TECHNOLOGIES

Integrated Solid Waste Management (ISWM) proposes a waste management hierarchy with the aim to reduce the amount of waste being disposed, while maximizing resource conservation and resource efficiency. The ISWM hierarchy ranks waste management operations according to their environmental, economic and energy impacts.

Figure: 6.1 Municipal solid waste management hierarchy



6.4 ALTERNATIVES TECHNOLOGY WHICH CAN BE ADOPTED

As suggested in the pre-feasibility study undertaken by the DPR Consultants, the most feasible technology option recommended for the Integrated Municipal Solid Waste Management Facility at village Lunglei, Mizoram based on the quality, quantity and characteristics of waste to be processed, land availability (limited in the area), proximity to residential areas, capital cost and maintenance cost, is Vermi Composting for processing of bio-degradable organic waste. Mechanical composting by machine is also an option for the treatment of Organic waste due less area in the site, as it is ideal for wet organic food i.e. non-veg cooked food. Inert wastes will be segregated, stored separately in a designated storage area and final disposed of in proposed sanitary landfill. The treatment of Municipal Solid Waste which can be an alternative options are broadly categorized into three sections:

6.4.1Thermal process technologies

The thermal processing technologies involve thermal decomposition of waste into gaseous, liquid and solid conversion products with release of heat energy. These technologies operate at temperature greater than 200oC and have higher reaction rates. They typically operate in a temperature range of 375oC to 5,500oC. Thermal technologies include advanced thermal recycling and thermal conversion (a process that converts the organic carbon based portion of the MSW waste stream into a synthetic gas which is subsequently used to produce products such as electricity, chemicals, or green fuels). The main thermal processing technologies adopted internationally for the treatment of municipal waste are :

a) **Incineration:** Mass-burn systems are the predominant form of the MSW incineration. Mass-burn systems generally consist of either two or three incineration units ranging in

capacity from 50 to 1,000 tons per day; thus, facility capacity ranges from about 100 to 3,000 tons per day. It involves combustion of unprocessed or minimally processed refuse.

b) **Pyrolysis:** In pyrolysis, at high temperatures of 700oC to 1200oC, thermal degradation of organic carbon-based materials is achieved through the use of an indirect, external source of heat, in the absence or almost complete absence of free oxygen. This thermally decomposes and drives off the volatile portions of the organic materials, resulting in a syngas composed primarily of hydrogen (H2), carbon monoxide (CO), carbon dioxide (CO2), and methane (CH4). Some of the volatile components form tar and oil, which can be removed and reused as a fuel. Most Pyrolysis systems are closed systems and there are no waste gases or air emission sources (if the syngas is combusted to produce electricity, the power system will have air emissions through a stack and air emission control system). After cooling and cleaning in emission control systems, the syngas can be utilized in boilers, gas turbines, or internal combustion engines to generate electricity or used as raw stock in chemical industries. The balance of the organic materials that are non-volatile or liquid that is left as a char material can be further processed or used for its adsorption properties (activated carbon). lnorganic materials form a bottom ash that requires disposal, although some pyrolysis ash can be used for manufacturing brick materials.

c) **Gasification** : In the gasification process, thermal conversion of organic carbon based materials is achieved in the presence of internally produced heat, typically at temperatures of 660oC to 1800oC, and in a limited supply of air/oxygen (less than stoichiometric, or less than what is needed for complete combustion) to produce a syngas composed primarily of H2 and CO. Inorganic materials are converted either to bottom ash (low-temperature gasification) or to a solid, vitreous slag (high temperature gasification that operates above the melting temperature of inorganic components). Some of the oxygen injected into the system is used in reactions that produce heat, so that Pyrolysis (endothermic) gasification reactions can initiate; after which, the exothermic reactions control and cause the gasification process to be selfsustaining. Most gasification systems, like Pyrolysis, are closed systems and do not generate waste gases or air emission sources during the gasification phase. After cooling and cleaning in emission control systems, the syngas can be utilized in boilers, gas turbines, or internal combustion engines to generate electricity, or to make chemicals.

6.4.2 Biological processing technologies

Biological treatment involves using microorganisms to decompose the biodegradable components of waste. Biological processing technologies operate at lower temperatures and

lower reaction rates. Biological processing technologies are focused on the conversion of organics in the MSW. MSW consists of dry matter and moisture. The dry matter further consists of organics (i.e., whose molecules are carbon-based), and minerals, also referred to as the ash fraction. The organics can be further subdivided into biodegradables or refractory organics, such as food waste, and nonbiodegradables, such as plastic. Biological technologies can only convert biodegradables component of the MSW. By-products can vary, which include: electricity, compost and chemicals. Biological process can be aerobic and anaerobic. Biological technologies adopted for treatment of solid waste include:

a) Composting : Composting is a natural micro-biological process, where bacteria break down the organic fractions of the MSW stream under controlled conditions to produce a pathogen-free material called "compost" that can be used for potting soil, soil amendments (for example, to lighten and improve the soil structure of clay soils), and mulch. The microbes, fungi, and macro-organisms that contribute to this biological decomposition are generally aerobic. A mixture of organic materials is placed into one or more piles (windrows), and the natural microbial action will cause the pile to heat up to 60 – 70oC killing most pathogens and weed seeds. A properly designed compost heap will reach 70oC within 6 to10 days, and slowly cool off back to ambient temperatures as the biological decomposition is completed. Systematic turning of the material, which mixes the different components and aerates the mixture, generally accelerates the process of breaking down the organic fraction, and a Proper carbon/nitrogen balance (carbon to nitrogen or C/N ratio of 20:1) in the feedstock ensures complete and rapid composting. The composting process takes from 30 to 90 days.

There are two fundamental types of composting techniques : (1) Open or window composting, which is done out of doors with simple equipment and is a slower process, and (2) enclosed system composting, where the composting is performed in some enclosure (e.g. a tank, a box, a container or vessel.

b) Anaerobic digestion: In anaerobic digestion biodegradable material is converted by a series of decomposition process by different bacterial groups into methane and CO2. A first group breaks down large organic molecules into small units like sugar. This step is referred to as hydrolysis. Another group of bacteria converts the resulting smaller molecules into volatile fatty acids, mainly acetate, but also hydrogen (H2) and CO2. This process is called acidification. The last group of bacteria, the methane producers or methanogens, produce biogas (methane and CO2) from the acetate and hydrogen and CO2. This biogas can

be used to fuel boilers or reciprocating engines with minimal pre-treatment. In addition to biogas, anaerobic bioconversion generates a residue consisting of in-organics, nondegradable organics, and bacterial biomass. If the feedstock entering the process is sufficiently free of objectionable materials like colourful plastic, this residue can have market value as compost. Anaerobic digestion process is also referred to as Biomethanation process.

c) Bioreactor landfill: A bioreactor landfill is a wet landfill designed and operated with the objective of converting and stabilizing biodegradable organic components of the waste within a reasonable time frame, by enhancing the microbiological decomposition processes. The technology significantly increases the extent of waste decomposition conversion rates and Process effectiveness over what would otherwise occur in a conventional wet landfill. Stabilization in this context means that landfill gas and leachate emissions are managed within one generation (twenty to thirty years) and that any failure of the containment system after this time would not result in environmental pollution. There is better energy recovery including increased total gas available for energy use and increased greenhouse gas reduction from reduced emissions and increase in fossil fuel offsets. These factors lead to increased community acceptance of this waste technology- Management of a bioreactor landfill requires a different operating protocol to conventional landfills. Liquid addition and recirculation is the single most important operational variable to enhance the microbiological decomposition processes. Other strategies can also be used, to optimize the stabilization process, including waste shredding pH adjustment] nutrient addition and temperature management.

6.4.3 Physical processing technologies

Physical technologies involve altering the physical characteristics of the MSW feedstock. The MSW is subjected to various physical processes that reduce the quantity of total feedstock, increase its heating value, and provide a feedstock. It may be densified or palletized into homogeneous fuel pellets and transported and combusted asa supplementary fuel in utility boilers. These technologies are briefly described below.

a) Refused Derived Fuel (RDF): The RDF process typically includes thorough preseparation of recyclables, shredding, drying, and densification to make a product that is easily handled. Glass and plastics are removed through manual picking and by commercially available separation devices. This is followed by shredding to reduce the size of the remaining feedstock to about eight inches or less, for further processing and handling.

Magnetic separators are used to remove ferrous metals. Eddy-current separators are used for aluminum and other non-ferrous metals.

The resulting material contains mostly food waste, non-separated paper, some plastics (recyclable and non-recyclable), green waste, wood, and other materials. Drying to less than 12% moisture is typically accomplished through the use of forced-draft air. Additional sieving and classification equipment may be utilized to increase the removal of contaminants. After drying the material often undergoes densification processing such as pelletizing to produce a pellet that can be handled with typical conveying equipment and fed through bunkers and feeders. The RDF can be immediately combusted onsite or transported to another facility for burning, alone or with other fuels. The densification is even more important when RDF is transported off-site to another facility, in order to reduce volume being transported. RDF is often used in waste to energy plants as the primary or supplemental feedstock, or co-fired with coal or other fuels in power plants, in kilns of cement plants, and with other fuels for industrial steam production.

b) Mechanical Separation: Mechanical separation is utilized for removing specific materials or contaminants from the inlet MSW stream as a part of the pre-treatment process. Contaminants may include construction and demolition (C&D) debris, tires, dirt, wet paper, coarse materials, and fine materials. Generally, MSW reaching the dumping sites is unsegregated and mixed containing C&D debris and other contaminants. Therefore, it is essential to remove these contaminants from the incoming MSW by mechanical separation before processing the waste further by either biological, physical and thermal technologies.

c) Size Reduction: Size reduction is often required to allow for more efficient and easier handling of materials, particularly when the feed stream is to be used in further processes. Sizing processes include vibrating screens and trommels. In order to reduce the size of the entire stream, or portions of it, mechanical equipment such as shredders, is utilized. This allows for other physical processes, such as dryers, magnetic and eddy current separators, and densification equipment to work more efficiently. Magnetic and eddy current separators may be installed both up- and down-stream of shredders to increase the recovery of metals.“Since the entire area and MSW Facility is in hilly region, hence Thermal Processing Technology (Gasification, Incineration and Pyrolysis will not be adopted. As such Biological and Physical Processing technology will be adopted at site.

CHAPTER 6: ENVIRONMENT MONITORING PROGRAMME

6.1 INTRODUCTION

Monitoring is an integral part of any environmental assessment process. The magnitude of changes being created due to alteration of landscape, water, air and noise quality and other environmental parameters can be quantified and evaluated only by carrying out monitoring of various parameters during different phases of project construction and operation.

The monitoring and evaluation of environmental parameters indicates potential changes occurring in the environment, which paves way for implementation of rectifying measures wherever required to maintain the status of the natural environment. Evaluation is also a very effective tool to judge the effectiveness or deficiency of the measures adopted and provides insight for future corrections.

In case of projects of such magnitude, the changes relating to water, air, noise, biodiversity of the area and compensatory afforestation programs need special attention, from monitoring point of view, during project construction as well post construction stages to judge the efficacy of measures implemented for conservation of environment.

6.2 ENVIRONMENTAL MENTORING OBJECTIVES AND RATIONALE

The key issues associated with the life cycle of a project are the monitoring of environmental parameters. Three types of environmental monitoring are associated with the project, which includes:

a) Baseline monitoring

b) Effects/ Impacts monitoring and

c) Compliance monitoring

a) Baseline monitoring -

Baseline monitoring deals with the measurement of environmental variables during a pre project period to determine existing conditions ranges of variation and process of change;

b) Effects/impact monitoring –

It involves measurements of environmental variable during construction and operation phase of the project to assess the impact that may have been caused by the project.

c) Compliance monitoring -

It takes the form of periodic sampling and continuous measurements of level of pollutant emissions in the air, waste discharge on land or water, level of noise to ensure that standards are met.

The basic objective of the environment-monitoring program is:

- To ensure implementation of mitigation measures during project implementation;
- To provide feedback to the decision makers about the effectiveness of their actions;
- To determine the project's actual environmental impacts so that modifications can be made to mitigate the impacts;
- To identify the need for enforcement action before irreversible environmental damage occurs;
- To provide scientific information about the response of an ecosystem to a given set of human activities and mitigation measures;

Various physical, biological and social components identified as of particular significance in affecting the environment at critical locations in various stages of the project have been suggested as Performance Indicators (PIs) listed below shall be the focus for monitoring.

- Air quality with respect to PM10, PM2.5 and CO;
- Water quality with respect to DO, BOD and Coliform count;
- Noise levels around sensitive locations; and
- Replantation success / survival rate.

For each of the environmental components, the monitoring plan specifies the parameters to be monitored; location of monitoring sites; frequency and duration of monitoring. The monitoring plan also specifies the applicable standards, implementation and supervising responsibilities.

The overall impact assessment of the proposed project will be carried out and monitoring plans have been framed based on the severity of impacts in different areas. During the EIA study, it has been observed that the air quality and water quality are not going to be affected significantly and only, temporary changes in these parameters are expected. The preventive/ curative measures to reduce the ill effects of construction activities on these parameters have been suggested under various plans. A holistic approach has been adapted for monitoring of air, noise and water related factors under different heads with suitable financial provisions for their implementation. Suggested monitoring Sites are tentative and may be changed as per the site monitoring requirement.

The environmental monitoring plan for the proposed project has been developed in view of the institutional, scientific and fiscal issues pertaining to the project. For developing the monitoring plan, appropriate Value Ecosystem Components (VEC's) which are likely to be affected have been identified. For each component, suitable measurable environmental indicators, which are appropriate to the impact mechanism and scale of disturbance and have a low natural variability, broad applicability and an existing data series have been defined. Locations may be selected based on criteria of vulnerable receptors like residential hamlets in project area.

As per the guidelines of MoEF&CC, environmental monitoring shall be required during construction and operational phases. The schedule for monitoring ambient air quality, ambient noise quality, ground water quality, and wastewater quality both during the construction and operation phases of the project is summarized in Table 6.1 and 6.2.

Table 6.1: Environmental Monitoring Program (Construction Phase)

S. No.	Component	Location	Parameters	Frequency	Annual Cost (in INR)

S. No.	Component	Location	Parameters	Frequency	Annual Cost (in INR)
1	Ambient air quality	AAQ designated stations within the project area.	Ambient air quality parameters as per NAAQS viz. PM10, PM2.5, SOx, NOx, CO	Twice in a week x 8 locations	2,912,000.00
2	Ambient Noise Quality	ANQ designated stations within the project area.	Ambient noise levels (Leqday & Leqnight)	Once in a month x 8 locations	98,000.00
3	Surface water quality	Treated raw water reservoir/ Water Streams	Parameters listed in ISO:10500	3 seasons x 6 locations	99,000.00
4	Ground Water quality	From Bore wells	Drinking Water parameters	3 seasons x 5 locations	99,000.00
5	Soil Quality	From project site		3 seasons x 8 locations	120,000.00
6	Aquatic Ecology	From Surface water body		3 seasons x 6 locations	153,000.00
Total					**3,481,000.00**

Table 6.2: Environmental Monitoring Program (Operation Phase)

S. No.	Component	Location	Parameters	Frequency	Annual Recurring Cost (in INR)
1	Stack emission characteristics	Stacks attached to Emission sources (e.g., Boilers, DG Sets) (for common facilities provided by developer)	Stack monitoring for PM, SOx, NOx and HC	Half-yearly	24,000.00
2	Ambient air quality	AAQ stations within the project area	Ambient air quality parameters as per NAAQS viz. PM10, PM2.5, SOx, NOx, CO	Half yearly	24,000.00
3	Surface Water quality	Treated raw water reservoir/surface Water stream	Parameters listed in ISO:10500	3 seasons X 5 locations	99,000.00
4	Ground Water quality	From Bore well	Drinking water parameters	3 seasons X 5 locations	99,000.00
5	Soil Quality	From project site		3 seasons x 10 locations	120,000.00
6	Aquatic Ecology	From Surface water body		3 seasons x 5	153,000.00

S. No.	Component	Location	Parameters	Frequency	Annual Recurring Cost (in INR)
				locations	
Total					**519,000.00**

The total recurring cost of the environment monitoring plan during the construction phase is approximately INR 34,81,000.00/year and during the operation phase it is estimated as INR 5,19,000.00 /year.

6.3 DATA MANAGEMENT

The monitoring shall be carried out through a NABL/MPCB approved laboratory. All results shall be maintained at the project site and submitted to the MPCB as per the reporting requirements in the Environmental Clearance.

6.4 REPORTING SCHEDULES

The environment management cell shall be responsible for timely conduct of the monitoring activities. The results of the analysis shall be intimated to the project head. Any anomaly in test results shall be investigated into and proper corrective actions shall be undertaken.

A complaint register shall also be maintained to note any complaints from the staff and visitors in the project or any other stakeholder. Corrective actions taken against the complaints shall also be noted.

As per the requirements, the compliance of environmental clearance will be submitted to MoEF&CC in every six months as per the procedure of MoEF&CC. The pollutants will be monitored on monthly basis.

The monitoring activity and schedule mentioned is for the entire project area; which will be carried out by developer/operator. Additionally, individual industries are encouraged to carry out environmental monitoring for their respective units.

6.5 EMERGENCY

Alarming levels of pollutants in any of the monitored components may raise alarm in the project site. However, such information should be made available to the in-house companies through notices. The latter may also be consulted on necessary steps to be taken on an immediate and long-term basis to tide over the problem.

6.6 OCCUPATIONAL HEALTH

Routine medical examination of personnel shall be carried out as a systematic programme at plant. People working at the high potential areas will be rotated at low potential and vice-versa. Health of the workers will be protected by routine medical checkup under the committee headed by the Environmental Health & Safety Committee.

6.7 INTERACTION WITH POLLUTION CONTROL BOARDS

EMD shall be in regular touch with MPCB and send them quarterly progress reports on EMP. Any new regulations considered by the State/ MPCB for the Industry will be complied with.

6.8 HSE POLICY

Mizoram government has well defined ***OCCUPATIONAL SAFETY, HEALTH & WORKING CONDTIONS RULES, 2023,*** same will be applicable to this project as well.

CHAPTER 7: ADDITIONAL STUDIES

7.1 GENERAL

After having gone through the various aspects of the project at the proposed site and the related documents like Form–I and PFR, the MoEF&CC set out the scoping clearance and issued ToR for environmental impact assessment studies and preparation of environmental management plan for the project and for submission of report after public hearing. The Terms of Reference issued by the SEIAA/SEAC are very comprehensive and subjective covering every aspect of project activities and the related environmental issues to be addressed.

7.2 PUBLIC HEARING AS PER EIA NOTIFICATION 2006

As per the procedure laid down in the EIA Notification for conducting Environmental Public Hearing will be conducted.

7.3 RISK ASSESSMENT & EMERGENCY PREPAREDNESS PLAN

The project activities involve certain types of hazards, during construction and operation, which can disrupt normal activities abruptly and lead to disaster like fires, failure of machinery, to name a few. The impending dangers or risks, which need to be investigated are addressed, disaster management plan formulated and loading and unloading management plan with an aim to taking precautionary steps to avert disaster and to take such action after the disaster, which limits the damage to the minimum. Following problems may be encountered during construction at the project site.

- Accidents due to loading/unloading.
- Failure of Machinery.
- Accidents due to transportation.
- Falling of object

In order to take care of above hazards/disasters, the following safety measures will be strictly complied with in the current project:

- Handling of objects and loading/unloading processes shall be carried out by competent persons only.
- Regular maintenance and testing of all project equipment/machinery and transport vehicles as per manufacturers guidelines
- Entry of unauthorized persons will be prohibited.

- Firefighting and first –aid provisions in the project office/complex and project area and ensuring periodic checking of worthiness of firefighting and first aid provision.
- Training and refresher courses for all the employees working in hazardous points. All employees shall have to undergo the training at a regular interval.
- As a part of the disaster management plan, a rescue team will be formed by imparting specialized training to select project staff.

7.4 POSSIBLE HAZARDS AND MITIGATION MEASURES

There are various factors that singularly and severely can cause disaster in a municipal solid waste management center project. The project activity is associated with many hazards, which are discussed in the following subsections:

7.4.1 Heavy Machinery

Most of accidents during transport of dumpers, excavators, dozers and other transport vehicles are often attributed to mechanical failures and human errors and can be significantly averted by adapting to following:

- All transport vehicle movement within the project area should be carried out under the direct supervision and control of the management;
- All project machinery and vehicles should be periodically maintained and weekly checked by a competent person authorized by the management;
- Conspicuous sign board should be provided at each and every bend for guidance of the operators/drivers during day/night time; and
- To avoid dangers while reversing the trackless vehicles, especially at the embankment and tripping points, all areas for reversing of vehicles should, as far as possible, be made man free, and should be a light and sound device to indicate reversing of trucks/project machinery.

7.4.2 Loading and unloading

Loading and unloading experience heavy traffic in the form of trains, trucks, forklifts, overhead cranes, carts, and other motorized vehicles. Some of these vehicles have considerable mass and some are moving at high speed, which means the momentum of an impact can cause serious damage. Add compromised visibility and signaling and it will increase the risk of two primary injuries: impact and pinning. Employees can easily be struck by a moving object or pinned between moving and stationary objects.

7.4.3 Falling Objects

Loading and unloading areas also involve heavy objects that are lifted off the ground by cranes or high metal shelving units. This can generate a risk of objects being dropped. It can also create problems if shelving supports are unstable, if objects are pushed off the backs of the shelves, or if unsecured objects walk off shelves as a result of workplace vibrations.

7.4.4 Fuel Storage

All project machinery will operate on diesel/Petrol for which no storage point is envisaged in the project area. It will be stored in the central workshop area of the proponent.

It is attempted to plan and construct the project facilities following all safety norms. However, it is not always possible to eliminate such eventualities and random failures of equipment or human errors. An essential part of major hazard control has therefore to be concerned with mitigating the effects of such an emergency and restoration of normalcy at the earliest. A detailed table showing activities during construction and operation phase along with mitigation measures are given in Table 7.1 and Table 7.2.

Table 7.1: Activities during Construction and Operation Phase along with Mitigation Measures

HAZARDS ASSOCIATED WITH ACTIVITIES (During Construction & Operation)	CONTROL/MITIGATION MEASURES
Manual Handling - Strains and sprains due to incorrect lifting - too heavy loads -Twisting - bending - repetitive movement - body vibration.	- Exercise/warm up - get help when needed - control loads - rest breaks/no exhaustion - no rapid movement /twisting/ bending / repetitive movement - Good housekeeping.
Falls - Slips - Trips - Falls on same level - falls to surfaces below - poor housekeeping	- Good Housekeeping - tidy workplace - guardrails, handholds, harnesses, hole

- slippery surfaces - uneven surfaces - poor access to work areas climbing on and off plant - unloading materials into excavations wind - falling objects.	cover, hoarding, no slippery floors/trip hazards - clear/ safe access to work areas - egress from work areas - dust/water controlled - PPE.
Fire Flammable liquids/Gases like LPG, Diesel Storage area and combustible building materials poor housekeeping grinding sparks Open flames, absence of Fire hydrant network.	Combustible/flammable materials properly stored/used good housekeeping fire extinguishers made available & Fire hydrant Network with reserve Fire water (As per NFPA Code) Emergency Plan in case of Fire or collapse of structure.
Absence of Personal Protective Equipment - Lack of adequate footwear - head protection - hearing/eye protection - respiratory protection - gloves -goggles.	- Head/face - footwear - hearing/eye - skin - respiratory protection provided - training - maintenance
Defective or wrong Hand Tools - Wrong tool - defective tool - struck by flying debris - caught in or on - missing guards	- Right tool for the job - proper use of tools - good condition/ maintenance guards - isolation/ proper demarcation of work space - eye/face protection - flying debris controlled
Electricity - Electrocution	Leads good condition and earthed

- overhead/underground services - any leads damaged or poorly insulated - temporary repairs -no testing and tagging - circuits overloaded - Nonuse of protective devices.	no temporary repairs no exposed wires good insulation no overloading use of protective devices testing and tagging no overhead/ underground services
Scaffolding Poor foundation lack of ladder access insufficient planking lack of guardrails and toe boards insufficient ties or other means All scaffolds incorrectly braced or stabilized to prevent overturning.	All scaffolds correctly braced and stabilized 3:1 height to base ratio firm foundation, plumb and level ladder access provided and used proper platform (3 planks/675 mm) planks secured guardrails and toe boards 900mm to 1100mm high, within 200mm of working face, mid-rail.
Ladders Carrying loads not secured against dislodgement defective ladders not sufficient length wrong positions Incorrectly placed (angles, in access ways, vehicle movements.	Secured against movement or footed ladders in good condition regularly inspected extend 1m above platform 4:1 angle out of access ways, vehicle movements not carrying loads 3 points of contact no higher than 3rd step down use for access only, not working platforms
Excavations - Trench collapse - material falling in undetected underground services	- Soil stability known - no water accumulation - existing services known

- falls - Hazardous atmosphere struck by traffic and mobile plants.	- material 600mm from edge - clear of suspended loads - hardhats/PPE - ladders - public protection – atmospheric testing - traffic controls - Emergency Plan.
Gas Cutting and Welding Fire welding flash, burns, fumes, electrocution in wet conditions flashback in oxygen set, leaking cylinders, acetylene cylinders lying down Poorly maintained leads.	Welding flash and burns controlled with PPE and shields fumes controlled with ventilation and PPE (in good condition and properly positioned), Gas cylinders be kept upright & secured position (properly tied) Combustible materials to be kept at a secured place to avoid fire & Fire Extinguishers to be kept in fire prone areas with training to people for its use.
Noise - Unknown noise levels - known noise levels over 85 decibels	- Levels below 85 decibels - Proper protection.
Falling Material Fall during carrying/Lifting materials-dislodged tools and materials from overhead work areas.	Materials to be secured kept away from edge toe boards Use of hard hats.
Craneage & Lifts - Display of carrying capacity i.e. load (No. Of person), incorrectly slung, defective lifting equipment, unsecured loads, craning in close proximity to building people and plant	- Periodic testing by competent authority - correctly slung/secured loads, lifting equipment good condition - use of proper hand signals - falls while unloading controlled.

- falls - falling materials.	
Visitors Presence at site Falls struck by dropped materials road accidents insufficient hoarding or fencing pedestrian access past site Mechanical plant movement on and off site.	Sufficient hoarding fencing and barricades safe pedestrian access past site traffic management for loading and delivery Construction separated from occupied areas of projects.

Table 7.2: Threat/ Emergency Risk Management Plan- Operation Phase of Project

Threat / Emergency	Mitigation	Actions During Emergency	Actions After Emergency
Chemical Incident (Spill)	Good housekeeping and safe handling practice. Allocation of spill kits throughout the area. Staff trained in use of spill kits	Immediate deployment of spill kits especially Bunding to ensure that chemical does not get into drains/waterways. Soak-up with spill kit contents. Where actual spill/release has occurred then PPE for those who are involved. Evacuate as required.	Advise the occupants as soon as practicable. Shut the zone as required to allow forensic investigation and for any contamination clean up. Write an incident report for review.
Fire and Smoke	Good housekeeping, responsive and well trained ECO, regularly maintained	As per Fire and Evacuation Plan	Incident Report Contact insurer as required.

Threat / Emergency	Mitigation	Actions During Emergency	Actions After Emergency
	detection and fire-fighting capability.		
Earthquake	Good housekeeping. Earthquake awareness sessions to include what to do when an earthquake strikes (shelter beneath desks or door jams if desks are not available).	Intimate the ECR and DMT. Evacuate persons as required. Need to be clear of buildings and glass in particular. Key will be roll calls so rescue crews know where to concentrate their efforts in the event of building collapse. In the event of the quake ceasing and no visible damage be aware of aftershocks. Re-occupy when safe to do so. Be aware that items, especially those Stored overhead, may well have become dislodged.	Re-open the area when safe to do so. Structural assessments may be necessary. Initiate Normal Life Plan. Involve insurer as required.
Flood	Good housekeeping, ensuring water streams kept clear of debris especially at the pinch points of the railway line and the culvert etc.	Intimate ECR and DMT as required. Move important assets to higher ground. Ensure all vehicles are driven to a safe location. Consider closure of the area as required. Where there is no power the default is to close the area. Consider the role to play in immediate post flood recovery.	

Threat / Emergency	Mitigation	Actions During Emergency	Actions After Emergency
Total Electrical Failure	Have emergency generator capacity available with adequate supply of diesel.	Establish minimal power to run the ECR. Call for electrical emergencies. Increase security guards given that the alarm system back-up batteries are likely to diminish to zero.	Consideration to be given to the battery recharge and/or replacement mentioned both emergency lighting, and the alarm system.

7.5 DISASTER MANAGEMENT PLAN

Disaster is an unexpected event due to sudden failure of the system, external threats, internal disturbances, earthquakes, fire and accidents. Disaster Management Plan (DMP) gives a broad idea of Emergency preparedness in case of an accident. Thus, an appropriate DMP shall be prepared in consultation with the project proponent, service consultant and maintenance staff. DMP envisages the need for providing appropriate action so as to minimize loss of life/property and for restoration of normalcy within the minimum time. Adequate manpower, training and infrastructure shall achieve this. An appropriate fire protection system is also developed to meet any emergency.

The emergencies are classified as construction hazard, natural hazard and Man-made hazard. Disaster risk reduction begins throughout our local communities. For greatest impact, these steps must be grounded in local knowledge and communicated broadly.

Construction Hazard:

During the construction of infrastructure facilities, construction practice and safety requirements should be enforced by the contractor at site. The construction manager can be the coordinator for the emergency management. Depending on the severity of the injury/ disaster outside medical help can be obtained. Before commencement of the work the hospital facilities should be identified and the address and phone numbers to be available to the contractor as well as the construction manager. Proper measures should be taken to ensure safety at heights. Fencing/railing should be provided at construction openings to prevent physical injuries and fall of construction workers.

Natural Hazard:

During natural hazard the emergency plan to be implemented with the help and guidance from the district collector, who is the coordinator for such activity. Disaster Management Team (DMT) will also be responsible for disaster mitigation and disaster recovery. The primary mass disaster potential for the area is fire and water damage. Forest Fire has an immediate response that can be delivered by the industrial occupants or nearby Fire Service Department. In terms of water damage this can occur via storm damage to roofs and/or flooding. In these instances, access to tarpaulins and sand bags are critical. Coordination of these efforts is through the DMT.

Man Made/ Operational Hazard:

During the operation phase project proponent and maintenance staff becomes the coordinator for the emergency activity and the emergency cell will be acting in accordance with the disaster management plan (DMP).

7.5.1 Objectives of Plan

This plan is developed to make best possible use of resources to:

- Rescue the victims and treat them suitably.
- Safeguard others (evacuating them to safer places).
- Contain the incident and control it with minimum damage.
- Identify the persons affected.
- Preserve relevant records and equipment needed as evidence in case on an inquiry.

The following important elements in the disaster management plan (DMP) are suggested to effectively achieve the objectives of emergency planning:

- Reliable and early detection of an emergency and careful planning.
- The command, coordination, and response organization structure along with efficient trained personnel.
- The availability of resources for handling emergencies.
- Appropriate emergency response actions.
- Effective notification and communication facilities.
- Regular review and updating of the DMP
- Proper training of the concerned personnel.

Prevention and Mitigation

Prevention and mitigation against and during a crisis is important. In terms of the ability of people (Industrial occupants) to be proactive this is limited by the actual event. There are some aspects that fall within people (Industrial occupants) control and many that do not. Natural disasters cannot be controlled and there may be short notice in terms of floods, Earthquakes etc. people can however mitigate the impact of such events through:

- Periodic structural reviews of the facilities to ensure integrity in a major event
- Good housekeeping around the site
- Ensuring that trees/bushes are trimmed accordingly
- Removal of cars and other important/expensive assets to higher ground in the event of heavy rains that may lead to flooding
- Storage of flammable liquids in the appropriate location and container
- Maintenance of the facility to a high standard including repair of damaged / deteriorated buildings in an urgent manner
- Maintenance of the roadways and car parks
- Close observation of weather patterns
- A preparedness to evacuate from the area early enough to save people a safe as possible
- Maintaining a means to alert tenants of an impending crisis
- Provision of monitored cameras in the security office which captures recorded footage of the entry to people (Visitors), the entry to the Building and the area around the office
- Having a well-equipped first aid room and trained staff to complement this
- Having a well-drilled plan and people who are familiar with its application.

7.5.2 The Key elements of Emergency Preparedness

Once the likelihood of a disaster is suspected, action has to be initiated to prevent a failure. The project in-charge, responsible for preventive action will identify sources of repair equipment, materials, labour and expertise for use during emergency. The multiple floors of a building create the cumulative effect of requiring great numbers of persons to travel great vertical distances on stairs in order to evacuate the building.

The Building in-charge will notify the occupants for the following information:

- Early Warnings (Through an alarm or Voice communication system)
- Exit routes (Adequate means of egress).
- Safety areas (Assembly points)

- Nearest infrastructure facilities (Medical aid / Fire aid)
- Familiarity with the plan through and Practice (Sign ages / Evacuation plan)

Emergency Communication System

An efficient communication system is absolutely essential for the success of any disaster management plan. Different types of alarms to differentiate types of emergencies should be provided. In case of failure of alarm, placards/boards of various colors should be used to indicate the situations. If everything fails, a messenger should be used for sending the information and the various placards mentioned would also be used. This has to be worked out in consultation with local authorities involving police and fire department, hospital department considering the following points.

- Identify the relevant officials to be involved for the first, second and third level of information
- Preparation of the telephone directory of these officials and making available to all concerned
- Allotment of toll-free number to a central communication center
- Provide wireless communication tools to safety and security and communication officers
- Empowering central communication center with latest communication equipment and tools

Infrastructure

Following infrastructure & systems should be provided to meet emergencies.

- First aid boxes
- Gas masks
- Emergency lighting system
- Stretchers
- Transport facility

Emergency services

This includes a fire-fighting system, first aid center, etc. Alternate sources of power supply for operating fire-pumps, communication with local bodies, fire-brigade etc. should also be clearly identified. Adequate number of external and internal telephone connections should be installed.

7.6 FIRE SAFETY AND EVACUATION PLAN

7.6.1 Fire safety provisions

Fire protection is one of the most essential services to be provided. The principal objective of the rescue and firefighting services is to save lives. For this reason, the provision for means of quick dealing with an accident or incident occurring at, or in the immediate vicinity of, any building, assumes primary importance because it is within this area that there is the greatest opportunity of saving lives. This must assume at all times the possibility of, and need for, extinguishing a fire which may occur either immediately following an accident or incident, or at any time during rescue operations. In the design component of the project, adequate measures are being taken. The firefighting system will comprise the following.

Fire hydrant system

Adequate fire water storage tank capacity to be provided. The center will be provided with adequate nos. of external and internal fire hydrants with fire hose cabinet refer layout - **Fire Hydrant**

Portable fire extinguishers:

Selection, installation and maintenance of first aid extinguishers will be done as per lS: 2190 - 1992 and among different types of portable fire extinguishers generally followed types will be provided.

7.6.2 Fire Risk & Emergency Preparedness Plan

Emergencies can occur at any time usually without warning. When an emergency occurs, the safety and prompt recovery of the project site depends on the preparedness and careful response of our workers, people and visitors.

The information listed below provides basic emergency information to help individuals respond thoughtfully in an emergency event. Each building contact and emergency preparedness coordinator will have regular meetings with people in their building to be certain everyone knows what to do and what to expect, as much as possible. These meetings will be held often enough to keep everyone properly informed. Training sessions will be coordinated through the Environmental Management Cell.

Emergency Response for fire:

A. Basic actions

- Immediate action is the most important factor in emergency control because the first few seconds count.
- Take immediate steps to stop Gas leakage / fire and raise alarm simultaneously.

- Stop all operations
- Electrical systems except the lighting and firefighting system should be isolated. If the feed to the fire cannot be cut off, the fire must be controlled and not extinguished.
- Block all roads in the adjacent area and enlist police support for the purpose, if warranted.

B. Actions in the event of fire

- Basic actions as detailed above.
- Extinguishing fires: A small fire at a point of leakage should be extinguished by enveloping with a water spray or a suitable smothering agent such as CO2 or DCP. Fog nozzles should be used.
- Firefighting personnel working in or close to un-ignited vapour clouds or close to fire must be protected continuously by water sprays. Fire fighters should advance towards the fire downwind if possible.

Earthquake Resistant Construction

Promotion of Earthquake resistant construction mainly includes construction safety, quality control and proper inspection.

Sensitization Programs

A series of awareness programs to be organized to reach out to the local residents Disaster can strike everyone irrespective of land, caste, people and gender.

The objectives of the programs shall be –

- To bring awareness about disasters among the inmates of all industries and people of all communities in the district.
- To pave the way for strict enforcement of building rules in the construction department and contractors.
- Preparation of Building evacuation plans and training the general public to save their lives at the time of Flood, earthquake, fire accidents or any other major disaster.

Severe Weather Warnings

Severe weather events are the most common hazard, Thunderstorms, cyclones and severe weather events are the possible scenarios than any other group of disasters. The warnings are provided when severe weather is expected that is not directly related to severe thunderstorms, tropical cyclones, etc. Examples include land winds, flooding.

Record Keeping and Reporting

Records will be maintained for regulatory, monitoring and operational issues. Log book of Equipment inspection and calibration records, Vehicle maintenance and inspection records, incident records, Maintenance of Corporate Social Responsibilities towards the society even after the completion of construction of the project work and during the operation/maintenance phase.

Table 7.5: Facilities near project site in case of natural disaster

S. No	Particulars
1	CHC, Lunglei; 12km
2	Police Station, Lunglei; 12 km

7.7 RESPONSIBILITY MATRIX

The employer will provide the information, instruction and supervision that can allow employees to protect themselves from various workplace hazards. Far too often, employees are hurt in incidents that could have been prevented if the employee had access to vital training or necessary warnings.

Employers also need to maintain and manage equipment in a safe way. Equipment should always be available, clean, properly fueled, and in good working order. Employees should never be asked to compromise their health, safety, or productivity by working with dangerous or subpar tools.

Workplace security also matters. The environment surrounding employees should be free of static hazards including insecure loads, weak shelving, leaks, faulty wiring, or environmental toxins. As far as possible, environmental hazards like temperature and noise, extremes should also be controlled. If the environment cannot be controlled, employees should be provided with adequate protective gear including warm clothing, ear guards, vision protection, and hard hats.

7.8 RESOURCE CONSERVATION

The project will lead to utilization of various natural resources. As an environmentally responsible corporation, the developers endeavor to conserve these resources by judicious management and recycling and strive to build up these resources where possible.

Water Resources: Water supply demand is estimated based on the proposed land use, built-up area and the population densities proposed in the master plan. The estimated water demand is segregated into potable and non-potable water demand.

It is assumed that the potable water source is reliable and the required treated water will be supplied to the premises of the Industrial Park.

The national water scenario, where availability of fresh water is fast dwindling, judicious use of the same cannot be over emphasized. Following means are proposed to be adopted for conservation of this life sustaining resource:

Reduced use of water: To further minimize the use of available freshwater, various low flow fixtures may be provided such as Low flow flushing systems, sensor based fixtures, tap aerators. Awareness will also be spread amongst the employees on the following lines:

- Timely detection and repair of all leakages;
- Avoiding use of running water while hand-washing;
- Avoiding use of hose for washing floors; Use of broom may be preferred;
- Watering of lawn or garden during the coolest part of the day (early morning or late evening, hours) when temperature and wind speed are lowest. This reduces losses due to evaporation.
- Planting of native and/or drought tolerant grasses, ground covers, shrubs and trees. Once fully grown, they need not be watered frequently.
- Avoiding over watering of lawns. Good rains eliminate the need for watering for more than a week.
- Setting sprinklers to water the lawn or garden only, not the street or sidewalk;
- Avoiding installation or use of ornamental water features unless they recycle the water and avoiding running them during drought or hot weather;
- Installation of high-pressure, low-volume nozzles on spray washers;
- Replacement of high-volume hoses with high-pressure, low-volume cleaning systems;
- Equipping spring loaded shutoff nozzles on hoses;
- Installation of float-controlled valve on the make-up line, closing filling line during operation, provision of surge tanks for each system avoid overflow;

Treatment and Recycling: The wastewater generated from the site will be treated in an on-site Common Effluent Treatment Plant (CETP). This will enable the treated wastewater to be used for landscaping, DG cooling etc., thereby reducing the requirement of freshwater for these purposes. The wastewater generated from the development shall be treated and reused for non-potable purposes. The total non-potable water demand includes 50% of the

processing water, flushing of toilets, horticulture and district cooling shall be met from the recycled wastewater.

Construction materials: As a large Industrial Estate, the project will require various kinds of natural construction materials such as sand, gravel etc. It is proposed for prior estimation of required quantities of these materials and procurement only as per requirement. This will also result in cost-efficiency. Excavated soil from the project site will be used within the site to the extent feasible. Excess soil will be made available to the construction sites, as per need.

Energy: To conserve the energy resources, good practices will be followed during the operation phase such as turning off lights and equipment when not in use, ensuring fuel efficiency of motors and vehicles through proper maintenance and minimal work at night. The principles of energy conservation will also be embedded in the buildings through use of energy efficient fixtures, maximum availability of natural light and use of solar energy for street lighting.

7.9 SOCIAL IMPACTS AND RESETTLEMENT -REHABILITATION

The proposed project lies at the outskirt of the city, so, resettlement and rehabilitation is not needed.

7.10 PROJECT IMPACT AREA

The project does not have any direct impact on the land use as well as living of the local people. There may be a small increase in traffic at Tlabung road which will not cause a major concern as the road connects only a few villages, where there is no regular vehicle movement.

CHAPTER 8: PROJECT BENEFITS

8.1 INTRODUCTION

Municipal Solid waste processing facility project at Lunglei, Tlabung Road, District – Lunglei (Mizoram) by US&PA will be established to treat Municipal Solid Waste from Lunglei and its sorrounding areas.

8.2 BENEFITS OF LANDFILL

Landfills minimize the natural impact of solid waste on the environment by the following ways:-

- Isolation of inert waste through containment
- Elimination of polluting pathways

8.3 RECYCLING

A number of recyclable materials, for example paper, glass, plastic, rubber, ferrous and non-ferrous metals present in the MSW are suitable for recovery and reuse. This will benefit rag pickers.

8.4 IMPROVEMENT IN PHYSICAL INFRASTRUCTURE

The proposed project is expected to yield a positive impact on the socio economic environment. It helps sustain the development of this area including further development of physical infrastructural facilities.

8.5 IMPROVEMENT IN SOCIAL INFRASTRUCTURE

Agriculture & plantation are one of the basic sectors of employment for the local people in this area. The project will lead to indirect and direct employment opportunity. Employment is expected during operation period, garbage lifting and other ancillary Services. Employment in these sectors will be temporary or contractual and involvement of unskilled labour will be more. A major part of this labour force will be mainly from local villagers who are expected to engage themselves both in agriculture and project activities. This will enhance their income and lead to overall economic growth of the area. The proposed integrated municipal solid waste management system would lead to improvement of social infrastructures. Few of the benefits, which could be:

- Reduction, reuse and recycle of the waste.
- Conversion of waste into a useful and marketable product (Manure) as recirculation of soil nutrients.

- Good market for compost sale.
- Public and private participatory mechanism to ensure a long-term sustainability of the project.
- Commercially viable project and long term sustainability.
- Clean, hygienic and better infrastructure of the city and surrounding.
- Improved and mechanized services for the community.
- Increase in employment opportunities in collection and transportation, door to door collection and in processing and disposal facility.
- Regulatory compliant system.
- Reduce financial burden and operational hassles on the municipal corporation.

8.6 SOCIAL BENEFITS

Better living ConditionsNo open dumping will be carried out during the course of this project. This will reduce the chances of air, water & soil contamination and also will reduce odour emission. This will improve the living standards of society & will provide safe & hygienic surroundings. Improved Health Conditions efficient waste collection & disposal of waste will make the living & health condition in the area better. Dumping of waste in open areas harms the aesthetic appearance of a place and emits foul odors. It also provides ground for breeding of mosquitoes & disease-causing pathogens. The proposed integrated solid waste management project will ensure timely collection of waste, efficient treatment & disposal in a scientific & environment-friendly manner. This will reduce the spread of diseases and improve the sanitary conditions of the area. Enhancement of Aesthetic Value of Area Cattles & other stray animals roam around the existing open dumpsite. This creates disturbance to society. Scavenging birds hover above the open dump site which may pose significant threat to aircrafts. Open dumping of waste also creates an unpleasant view and leads to emission of foul odour. The proposed project will use scientific technology and methods for management of waste. This will reduce bird menace. An entry gate & wired fence will be provided around the project site to prevent entry of stray animals & cattle.

A thick green belt will also be developed around the project site. The project will lead to improvement in aesthetic value of the area. Direct & Indirect Employment Opportunities. Development of the project will provide employment opportunities to local skilled, unskilled & semi- skilled people during both construction & operation phases. Also, indirect employment may be generated during the construction phase of the project. With this proposed project direct employment generation of about 25 persons will be awarded there

including worker/supervisor/ managerial category. Indirect generation of employment will also be there in way of contractors, transportation, suppliers. Other service providers with continues chain of employment will also have a chance.

8.7 ECONOMIC BENEFITS

Revenue from Waste Municipal Solid waste facilities are economically sound investments that provide multiple financial and environmental benefits to the communities that utilize them. Waste is material that is being rejected as it has no use for the people. Project comprises of collection of waste, waste processing & safe disposal. From waste following products will be recovered, which can generate revenue

- Recyclable
- Inert waste as filler material.

Improved Economic Status.

The proposed project will generate both direct & indirect employment. Local people will be preferred for giving employment. This will improve the economic status of the area. Migration of local people to other parts of state/country due to unavailability of employment will be reduced.

8.8 ENVIRONMENTAL BENEFITS

Prevention of Air, Water & Soil Contamination

This project involves scientific management of waste which will prevent environmental pollution & spread of disease.

Monitoring Benefits:

Regular monitoring of the surrounding will keep the area environmentally safe and under any adverse circumstance, immediate measures will be taken and enacted upon.

The overall effect will improve buying power of employees and thus a higher standard of living viz. better education, improved health and sanitation facilities housing and acquisition of consumer durable. This is envisaged as a major positive benefit.

An integrated municipal solid waste management system would lead to an effective management of the solid waste of the city along with a commercially viable and sustainable implementation plan for the solid waste. Few of the benefits, which could be:

- Transportation of waste in covered /closed vehicles to the site.
- Source Segregation & collection of waste (Systematic Door to Door collection has been proposed in the project)

- Reduction, reuse and recycle of the waste.
- Conversion of waste into a useful and marketable product (Manure) as recirculation of soil nutrients.
- Only inert/processing rejects to be land filled which is about 20% of total waste quantity shall be disposed off into the landfill. This would save upon the future requirements of area for land filling.
- Reduction of greenhouse gases (carbon foot prints) because of waste processing.
- Organized and a scientific land fill site with 20 years of life in order to prevent water & soil Contamination.
- Regulatory compliant system.

Development of Green Belt

Green belt developed along with lawns & green buffer at site. This will help in attenuating dust & noise level at site as well as increasing the aesthetic nature of the area.

8.9 OTHER PROJECT BENEFITS

Benefit to the Urban Local Body:

Due to implementation of this project, the ULB i.e Lunglei Municipal corporation will comply with the Municipal Solid Waste Management Rules 2020, wherein it has been stated that the ULBs are responsible for scientific collection, transportation, segregation and disposal of municipal solid waste within this limits.

Organized Collection of MSW:

The systematic collection, transportation, segregation and disposal of the municipal wastes will lead to an organized, accountable and reliable mechanism of disposal of waste.

CHAPTER 9: ENVIRONMENT COST AND BENEFIT ANALYSIS

There has been no mention of Environment Cost and benefit Analysis study in the ToR; hence the same is not required.

CHAPTER 10: ENVIROMENTAL AND SOCIAL MANAGEMENT PLAN

10.1 INTRODUCTION

This chapter presents the Environmental and Management Plan (EMP) that will need to be implemented by project proponent to prevent or reduce significant negative impacts to acceptable levels. The entire project components including construction, operational and decommissioning phases were considered when this EMP was developed.

The table details all necessary mitigation measures as well as the person responsible for implementing such measures hence the EMP will be used as checklist in future environmental audits.

Due to the magnitude of the project, compliance with the EMP must be monitored periodically and reports prepared and provided at monthly site meetings during the construction phase and quarterly during the operations and maintenance period as required in EIA notification, 2006. Annual audits will be conducted during the construction, operation and maintenance phases.

10.2 EMP IMPLEMENTATION

For effective implementation of the EMPs, the project must establish an Environment, Health and Safety (EHS) unit that will be responsible for Project Environmental Monitoring and Evaluation to ensure compliance to EIA, Policies and Procedures. The project proponent will be responsible for all costs of implementing the project's EIA license conditions, including the EMPs and the actual costs of public involvement in the EIA process. Hence all costs proposedin the EMPs below will be incurred by the project proponent who may transfer all to the contractor except those of land acquisition and resettlement. The costs for actual activities should be included in the main bill of quantities of the project.

The tables have EMP for the following phases:

- Planning phase
- Construction phase
- Operational Phase
- Decommissioning phase

Table 10.1: Environmental and Social Management Plan for Planning Phase

Anticipated Impacts	Mitigation Measures	Responsibility	Timeline	Cost(KES)
Project design and approval	• The project needs to be approved by all relevant Departments both at the National level, state level and project engineers	Proponent	Before commencement of works	Per statutory fee

Table 10.2 : Environmental and Social Management Plan for Construction Phase

Anticipated Impacts	Mitigation Measures	Responsibility	Timeline	Cost(KES)
Extraction and use of building materials	• The contractor will source materials such as sand, ballast and hard core from registered and approved quarry and sand mining firms • The contractor will only order for what will be required through accurate budgeting and estimation of actual construction requirements. • The proponent will ensure that wastage, damage or loss (through run-off, wind, etc) of materials at the construction site is kept minimal. • The contractor shall consider reuse of materials and use of recycled building materials. • The contractor will use environmentally friendly inputs.	Proponent/ contractor	Throughout construction phase	As per standard

Destruction of vegetation	• Site Clearance and Construction activities will be limited to the area set out for construction. • Some part of the project area should be set aside for green spaces and trees grown during or after construction phase. • Design and implement an appropriate landscape program to help in re-vegetation.	Propone nt/ contracto r	Beginning and end of construction phase	Landscaping and tree planting budget be included in the project cost
Contamination of surrounding water sources	• The machineries are hired and therefore any repair must be done at a garage and not on the site. • The contractor and the operator of the machineries must ensure that the machineries are properly maintained to prevent any spilt. • Refueling of the machineries must not be done on site if a must then care must be taken to ensure that there is no spill. • Any contaminated soil shall be scooped and disposed appropriately	Contractor	Throughout project cycle	350,000.00
Soil erosion	• Excavated earth shall be held on locations of the site not susceptible to storm water runoff awaiting reuse or collection for disposal which need to be done as soon as possible. • Minimize the areas to be cleared and leave as much vegetation as possible to filter runoff water from the site • Avoid stock piling topsoil, sand and other building materials on foot path, roads and drainage channels.	Contractor	Throughout construction phase	200,000.00

	• Fill and compact trenches immediately after services have been laid			
	Solid waste	• Construction wastes (residual earth, debris an collected and sorted into designated points for landfills, composting. • There shall be no disposal of waste on the neig • Use of building materials that have minimal generation of excessive packaging waste • Use of construction materials containing r possible and in accordance with accepted stand • Construction materials requirements are caref that the amount of construction materials left c is kept minimal. • Environmental Management, Health and Safet be conducted for Contractor's Staff to create av wastes management			
	down.			

	Air pollution and dust generation	• Workers shall be trained on management of air and machinery. • Provision of PPEs for workers • All construction machinery shall be mainta accordance with the contractor's specifications			
	• Drivers of construction vehicles and delivery trucks should be cautioned to drive slowly near the site of the earthen road to avoid creating dusty conditions; • Vehicle transporting materials such as sand, ballast and cement to the site and waste from the site must be covered.				

	• Planning of transportation of materials to ensure that vehicle fills are increased in order to reduce the number of trips done or the number of vehicles on the road. • Truck drivers will be sensitized to avoid unnecessary racing of vehicle engines at loading/offloading areas, and to switch off or keep vehicle engines at these points. Prompt maintenance of vehicle. • Use low sulphur diesel and petrol in all machinery and trucks • Drivers of construction vehicles and delivery trucks must be supervised so that they do not leave vehicles idling and limit their speeds so that dust levels are lowered. • All machinery and equipment should be maintained in good working order to ensure minimum emissions including carbon monoxide, oxides of Nitrogen and Sulphur, as well as suspended particulate matter; • The removal of vegetation shall be avoided until such time as clearance is required and exposed surfaces shall be re-vegetated or stabilized as soon as practically possible. • The contractor shall not carry out dust generating activities (excavation, handling and transport of soils) during times of strong winds • Vehicles delivering construction materials and vehicles hauling excavated materials shall be covered to reduce spills and windblown			

	dust • Water sprays shall be used on all earthworks areas.			

Increased Water use	• The contractor shall ensure that water is used efficiently and reused where necessary at the site by sensitizing construction staff to avoid irresponsible water usage.	Contractor and construction workers	Throughout construction phase	Nil
Reduced aesthetic beauty	• Spoiled materials, including solid waste generated during construction works at the site and cleared vegetation should be properly disposed and within appropriate time.	Contractor	Throughout construction phase	100,000.00
Increased energy consumption	• Ensure construction machinery and trucks are well maintained to ensure optimal fossil fuel consumption • Use energy-efficient construction machinery and trucks during construction phase of the project • Ensure compliance with Energy Management Regulations of 2012.	Contractor and workers	Throughout construction phase	Nil
Increased influx of workers	• The contractor and the supervising engineer should ensure that the personnel on site are protected as provided for under the building and construction act which ia available or applicable in the state.	Contractor and supervisors	Throughout project cycle	As per project budget

Noise and excessive vibrations	• Construction works should be carried out only during the specified time of 0800hrs to 1700hrs. • Machinery should be maintained regularly to reduce noise resulting from friction • There should not be unnecessary horning of the involved machinery • Provision of billboards at the construction site notifying of the construction activity and timings • The contractor shall comply with the Environmental Management and Noise Pollution (Regulation & Control) Rules,2000 where he will ensure that only noise permitted level of 75dB (A) is emitted. • Any complaints received by the Contractor regarding noise will be recorded and communicated to the Supervising Engineer for appropriate action.	Contractor & workers	Throughout construction phase	150,000.00

Risk of accidents at Work Site	• All workers should be provided with protective gear. These include working safety boots, overalls, helmets, goggles, earmuffs, respirators/masks and gloves • Construction team at the site will be sensitized on social issues such as drugs, alcohol, diseases • Fencing or construction of perimeter wall on site to restrict access by the local communities during the construction for their safety and health • Contractor to provide a Healthy and Safety Plan prior to the commencement of works to be approved by the Supervising Engineer. • A first aid kit should be provided within the site. • Food handlers preparing food for the workers at the site should be controlled and monitored to ensure that food is hygienically prepared • Regular maintenance of machinery on site • Conducting risk assessments before the work commences to ensure that hazards are identified and eliminated before the work commences. • Before the work begins every day, the contractor/foreman shall instruct	Contractor & workers	Throughout construction phase	400,000.00

	all the workers on safety and health issues at work place so that they can avoid occurrence of any accident to the workers and the neighborhood. • The contractor must be committed to adherence to the occupational health and safety rules and regulations stipulated **Occupational Safety, Health and Working Conditions Code, 20110.**			

Table 10.3: Environmental and Social Management Plan for Operation phase

Anticipated Impacts	Mitigation Measures	Responsibility	Timeline	Cost(KES)
Odor production	• Advanced Techniques of controlling fumes • Avoid burning of solid wastes.	Proponent/contractor	Throughout occupational phase	Project budget

Emission of GreenHouse Gases	• Ensure controlled landfilling with landfill gas recovery and utilization • Avoid open and haphazard waste dumping • To develop programs to sensitize and sustain the waste management concepts among communities through media and established models through: o Practice segregation at source through source separation involving communities; o Reduce waste production through unnecessary packaging, o Adopting practices that reduce waste toxicity o Encourage small-scale	Proponent Community	Continuous	Varied

	wastewater management such as septictanks and recycling of grey water,			
	○ Construction of medium-technology landfills with controlled waste placement and use of daily cover (perhaps including a final bio cover to optimize CH4 oxidation), ○ Controlled composting of organic waste. • Ensure the sections within the			

	dumpsite are fully operational			
Pests and diseases	• Ensuring all solid waste management techniques are adhered to and waste is properly sorted and segregated at specified points • Ensuring workers have protective gear including helmets and face masks while handling any waste that is prone to pests breeding like decomposing organic waste • Proper treatment of waste before/after recycling or repurposing to ensure disease causing variants are not transferred to end users.	Proponent/ project workers	Throughout occupational phase	project budget

Surface run-off and waste watermanagement	• Embankment, re-vegetation, proper drainage systems • Efficient use of water resources • Spill prevention procedures and response plan	Proponent,	Continuous	Varied
Pollution of surfaceand ground water	• All liquid waste from the site should be directed to the septic system • Installation of pre-treatment chambers before discharge to septic system	Proponent,	Through out	Varied
Emissions from site and vehicles	• Use of air pollution control devices through installation of scrubbers/filters to the incinerator to remove particulate matter and other gases • Train the site operators on best operational practices • Periodic operation and maintenance	Proponent,	Continuous	50,000

	of the site • Conduct periodic air quality monitoring of the site area			
Increased energy consumption	• Truck drivers will be sensitized to avoid unnecessary racing of vehicle engines at loading/offloading areas, and to switch off or keep vehicle engines at these points. Prompt maintenance of vehicle. • Establish other sources of energy like solar energy to run incinerators and recycling plants. This would reduce overreliance of electricity andwood/fossil fuels.	Proponent/ Contractor/ workers	Throughout occupational phase	1,000,000.00
Increased crime and insecurity	• Contractor and Supervision Team to liaise regularly with the Local Administration and Police Service	Contractor/ Proponent/ Local administration police	Throughout occupational phase	Project budget

	to address any security and crime arising during project implementation. • Security lights installation around the project site • Security guard(s) be stationed on site to monitor movement of people in and out of the site area.			
Occupational hazards, health andSafety Risks	• All workers should be provided with protective gear. These include working safety boots, overalls, helmets, goggles, earmuffs, respirators/masks and gloves • A first aid kit should be provided within the site. • Food handlers preparing food for the workers at the site should be controlled and monitored to ensure	Proponent,workers	Occupational phase	500,000.00

	that food is hygienically prepared. • Measures shall be put in place to ensure that there is good fresh air circulation in all structures. • Appropriate firefighting equipment and response measure shall be put in place • Noise generating activities will be avoided as much as practicable and as per the noise control regulation • Proper waste management systems will be put in place as earlier discussed • Provide condom dispenser at the washrooms • Water supplied for consumption will be that fit for consumption;			

	• Health and environment committee to be formed to address matters health and environment; • It is also important that good hygiene practices be ensured to reduce exposure of the traders, customers, the public and the neighboring community to unexpected infections. • Regular medical check-up for healthcare waste handlers and vaccination such as against Hepatitis A, B and tetanus etc. • OHS policy strategically displayed • Ensure observance of public and community health and safety • Train site waste operators on operation and maintenance			
Contamination ofwater sources	• Construction of perimeter wall to ensure no waste flows from thedesignated area and onto the river • Establishment of landfills to composting techniques as opposed to highheaps of wastes that can easily be blown by wind and end up in the river channel.	Proponent/ Contractor	Occupational phase	300,000.00

Vegetation cover	• Ensure proper nurturing and maintenance of the vegetation • Plant trees at strategic points within the project site	Proponent	Occupational phase	250,000.00

Surface run-off and waste water management	• Embankment, re-vegetation, proper drainage systems • Efficient use of water resources • Spill prevention procedures and response plan	Proponent,	Continuous	150,000.00
Increased traffic	• Appropriate road signs be put in place to control and guide road use by motorists and the pedestrians. • Put road bumps at intervals where necessary.	Contractor/ proponent	Occupational phase	300,000.00

Table 10.4: Environmental and Social Management Plan for Operation phase

Social Impacts

Increased transmission of HIV/AIDS	• HIV/AIDS Awareness Program to be instituted and implemented as part of the Contractor's Health and Safety Management Plan. This will involve periodic HIV/AIDS Awareness Workshops for Contractor's Staff • Contractor to provide standard quality condoms to personnel on site	Proponent/ Contractor	Throughout construction phase	200,000.00
Insecurity / public safety	• Having guards dedicated to the project sites and fencing off the projectsites	Contractor, Proponent	Continuous	As per project budget
Exclusion (ethnicity, gender, age, location and disability	• Public awareness of the project requirements, • Stakeholder engagement and collective reasoning.	Contractor, Proponent ,Gender Expert	Continuous	Varied

Gender based Violence/Sexual Exploitation and Abuse	• The contractor should develop a code of conduct which should encompass clear warning to workers on any kind of sexual exploitationand abuse. • The contractor should provide a mechanism where workers are free to report any sexual advances and abuse to the senior management withoutfear of intimidation.	Contractor, Proponent ,Gender Expert	Continuous	Varied

Table 10.5: Environmental and Social Management Plan for Decommissioning phase

Anticipated Impacts	Mitigation Measures	Responsibility	Timeline	Cost(KES)
Solid waste generation	• All foundations must be removed and recycled, reused or disposedin accordance to NEMA regulations. • Donate reusable demolition waste to charitable organizations,community, individuals and institutions	Proponent	Decommissioning phase	To be determined during decommissioning phase

Noise Pollution	• Demolition works should be carried out only during the specifiedtime of 0800hrs to 1700hrs. • Workers be provided with ear muffs	Proponent	Decommissioning phase	To be determined during decommissioning phase
Occupational hazard	• All workers should be provided with protective gear. These include working safety boots, overalls, helmets, goggles, earmuffs, respirators/masks and gloves • A first aid kit should be provided within the site.	Proponent	Decommissioning phase	To be determined during decommissioning phase

CHAPTER 11: SUMMARY & CONCLUSION

11.1 INTRODUCTION

The Integrated Municipal Solid Waste Management Facility has become an urgent requirement to be established as a Cluster for Lunglei and its surrounding towns in District Lunglei, Mizoram. As such, it is anticipated that due to growing population there will be generation of more Municipal Solid Waste from household and commercial places of both Lunglei and its surrounding towns. In view of this UD&PA in collaboration with Lunglei Municipal Corporation aims to achieve 100% source collection, segregation, transportation, storage & treatment of the Municipal Solid Waste. The proposed project is categorized under Item "7(i) Common Municipal Solid Waste Management Facility (CMSWMF)" in the EIA Notification, dated September 14, 2006 issued by Ministry of Environment Forest & Climate Change (MoEF & CC), New Delhi and needs prior Environmental Clearance. The proposed project falls under Category 'B', and thus, being appraised by the SEIAA at SEIAA, Mizoram. The draft EIA has been prepared as per the approved ToR and hereby submitted for Public Hearing.

11.2 COLLECTION AND TRANSPORTATION

Collection and transportation (C&T) are the most important component of the SWM operations and requires active involvement of citizens, societies and RWA's. Besides introduction of latest equipment and vehicles for minimum handling of waste, IEC activities and awareness creation has key role in developing model system for C&T considering following:

- Promotion of the practice of source segregation
- Door to door collection with community participation
- Minimize the multiple handling of waste
- Improvement in the productivity of labour and equipment
- An organized and hierarchical system for C&T system
- Containerized secondary storage facilities with designated bins for effective source segregation.
- Daily transportation of waste to the processing facility
- Vehicle tracking & monitoring using GPS/GPRS and latest IT services

• Customer care and timely complaint redressal

Waste collection, transportations and disposal are interrelated functional elements of solid waste management system. It is essential to segregate waste into different fractions, commonly referred to as primary segregation. Segregation of MSW needs to be linked to primary collection of waste from the doorstep and given high priority. The fractions into which the waste has to be segregated in detail should be based on waste characterization. At a minimum level, indicated as the basic segregation, waste should be segregated by waste generators into three fractions: wet (Green container), dry (Blue container), and domestic hazardous waste (Black container). This is referred to as the three-bin system. Apart from these wastes, construction and demolition and Industrial Waste shall be collected and disposed off separately by respective municipal council.

Waste collection service is divided into primary and secondary collection. Primary collection refers to the process of collecting waste from households, markets, institutions, and other commercial establishments and taking the waste to a storage depot or transfer station or directly to the disposal site, depending on the size of the city and the prevalent waste management system.

Secondary collection includes picking up waste from community bins, waste storage depots, or transfer stations and transporting it to waste processing sites or to the final disposal site. Primary collection must be introduced both in small and large towns and cities. Secondary collection systems are necessary in all cities and towns for collection of waste in the community bins or at the secondary waste storage depots or at decentralized sorting centers by sanitation workers for onward transportation of waste to processing and disposal facilities.

Transportation of waste from collection centers to processing or final disposal site is very important step for solid waste management system and for this purpose; suitable vehicles (1 no. of Auto tippers - nearly140 Kg per trip and 4 no. of hydraulic pickup vehicles - nearly 600-900 Kgs per trip) and equipment are required. A well synchronized primary and secondary collection and transportation system is essential to avoid containers' overflow and waste littering on streets. Further, the transport vehicles should not only be able to transport segregated waste, but also be compatible with the equipment design at the waste storage depot to avoid multiple handling of waste.

11.3 Processing

The entire area and MSW Facility is in hilly region, hence Thermal Processing Technology (Gasification, Incineration and Pyrolysis will not be adopted. As such Biological and Physical Processing technology will be adopted at site.

MSW Processing Technologies

Biological processing technologiesz		**Pros**
Composting	Controlled decomposition of organic matter by microorganisms into stable humus. It can be done by either open/window composting or enclosed/in vessel composting	● Relatively cost effective
Vermi-composting	Decomposition of biodegradable waste with the help of selected earthworm species. The site will be prepared and design form vermicompost shed and bed. The compost derived from the waste will be commercialized as a fertilizers.	● Environment friendly ● The compost is rich in nutrients and better than compost from mechanical drum composting.
Bio-methanation	Biodegradable material is broken down by bacteria into methane and CO2 in the absence of oxygen	● Treatment at source ● Gas/Power generation

Physical Processing Technologies		**Pros**
Refuse Derived fuel Technology	MSW may be separated, shredded and/or dried in a processing facility The resulting material is referred to as Refuse Derived Fuel (RDF)	● Higher calorific value from for Power generation

		● Suitable for low input capacity

11.4 BASELINE ENVIRONMENTAL STATUS

The Baseline study has been conducted during April 2022 to October 2022 covering Ambient Air Quality, Water Quality, Soil Quality, Noise Level, Ecological and Socio-Economic parameters as per applicable CPCB guidelines in the study area of 10 Km radius circle from the project site. All the environmental parameters, i.e. Ambient Air, Water, Soil and Noise are found well within the applicable IS/CPCP standard. The details have been presented in the Chapter -3 of the EIA report.

11.5 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Any development activity in its wake will bring about some impacts associated with its origin, which can be broadly classified as reversible, irreversible, long-term and short-term impacts, an endeavour has been made to identify various environmental impacts associated with the construction and operation of facility and other activities wherein, there may be chance of pollution. The anticipated impacts during various phase of the project have been discussed and mitigation measures have been provided in Chapter-4 of the EIA report.

11.6 ENVIRONMENT MANAGEMENT PLAN

The Environmental Management Plan (EMP) is required to ensure a sustainable development of the plant area and the surrounding areas of the plant. The EMP will be integrated in all the major activities of the project, with clearly defined policies, to ensure that the ecological balance of the area is maintained and the adverse effects are minimized. EMP requires multidisciplinary approach with mitigation, management, monitoring and institutional measures to be taken during implementation and operation, to eliminate adverse environmental impacts or reduce them to acceptable levels. In order to ensure sustainable development in the study area; it needs to be an all-encompassing plan for which the plant authorities, government, regulating agencies, and the population of the study area need to extend their cooperation and contribution. The Environmental management cost has to be finalized and needs to be proposed by the competent authority.

Addition to above the project proponent has proposed to invest on Labours safety, proper drinking water facilities at site, Health checkup facilities, awareness & recreation programs etc.

The mitigation measures are planned for construction and operation phases and the overall management plan helps to improve the supportive capacity of the receiving bodies. The EMP aims to control pollution at the source level to the possible extent with the available and affordable technology followed by the standard treatments before getting discharged. The recommended mitigation measures will synchronize the economic development of the study area with the environmental protection of the region.

11.7 ENVIRONMENT MONITORING PROGRAM

Environmental monitoring program describes the processes and activities that need to take place to characterize and monitor the quality of the environment. Environmental monitoring is used in the preparation of environmental impact assessments, as well as in many circumstances in which human activities carry a risk of harmful effects on the natural environment. Different activities involved in the proposed project and their impact on various environmental attributes have been taken into account while designing a detailed environmental monitoring program. Environmental monitoring program has been prepared for the proposed project for assessing the efficiency of implementation of Environment Management Plan and to take corrective measures in case of any degradation in the surrounding environment. A comprehensive monitoring mechanism has been devised for monitoring of impacts due to proposed project.

All monitoring strategies and program have reasons and justifications which are often designed to establish the current status of an environment or to establish trends in environmental parameters. In all cases the results of monitoring will be reviewed, analyzed statistically and submitted to concerned authorities. The design of a monitoring program must therefore have regard to the final use of the data before monitoring starts. The monitoring program will have three phases:

- Construction phase
- Operation phase
- Post Operation phase

11.8 PROJECT BENEFITS

The contribution of the proposed project on local social infrastructure is expected to be significant. This Project will provide a significant amount of direct and indirect employment opportunities to the local people. From the proposed project the major benefits, include improving the degraded environment by establishing an Integrated Solid Waste Management Facilities. From the proposed project the major benefits, include improving the degraded environment by establishing Integrated Municipal Solid.

Waste Processing and Disposal Facility:

- It will be the showcase for other states for management of solid waste with additional benefit of green and clean environment.
- It minimizes the pollution load on environment from municipal solid waste.
- Compliance with prescribed regulatory norms which in turn avert the risk of closure on account of violation of rules.
- It reduces the number of Municipal Solid Waste dump sites in the area and also eliminates the pollution potential.
- The management of wastes is relatively easier & economically viable at common facility.
- Cost of environmental monitoring is less at common facility.
- Prevention of natural resource contamination thereby improving overall environmental status of the region.

CHAPTER 1: DISCLOSURE OF CONSULTANT

12.1 BRIEF PROFILE OF COMPANY

Voyants Solutions Private Limited (VSPL) is one of India's fastest growing, premier infrastructure consultancy services firms with global footprint. Voyants provides end-to-end, integrated infrastructure solutions across all major sectors viz. transportation, roads, bridges, railways, ports, residential townships, commercial complexes, industrial parks, SEZs, urban infrastructure, smart cities, energy, water & sanitation and **waste management**.

Voyants provides concept to commissioning services throughout the project life cycle. It takes on every element of infrastructure project ranging from project initiation and feasibility, planning, environment and sustainability management, privatization and project advisory, detailed design, tendering, project management and construction supervision, commissioning and finally to operation and maintenance.

The creative energies of our multi-disciplinary team of more than **1000 professionals** help transform great ideas into realities. Our technical prowess and global footprint enable us to provide engineering solutions under myriad codes and specifications applicable across the world coupled with state-of-the-art analytical tools and market sensitive strategic thinking. Our multifarious teams have helped multilateral, public and private sector Clients in their endeavour to build infrastructure for tomorrow. Our teams have delivered some of the most innovative, challenging and fast track projects across **200 cities in 28 countries in three continents viz. Asia, Africa and Europe.**

Voyants is an ISO 9001: 2015 certified firm and NABET accredited EIA consultant in thirteen sectors. Voyants is registered with a number of international and national funding agencies and empaneled with more than 100 government agencies globally. Our Clients include Fortune 500 companies, blue-chip corporations, multilateral funding institutions, prestigious government agencies and key lending institutions.

We take pride in listening to our Clients, understand their needs and deliver effective and efficient solutions. We have nurtured many successful partnerships to evolve best suited infrastructure models. Consequently, most of our Clients give us repeat assignments. We

differentiate our services on the basis of continuous Client engagement, timely delivery, cost efficient plans / designs and the quality of our service delivery.

VSPL is constantly striving towards excellence in terms of value addition to the projects being handled and, in this endeavour, we are broadening our horizons in terms of major sectors The Company has Nine Operational Verticals:

- Infrastructure Planning & Design (IPD)
- Architecture & Project Management (APM)
- Environment Management Service (EMS)
- Rail Infrastructure Division (RID)
- Ports & Marine Services (PMS)
- Transportation, Road & Bridges (TRB)
- Energy Division (ED)
- Water & Sanitation Division (WSD)
- Operations & Maintenance Services (OMS)

At Voyants, we carefully plan and manage the environmental outcome of each of our projects. When we think projects, we think of sustainability. We work in partnership with clients to strive for the twin goals of growth and sustainability. The strength of VSPL lies in its Environmental, Social & Sustainability Advisory Services. VSPL has extensive experience and proven track record in the field of Environmental and Social Impact Assessment (ESIA), Environment & Social Due Diligence Audit (ESDD) and Reporting, Occupational Health and Safety (OHS) Management, Environment Social Management Framework (ESMF), Environmental and Social Management Plan (ESMP), Social & Environmental Safeguard Monitoring and Review, Implementation of Environmental Management Plans (EMP),Public Consultations & Stakeholder Engagement Plan (SEP), Resettlement Action Plan (RAP), Resettlement Action Framework (RAF), Rehabilitation & Resettlement (R&R study), Livelihood Restoration Plan (LRP), Social Impact Assessment, Ecology & Biodiversity Study including Biodiversity Management Plan (BMP),Water & Energy Audits, Analysis of Alternatives, Monitoring Supervision and Implementation of ESMP.

We have delivered more than 500 projects; that have successfully cleared all stringent environmental prerequisites. We strongly believe that by shifting the energy burden from non-renewable to renewable resources, we can stand up to the challenges of the future. VSPL

is accredited as "Category "A" Organization under QCI NABET Version 3 for twelve Sectors". Viz.

1. Sector: 1 Mining of Minerals (open cast only)
2. Sector: 3 River Valley Projects
3. Sector: 4 Thermal Power Plants
4. Sector: 7 Mineral Beneficiation
5. Sector: 27 Oil & gas transportation pipeline (crude and refinery/ petrochemical products), passing through national parks/ sanctuaries/coral reefs / ecologically sensitive areas including LNG terminal
6. Sector: 28 Isolated Storage & Handling of Hazardous Chemicals
7. Sector: 31 Industrial estates/ parks/ complexes/Areas, export processing Zones (EPZs), Special economic zones (SEZs), Biotech Parks, Leather Complexes
8. Sector: 33 Ports, harbours, break waters and dredging
9. Sector: 34 Highways
10. Sector: 36 Common Effluent Treatment Plants
11. Sector: 37 Common Municipal Solid Waste Management Facility (CMSWMF)
12. Sector: 38 Building and Construction Projects
13. Sector: 39 Township and Area Development projects

M/s VSPL is a NABET accredited consultant (Certificate No. **NABET/EIA/2124/RA 0223** valid till Dated 14/09/2024) for different categories including Common Municipal Solid Waste Management Facility, Cat B Projects and hence eligible for completing the Environment Assessment. Expert team worked on the present report is given in the earlier part of the report. Certificate of accreditation of the consultant M/S VSPL, is enclosed as **Annexure.**

12.2 TEAM OF PROFESSIONAL

Voyants has team of highly talented and experienced professionals. Our multi-disciplinary team, comprising more than 1000 professionals including approved EIA Coordinators and Functional Area Experts covering all the functional area expertise (LU, AP, AQ, WP, EB,

NV, SE, HG, GEO, SC, RH, and SHW) & many more from premier institutions and hand-picked from the best in the industry. We provide robust intellectual infrastructure for our talent pool with state-of-the-art hardware and software. Our expert's team consists of Environment engineers, Environment specialist, Policy analysts, geologists, chemists, Safety Experts, civil engineers, hydro geologists, Bio-diversity experts, industrial hygienists, technicians, research associates, sociologists and others with expertise in various niche areas. They undergo various training sessions at regular intervals to keep themselves updated with new ideas, techniques and tools.

Table 12- 1: Qualification and Area of Expertise of Professional

Name of Expert	Qualification	Project Role	Experience/Responsibility
Dr Raj Kumar Singh	PhD -Botany	Project Coordinator	Overall responsibility to deliver the project to VSPL standards and client expectations following the applicable guidelines. The Key Tasks assigned to him include but not limited to • Single Point of Contact (POC) to APIIC & the concerned departments and other key statuary Stakeholders including Govt. /Non Govt. Agencies; • Client coordination and Team Management; • As a Technical Team Lead consultation with all the concerned stakeholders and departments; • Review of all available documentation about the project; • Review of the progress of the work and update on the status of the work and action plan;

Name of Expert	Qualification	Project Role	Experience/Responsibility
			• Review of Environmental Impact Assessment report; • Review of identified unanticipated impacts and implement necessary mitigation measures.
Yamesh Sharma	B.Sc. Civil Engineering	FAE HG, SC & NV.	He has more than 46 year comprehensive experience in designing, planning, construction and maintenance of hydraulic structures, besides in following areas: - • Hydrology & Hydro-Geology • Ground Water Estimation • Water optimization & conservation • Noise modelling & Vibration • Soil Conservation & Quality Analysis
Dr. Dhananjay Meshram	Ph. D Geology M. Sc. Geology	FAE Geo and HG	He has more than 30 years of technical working experience, out of which he worked more than 27 years with University of Pune mainly for 1. Geology, Petroleum Geology, 2. River basin Studies. 3. Groundwater exploration in Tamil Nadu State Since 2005 (More than 14 years), he is working as FAE for Geology and Land Use doing the following works • Assessment of baseline geology

Name of Expert	Qualification	Project Role	Experience/Responsibility
			and land use • Impact prediction w.r.t. Geology & Land use of the study area
Ms. Reshma Thakur	M. Tech Environmental Management	EIA coordinator	More than 17 years of comprehensive experience in infra Structure projects in following areas: - • Carrying out impact assessment studies and work related to Industrial Estate, Construction Project, Area Development, and Municipal Solid Waste Management facility • Write and Review EIA – EMP report and compile as EC. • Attend Public Hearing • Finalize the Draft EIA- EMP report • Presentation in SEIAA/SEAC/MOEF&CC • Address the Comments if any Spearhead the project as Sector Expert and complete in stipulated time unless delay by Statutory Authorities
Dr. Rekha Singh	Ph. D Environment science M. Sc. Environment science	Water Pollution Prevention and Monitoring (WP)	Environment is my profession and passion both. I work internationally as freelance Environment, Sustainability and Occupational Health Safety Specialist as my profession. I work with NGOs for environment related

Name of Expert	Qualification	Project Role	Experience/Responsibility
		Solid & Hazardous Waste (SHW) Risk and Hazards (RH)	projects mainly related to solid waste management, plantation and water body restoration, which are sponsored by corporates as part of their CSR activities. She has done M. Sc. and Ph. D in Environmental Sciences, postgraduate diploma in Industrial Safety Management and M.B.A in HRM she has more than 20 years of experience & working exposure with KLG-TNO (India- Netherlands), G4S (UK), Voyants, PwC, Tata Group, AVADA, ReNew Power, Mytrah, GEDCOL "PAZ" Engineering (Israel), SONOL (Israel) IOCL, IRSDC, NHIDCL CMRL, ONGC, MRPL, NFL, KRIBHKO, HSIIDC, KINFRA, Gov. of MP, UP, Uttarakhand & Jharkhand. QCI Accredited Environment Coordinator for sectors- Mining (1), Industrial Estate (31), Municipal Solid Waste Management Facility (37), Large Building Construction (38) and Area Development &Township (39); Functional Area Expert for- Risk &

Name of Expert	Qualification	Project Role	Experience/Responsibility
			Hazard (RH), Solid & Hazardous Waste (SHW) and Water Pollution Monitoring (WP). Consultant for ISO 9001:2008 (QMS), ISO 14001:2015(EMS), ISO 14064 (GHG management) and OHSAS 18001:2007 (Occupational Health Safety Assessment). Published 8 papers on different subjects of environment guided three projects of M.Sc. and one project for M. Phil Life member of "International Journal of Chemistry and Environment", "Environment & Consumer Protection Forum" and “National Academy of Medical Toxicology” Done Environment Impact Assessment Study, Risk Assessment Study and Preparation of Disaster Management Plan of open cast Mining, Building and Large Construction, Township Development, Oil Pipeline, Oil and Gas Storage Facility, Petroleum Refinery, Fertiliser Units, Industrial Estate and Municipal

Name of Expert	Qualification	Project Role	Experience/Responsibility
			Solid Waste Management Facilities in India and Middle East.
Mr. Kamal Singh	MA Public Administration	FAE- SE	Mr. Kamal is a social expert with over 14 years of experience Shall be responsible for carrying out socio economic survey and preparation of R&R plan if applicable.
Ms. Preeti Chand	M.Tech in Energy and Environmental Science	FAE-AP, WP, Team Member- EB and AQ	More than 8 years of working experience in Pollution Control, Waste Water, Hazardous Waste Management. Ms. Preeti Chand has working in Environmental Impact Assessment Study for more than 8 years in various sectors Mining, Oil & Gas Transportation, Highways, Railway development, River Valley, Thermal Power, Industrial Park projects etc.
Ms. Avi	Mtech Environmental Science	FAE – AQ, SW (SW), WP	7 year experience in the Environment Consulting. Worked on following areas: ▪ Preparation of EIA/EMP report for Industrial, mining (Coal & Non Coal) and Infrastructure Airport, Port projects. ▪ Handling and Managing NABET Application, QMS, coordinating with the IH and Empaneled experts.

Name of Expert	Qualification	Project Role	Experience/Responsibility
			▪ Carrying out Air Dispersion Modelling using Aermod 9.6.1 software. Interpretation and assessment of ambient air quality data and meteorological data for cumulative impact assessment. Waste design calculation for STP, ETP and ZLD for industrial projects.
Debasmita Biswal	B. Tech Mechanical Engineering and Specialization in Photogrammetry	FAE- Land Use	She has more than 15 year experience in the following areas: • Land Use & Land Cover • Mapping (Remote Sensing &GIS Software) • Change in Land Use /Land cover • Photogrammetry
Support Staff			
Ms. Ankur Agarwal	M. Sc. Environmental Science	FAE – LU TM- AQ & SHW	He has more than 15 years of experience in the field of Environment. He has worked in following areas: • Preparation of EIA/EMP report for Highway, Airport, Mining (Coal & Non Coal) and Infrastructure projects. • Handling and Managing NABET Application, QMS, coordinating with the IH and Empaneled experts.

Name of Expert	Qualification	Project Role	Experience/Responsibility
			• Preparation of Land Use / Land Cover Map using various satellite imager through GIS and remote Sensing Software • Interpretation and assessment of land use data.
Mr. Manish Markand Indurkar	M. Sc. Botany	FAE – Ecology & Biodiversity (EB)	Approx. 17 years' experience in the following areas: • Handling Biodiversity Assessment and conducting primary survey for Flora & Fauna, Habitat (Critical Habitat) • Data collection from Forest Department • Preparation of EIA/EMP reports, Wildlife Conservation Plan and Maritime Masterplans. • Online submission of Environment Clearance (EC) & Forest Clearance (FC) to the Ministry of Environment & Forest (MOEF&CC) PARIVESH portal. • Dealing with Infrastructure projects like Indian Railways, MRTS (Metro Rail), Highways, Airports, Oil and Gas Pipeline, Oil and Gas exploration and Iron ore mine Projects. • Dealing with AIIB, JICA, AFD,

Name of Expert	Qualification	Project Role	Experience/Responsibility
			EIB, KFW, World Bank/ ADB funded MRTS, Road Transportation & Highway Projects.

Laboratory

Green Tech Enivronmental Engineer & Consultants was engaged by the consultant for carrying out the environmental monitoring for the various parameters of Meteorology, Ambient Air Quality, Ambient Noise Quality, Water Quality and Soil Quality.

12.3 ECO-MANAGEMENT SERVICES (ECOMS)

Eco-Management Services is an ISO-14001:2015 and ISO/IEC 17020:2012 certified, young promising partnership firm dealing in different fields of environmental monitoring and Impact assessment including hydrological surveys inside the state of Mizoram. We have several experiences in the field of environmental components such as Air, Water, Soil and Noise quality Monitoring also on floral diversity assessment. We have client from different Government departments as well as some consultancy firms inside Mizoram.

We have conduct environmental monitoring in the field of highway, hospital, solid waste management center, buildings and pipelines. We establish our own laboratory which we aim to be NABL certified in the near future.

Our expertise area

Environmental Impact Assessment studies for the following areas

- Land Use (LU)
- Air Pollution Monitoring, Prevention and Control
- Meteorology
- Water Pollution Monitoring, Prevention and Control

- Ecology and Biodiversity
- Socio-Economic Aspects
- Hydrology, Groundwater & Conservation
- Geology
- Soil Conservation
- Risk & Hazards Management
- Solid & Hazards Waste Management (including Municipal Solid waste)

In addition to this, we offer consultancy services for Environmental Management Plan (EMP), Compliance Reports, Disaster Management Plan (DMP), Risk Assessment (RA) studies, Environmental Audit Report (EA), Feasibility Studies and treatability Studies for establishing treatment of wastes, Bathymetric River survey. We also have experts in the area of microbiology and physico-chemical analysis of food products.

Table 12.2: Project Team B

Sl.No	Name	Work Assigned	Team
1	Dr. Lalmuansangi	Coordinator	Coordinator
2	Zohmangaiha	Biodiversity Expert	Team Leader
3	Lalmuansangi	Water Expert	Expert
4	Benjamin Lalbiakmawia	Microbiology Expert	
5	Dany Zonuntluanga	Noise Expert	
6	V.L Thachunglura	Air Expert	
7	Lallawmkima	Soil Expert	
8	Malsawmsanga	Technical Expert	Technical
9	Laltanpuia	Technical Expert	
10	Lalruatthara	Zoologist	
11	Isaac Zosangliana	Geographical Expert	
12	Malsawmtluangkima	Geological Expert	
13	Zorinpuia		Support
14	Lalhumhima		

15	Lawmsangzuala		
16	Lalhriatpuia		

12.4 RESPONSIBILITY MATRIX:

i.Voyants Solution Pvt Ltd will be the lead group of this Consortium and will be taking all responsibility for the entire project allocated to them by Govt. Department of Mizoram with the help of the Eco-Management Services.

ii.All Liasoning works with Govt. Department and local people pertaining to this work will be carried out by Eco-Management Services including furnishing of all projects related data primary- secondary/drawings/information's etc with the help of Voyants Solution Pvt Ltd .

iii.All works involving environment aspects will be carried out by both parties connection to this project.

iv.All permissions and clearance from Govt. authorities or any other local bodies shall be obtained by Eco-Management Services whenever necessary to carry out the field works smoothly by Voyants Solution Pvt Ltd.

v.Any obstruction/protection, in case need arises, from public or other organization during the survey work, it should be resolved by Eco-Management Services and Voyants Solution Pvt Ltd. wouldn't be liable for any delays in project deliverable due to such reasons/causes.

vi.The project will be executed as per the Scope of Work agreed upon by the both parties. All maps/drawings/documents related to the alignments under study shall be arranged by both parties.

vii.Necessary permissions for execution of work has to be taken by the Eco-Management Services. Delay and its implication in such a situation would be the responsibility of Eco-Management Services.

12.5 IMPORTANTS NOTES:

1. All the samples (Soil, Water, Air and Noise) were collected by Eco-Management Services under the guidance of expert from Voyants Solutions Pvt. Ltd.

2. All the equipment used for testing and collection were calibrated by NABL Calibrating Laboratories.

3. Water samples were preserved and tested in Green Tech Environmental Engineer & Consultants (NABL Laboratory).

4. Due to unavailability of Laboratories nearby for Soil and Air, testing were done in BioNest Incubation Centre, Mizoram University with NABL Calibrated Instruments.

QUALITY COUNCIL® OF INDIA
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National Accreditation Board for Education and Training

NABET

Certificate of Accreditation

Voyants Solutions Pvt. Ltd

403, 4th Floor, Park Centra, Sec-30, NH-8, Gurugram -122001

*The organization is accredited as **Category-A** under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –*

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals including opencast / underground mining	1	1 (a) (i)	A
2	River Valley projects	3	1 (c)	A
3	Thermal power plants	4	1 (d)	B
4	Mineral beneficiation	7	2 (b)	B
5	Isolated storage & handling of Hazardous chemicals (As per threshold planning quantity indicated in column 3 of schedule 2 & 3 of MSIHC Rules 1989 amended 2000)	28	-	B
6	Industrial estates/ parks/ complexes/areas, export processing Zones (EPZs), Special Economic Zones(SEZs), Biotech Parks, Leather Complexes	31	7 (c)	A
7	Ports, harbours, break waters and dredging	33	7 (e)	A
8	Highways	34	7 (f)	A
9	Common Effluent Treatment Plants (CETPs)	36	7 (h)	B
10	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (i)	B
11	Building and construction projects	38	8 (a)	B
12	Townships and Area development projects	39	8(b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated Nov 26, 2021 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/21/2195 dated Dec 30, 2021. The accreditation needs to be renewed before the expiry date by Voyants Solutions Pvt. Ltd, Gurugram following due process of assessment.

Sr. Director, NABET
Dated: Dec 30, 2021

Certificate No.
NABET/EIA/2124/RA 0223

Valid up to
Sept 14, 2024

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

গ্রীনটেক্ এনভাইৰনমেন্টল ইঞ্জিনিয়াৰ এণ্ড কন্সালটেন্টছ্
GREEN TECH ENVIRONMENTAL ENGINEER & CONSULTANTS
House No-11, Champaknagar, Narayan Path, Bhetapara, Guwahati-781028, www.greentecheec.in
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TC-5991

Format No.: GEEC/FM/50

TEST REPORT

ULR Number: TC599124000000308F			
Ref. No.:	GEEC/FL/23/2024/04/05	Date of Reporting:	02/05/2024
Customer Name:	M/S ECO - MANAGEMENT SERVICES	Lab. ID No.:	GEEC/WS/2024/04/05
Customer Address:	M/S ECO - MANAGEMENT SERVICES (ECOMS MIZORAM) Zemabawk North Aizawl 796017	Date of Sampling:	____
Sampling Location:	Lunglei 1	Sample Receipt Date:	17/04/2024
Sample Description:	Ground Water	Test Start Date:	17/04/2024
Sample Drawn By:	Client	Test Completion Date:	30/04/2024
Sample Condition:	Sealed	Sampling Method:	----

SL. NO.	DESCRIPTION	METHOD	UNIT	RESULTS	IS-10500:2012	
					Requirement (Acceptable Limit)	Permissible Limit in the absence of alternate source
1	Alkalinity	IS 3025 Part 23 - 1986 (RA:2019)	mg/l	190	200	600
2	Arsenic	IS 3025 Part 37 - 1988 (RA:2019)	mg/l	<0.01	0.01	0.05
3	BOD	IS 3025 Part 44 1993(RA:2019)	mg/l	< 2	–	–
4	Calcium	IS 3025 Part 40 - 1991 (RA:2019)	mg/l	44	75	200
5	Chloride	IS 3025 Part 32 1988 (RA:2019)	mg/l	6.9	250	1000
6	Colour	IS 3025 Part 4 - 2021	Hazen	Colourless	5	15
7	COD	IS 3025 Part 58 2006(RA:2017)	mg/l	<5	–	–
8	Conductivity	IS 3025 Part 14 1984 (RA:2019)	ms	0.47	–	–
9	Copper	IS 3025 Part 42 - 1992 (RA:2019)	mg/l	<0.05	0.05	1.5
10	DO	IS 3025 Part 38 1989(RA 2019)	mg/l	4.8	–	–
11	Fluoride	IS 3025 Part 60 - 2008 (RA:2019)	mg/l	<0.5	1	1.5
12	Hardness	IS 3025 Part 21 - 2009 (RA:2019)	mg/l	187	200	600
13	Iron	IS 3025 Part 53 - 2003 (RA:2019)	mg/l	0.26	0.30	No relaxation
14	Lead	IS 3025 Part 47 - 1994 (RA:2019)	mg/l	<0.01	0.01	No relaxation
15	pH	IS 3025 Part 11 - 2022	–	7.14	6.5 - 8.5	No relaxation
16	Total Dissolved Solids	IS 3025 Part 16 - 1984 (RA:2017)	mg/l	270	500	2000
17	Sulphates	IS 3025 Part 24 - 1986 (RA:2019)	mg/l	20	200	400
18	Suspended Solids	IS 3025 Part 17 - 1984 (RA:2017)	mg/l	<10	–	–
19	Turbidity	IS 3025 Part 10 - 1984 (RA:2017)	NTU	<1	1	5
20	Zinc	IS 3025 Part 49 - 1994 (RA:2019)	mg/l	<0.5	5	15

Checked by:
Dr. Belinda Lahon
Quality Manager

Authorised by:
Mr. Pranjal Buragohain
Authorised Signatory

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Format No.: GEEC/FM/50

TEST REPORT

Ref. No.:	GEEC/FL/23/2024/04/05	Date of Reporting:	02/05/2024
Customer Name:	M/S ECO - MANAGEMENT SERVICES	Lab. ID No.:	GEEC/WS/2024/04/05
Customer Address:	M/S ECO - MANAGEMENT SERVICES (ECOMS MIZORAM) Zemabawk North Aizawl 796017	Date of Sampling:	____
Sampling Location:	Lunglei 1	Sample Receipt Date:	17/04/2024
Sample Description:	Ground Water	Test Start Date:	17/04/2024
Sample Drawn By:	Client	Test Completion Date:	30/04/2024
Sample Condition:	Sealed	Sampling Method:	----

SL. NO.	DESCRIPTION	METHOD	UNIT	RESULTS	IS-10500:2012	
					Requirement (Acceptable Limit)	Permissible Limit in the absence of alternate source
1	Cadmium	IS 3025 Part 41 - 1992 (RA:2019)	mg/l	<0.003	0.003	No relaxation
2	Magnesium	IS 3025 Part 46 - 1994 (RA:2019)	mg/l	4	30	100
3	Nickel	IS 3025 Part 54 - 2003 (RA:2019)	mg/l	<0.02	0.02	No relaxation
4	Odour	IS 3025 Part 5 - 1983 (RA:2017)	_	Agreeable	Agreeable	Agreeable
5	Phenolic compound	IS 3025 Part 43 - 1992 (RA:2019)	mg/l	<0.001	0.001	0.002
6	Salinity	IS 3025 Part 45 - 1993 (RA:2019)	mg/l	9	--	--
7	E. Coli	HiMedia Kit	MPN/ 100ml	Absent	Absent	Absent
8	Total coliform	APHA 23rd Edition 2017	MPN/ 100ml	Absent	Absent	Absent
9	Pesticide	APHA 23rd Edition 2017	µg/l	Not Detected	--	--

Checked by:

Dr. Belinda Lahon
Quality Manager

Authorised by:

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TC-5991

Format No.: GEEC/FM/50

TEST REPORT

ULR Number: TC599124000000309F			
Ref. No.:	GEEC/FL/23/2024/04/06	Date of Reporting:	02/05/2024
Customer Name:	M/S ECO - MANAGEMENT SERVICES	Lab. ID No.:	GEEC/WS/2024/04/06
Customer Address:	M/S ECO - MANAGEMENT SERVICES (ECOMS MIZORAM) Zemabawk North Aizawl 796017	Date of Sampling:	____
Sampling Location:	Lunglei 2	Sample Receipt Date:	17/04/2024
Sample Description:	Surface Water	Test Start Date:	17/04/2024
Sample Drawn By:	Client	Test Completion Date:	30/04/2024
Sample Condition:	Sealed	Sampling Method:	----

SL. NO.	DESCRIPTION	METHOD	UNIT	RESULTS	IS-10500:2012	
					Requirement (Acceptable Limit)	Permissible Limit in the absence of alternate source
1	Alkalinity	IS 3025 Part 23 - 1986 (RA:2019)	mg/l	115	200	600
2	Arsenic	IS 3025 Part 37 - 1988 (RA:2019)	mg/l	<0.01	0.01	0.05
3	BOD	IS 3025 Part 44 - 1993(RA:2019)	mg/l	2.6	–	–
4	Calcium	IS 3025 Part 40 - 1991 (RA:2019)	mg/l	47	75	200
5	Chloride	IS 3025 Part 32 - 1988 (RA:2019)	mg/l	71.5	250	1000
6	Colour	IS 3025 Part 4 - 2021	Hazen	Colourless	5	15
7	COD	IS 3025 Part 58 - 2006(RA:2017)	mg/l	<5	–	–
8	Conductivity	IS 3025 Part 14 - 1984 (RA:2019)	ms	0.48	–	–
9	Copper	IS 3025 Part 42 - 1992 (RA:2019)	mg/l	<0.05	0.05	1.5
10	DO	IS 3025 Part 38 - 1989(RA 2019)	mg/l	5.1	–	–
11	Fluoride	IS 3025 Part 60 - 2008 (RA:2019)	mg/l	<0.5	1	1.5
12	Hardness	IS 3025 Part 21 - 2009 (RA:2019)	mg/l	108.8	200	600
13	Iron	IS 3025 Part 53 - 2003 (RA:2019)	mg/l	0.06	0.30	No relaxation
14	Lead	IS 3025 Part 47 - 1994 (RA:2019)	mg/l	<0.01	0.01	No relaxation
15	pH	IS 3025 Part 11 - 2022	–	6.62	6.5 - 8.5	No relaxation
16	Total Dissolved Solids	IS 3025 Part 16 - 1984 (RA:2017)	mg/l	275	500	2000
17	Sulphates	IS 3025 Part 24 - 1986 (RA:2019)	mg/l	28	200	400
18	Suspended Solids	IS 3025 Part 17 - 1984 (RA:2017)	mg/l	<10	–	–
19	Turbidity	IS 3025 Part 10 - 1984 (RA:2017)	NTU	<1	1	5
20	Zinc	IS 3025 Part 49 - 1994 (RA:2019)	mg/l	<0.5	5	15

Checked by:
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Authorised by:
Mr. Pranjal Buragohain
Authorised Signatory

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Format No.: GEEC/FM/50

TEST REPORT

Ref. No.:	GEEC/FL/23/2024/04/06	Date of Reporting:	02/05/2024
Customer Name:	M/S ECO - MANAGEMENT SERVICES	Lab. ID No.:	GEEC/WS/2024/04/06
Customer Address:	M/S ECO - MANAGEMENT SERVICES (ECOMS MIZORAM) Zemabawk North Aizawl 796017	Date of Sampling:	____
Sampling Location:	Lunglei 2	Sample Receipt Date:	17/04/2024
Sample Description:	Surface Water	Test Start Date:	17/04/2024
Sample Drawn By:	Client	Test Completion Date:	30/04/2024
Sample Condition:	Sealed	Sampling Method:	----

SL. NO.	DESCRIPTION	METHOD	UNIT	RESULTS	IS-10500:2012	
					Requirement (Acceptable Limit)	Permissible Limit in the absence of alternate source
1	Cadmium	IS 3025 Part 41 - 1992 (RA:2019)	mg/l	<0.003	0.003	No relaxation
2	Magnesium	IS 3025 Part 46 - 1994 (RA:2019)	mg/l	10	30	100
3	Nickel	IS 3025 Part 54 - 2003 (RA:2019)	mg/l	<0.02	0.02	No relaxation
4	Odour	IS 3025 Part 5 - 1983 (RA:2017)	_	Agreeable	Agreeable	Agreeable
5	Phenolic compound	IS 3025 Part 43 - 1992 (RA:2019)	mg/l	<0.001	0.001	0.002
6	Salinity	IS 3025 Part 45 - 1993 (RA:2019)	mg/l	117	--	--
7	E. Coli	HiMedia Kit	MPN/ 100ml	Absent	Absent	Absent
8	Total coliform	APHA 23rd Edition 2017	MPN/ 100ml	Absent	Absent	Absent
9	Pesticide	APHA 23rd Edition 2017	µg/l	Not Detected	--	--

Checked by:
Blahon
Dr. Belinda Lahon
Quality Manager

Authorised by:
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Authorised Signatory

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TC-5991

Format No.: GEEC/FM/50

TEST REPORT

ULR Number: TC599124000000310F			
Ref. No.:	GEEC/FL/23/2024/04/07	Date of Reporting:	02/05/2024
Customer Name:	M/S ECO - MANAGEMENT SERVICES	Lab. ID No.:	GEEC/WS/2024/04/07
Customer Address:	M/S ECO - MANAGEMENT SERVICES (ECOMS MIZORAM) Zemabawk North Aizawl 796017	Date of Sampling:	____
Sampling Location:	Lunglei 3	Sample Receipt Date:	17/04/2024
Sample Description:	Surface Water	Test Start Date:	17/04/2024
Sample Drawn By:	Client	Test Completion Date:	30/04/2024
Sample Condition:	Sealed	Sampling Method:	----

SL. NO.	DESCRIPTION	METHOD	UNIT	RESULTS	IS-10500:2012	
					Requirement (Acceptable Limit)	Permissible Limit in the absence of alternate source
1	Alkalinity	IS 3025 Part 23 - 1986 (RA:2019)	mg/l	115	200	600
2	Arsenic	IS 3025 Part 37 - 1988 (RA:2019)	mg/l	<0.01	0.01	0.05
3	BOD	IS 3025 Part 44 - 1993(RA:2019)	mg/l	2.4	–	–
4	Calcium	IS 3025 Part 40 - 1991 (RA:2019)	mg/l	33.6	75	200
5	Chloride	IS 3025 Part 32 - 1988 (RA:2019)	mg/l	62.5	250	1000
6	Colour	IS 3025 Part 4 - 2021	Hazen	Colourless	5	15
7	COD	IS 3025 Part 58 - 2006(RA:2017)	mg/l	<5	–	–
8	Conductivity	IS 3025 Part 14 - 1984 (RA:2019)	ms	0.47	–	–
9	Copper	IS 3025 Part 42 - 1992 (RA:2019)	mg/l	<0.05	0.05	1.5
10	DO	IS 3025 Part 38 - 1989(RA 2019)	mg/l	5	–	–
11	Fluoride	IS 3025 Part 60 - 2008 (RA:2019)	mg/l	<0.5	1	1.5
12	Hardness	IS 3025 Part 21 - 2009 (RA:2019)	mg/l	97.6	200	600
13	Iron	IS 3025 Part 53 - 2003 (RA:2019)	mg/l	0.15	0.30	No relaxation
14	Lead	IS 3025 Part 47 - 1994 (RA:2019)	mg/l	<0.01	0.01	No relaxation
15	pH	IS 3025 Part 11 - 2022	–	6.53	6.5 - 8.5	No relaxation
16	Total Dissolved Solids	IS 3025 Part 16 - 1984 (RA:2017)	mg/l	273	500	2000
17	Sulphates	IS 3025 Part 24 - 1986 (RA:2019)	mg/l	26	200	400
18	Suspended Solids	IS 3025 Part 17 - 1984 (RA:2017)	mg/l	<10	–	–
19	Turbidity	IS 3025 Part 10 - 1984 (RA:2017)	NTU	<1	1	5
20	Zinc	IS 3025 Part 49 - 1994 (RA:2019)	mg/l	<0.5	5	15

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TEST REPORT

Ref. No.:	GEEC/FL/23/2024/04/07	Date of Reporting:	02/05/2024
Customer Name:	M/S ECO - MANAGEMENT SERVICES	Lab. ID No.:	GEEC/WS/2024/04/07
Customer Address:	M/S ECO - MANAGEMENT SERVICES (ECOMS MIZORAM) Zemabawk North Aizawl 796017	Date of Sampling:	____
Sampling Location:	Lunglei 3	Sample Receipt Date:	17/04/2024
Sample Description:	Surface Water	Test Start Date:	17/04/2024
Sample Drawn By:	Client	Test Completion Date:	30/04/2024
Sample Condition:	Sealed	Sampling Method:	----

SL. NO.	DESCRIPTION	METHOD	UNIT	RESULTS	IS-10500:2012	
					Requirement (Acceptable Limit)	Permissible Limit in the absence of alternate source
1	Cadmium	IS 3025 Part 41 - 1992 (RA:2019)	mg/l	<0.003	0.003	No relaxation
2	Magnesium	IS 3025 Part 46 - 1994 (RA:2019)	mg/l	8	30	100
3	Nickel	IS 3025 Part 54 - 2003 (RA:2019)	mg/l	<0.02	0.02	No relaxation
4	Odour	IS 3025 Part 5 - 1983 (RA:2017)	_	Agreeable	Agreeable	Agreeable
5	Phenolic compound	IS 3025 Part 43 - 1992 (RA:2019)	mg/l	<0.001	0.001	0.002
6	Salinity	IS 3025 Part 45 - 1993 (RA:2019)	mg/l	103	--	--
7	E. Coli	HiMedia Kit	MPN/ 100ml	Absent	Absent	Absent
8	Total coliform	APHA 23rd Edition 2017	MPN/ 100ml	Absent	Absent	Absent
9	Pesticide	APHA 23rd Edition 2017	µg/l	Not Detected	--	--

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ANNEXURE 1

1.1. Recommendations of Hon'ble Supreme Court of India for Solid Waste Management Practices for Class I Cities

1. Waste shall be stored at source of generation in two bins/bags, one for food/bio-degradable wastes and another for recyclable waste. Domestic hazardous waste, as and then produced, shall be kept separately from the above two streams.
2. Both the streams of waste, organic/biodegradable waste as well as recyclable waste, shall be collected from the doorstep.
3. Work norms ranging from 250 to 750 running meters of road have been recommended, depending on the density of the area and local conditions.
4. Provisions of litter bins at railway stations, market places, parks, gardens, and important commercial streets may be made, to prevent littering of streets.
5. Transportation of waste shall be done on a regular basis before the temporary waste-storage containers start over-flowing. Transfer stations may be set up in cities where the distance to waste-disposal sites is more than 10 kilometers (km).

1.2. Municipal Solid Waste Management Rules published by the Ministry of Environment and Forests (MoEF)

In accordance with Sections 3, 6, and 25 of the Environment (Protection) Act, 1986, the MEOF published the MSW (Management and Handling) Rules in 2000. As per these rules, 'Every municipal authority shall, within the territorial area of the municipality, be responsible for the implementation of the provisions of these rules, and for any infrastructure development for collection, storage segregation, transportation, processing and disposal of municipal solid wastes'. In addition, 'the CPCB shall coordinate with the State Pollution Control Boards (SPCB) and the Pollution Control Committees in the matters of MSW disposal and its management and handling'. A summary of the SWM rules is provided below:

1. The set up of composting facilities for Class I cities (with population ranging between one to 10 lakhs) shall be implemented by December 31, 2001. Monitoring of disposal facilities for Class I cities shall be performed once in six months on yearly basis. The existing landfill sites shall be improved by December 31, 2000 and the identification of future landfill sites shall be completed by December 31, 2001.
2. The MSW generated shall be collected from house to house using containerized collection, community bin collection, collection of regular pre-informed timings and scheduling by using bell ringing/musical vehicle. Collected waste from residential and other areas shall be transferred to community bin by hand-driven containerized carts and shall not be handled manually.

3. The MSW shall be stored special 'bins' designed for easy handling, transfer, and transportation of waste. In addition, these bins shall be categorized based on the type of waste collected. The bio-degradable waste shall be stored in green colored bins, the recyclable wastes shall be stored in white colored bins, and other wastes shall be stored in black colored bins. These storage facilities shall be cleared daily by the Municipal authorities.
4. The MSW shall be transported to the disposal or processing site in covered vehicles. The biodegradable wastes shall be processed using composting, vermicomposting, anaerobic digestion, or any other appropriate biological processing for stabilization of waste. Any recoverable waste such as paper and glass shall be sent to a recycling unit. Inert and non-biodegradable wastes and other wastes unsuitable for recycling or biological processing shall be disposed off at a landfill site.
5. The landfill site shall be designed to last for at least 20-25 years and shall be located away from habitation clusters, forest areas, water bodies monuments, National Parks, Wetlands, and places of important cultural, historical or religious interests and at least 20 kilometers (km) from the airport, including the airbase. In addition, a buffer-zone shall be maintained around the landfill site and shall be incorporated in the Town Planning Department's land-use plans.
6. The storm water drains shall be diverted away from the landfill site to minimize leachate generation, prevent pollution of surface water, and to avoid flooding and creation of marshy conditions. The landfill site shall be well compacted using landfill compactors to provide high density waste and lined immediately with at least 10 centimeters (cm) of soil. During rainy reasons, a soil lining of 40-50 cm thickness shall be provided. The final soil cover shall be of 60 cms of clay, topped by an additional drainage layer of 15 cms, and a vegetative layer of 45 cms.
7. In order to ensure that the ground water within 50 meters (m) of landfill site is not contaminated beyond acceptable limit decided by the Ground Water Board or the State Board or the Committee, the site shall be monitored periodically.
8. The surface runoff from the landfill site shall be prevented from entering any stream, river, lake or pond.
9. In order to maintain the air quality, a landfill gas control and collection system shall be installed at the site. The concentration of methane gas generated at the landfill site shall not exceed 25-percent of the lower explosive limit.
10. The closed landfill site shall be monitored for its integrity and effectiveness of the final vegetative cover. If required, repairs shall be done to the final vegetative cover to prevent erosion or leaching from the site.

1.3. Objectives of Swachh Bharat Mission

The following summary of objectives of the Swachh Bharat Mission was taken from SBM Guidelines.

The primary objective of Swachh Bharat Mission are: :

1. Elimination of open defecation
2. Eradication of Manual Scavenging
3. Modern and Scientific Municipal Solid Waste Management
4. To effect behavioral change regarding healthy sanitation practicesGenerate awareness about sanitation and its linkage with public health
5. Capacity Augmentation for ULB's

The Mission has the following components:

1. Household toilets, including conversion of insanitary latrines into pour-flush latrines;
2. Community toilets
3. Public toilets
4. **Solid waste management**
5. IEC & Public Awareness
6. Capacity building and Administrative & Office Expenses (A&OE)

ANNEXURE 2

STUDIES OF 23 CENSUS TOWNS OF MIZORAM

Sl. No	Name of Town	No of Household	Population (2011)	SW Generation per/capita/day	Projected Population (2032)	Projected SW Generation
1	Aizawl	53285.00	293416.00	132.04	432427	214.05
2	Champhai	7196.00	34540.80	214.05	185233	83.35
3	Serchhip	3835.00	21158.00	9.52	26449	11.90
4	Kolasib	5990.00	24272.00	11.89	34143	18.00
5	Saitual	3070.00	14736.00	6.63	29488	13.27
6	Khawzawl	2082.00	11022.00	4.96	14687	6.61
7	Thenzawl	1665.00	7259.00	3.27	7816	3.52
8	Darlawn	840.00	4032.00	1.81	4892	2.20
9	Mamit	1571.00	7540.80	3.39	8665	3.90
10	Sairang	1214.00	5827.20	2.62	6620	2.98
11	N. Vanlaiphai	782.00	3753.60	1.69	4598	2.07
12	Bairabi	862.00	4137.60	1.86	6491	2.92
13	Biate	465.00	2232.00	1.00	2678	1.21
14	N. Kawnpui	1845.00	8856.00	3.99	9126	4.11
15	Khawhai	634.00	3043.20	1.37	3725	1.68
16	Lengpui	738.00	3542.40	1.59	4125	1.86
17	**Lunglei**	**11591.00**	**57011.00**	**25.65**	**87529**	**39.39**
18	Hnahthial	1411.00	6772.80	3.05	7581	3.41
19	Tlabung	864.00	4147.20	1.87	7300	3.29
20	Lawngtlai	3116.00	14956.80	6.73	40413	18.19
21	Saiha	3746.00	17980.80	8.09	33569	15.11
22	Vairengte	1872.00	10554.00	4.75	17283	7.78
23	Zawlnuam	718.00	3446.40	1.55	4644	2.09

POPULATION PROJECTIONS

Method 1 Arithmetical Increase Method

INPUT DATA

Base Year	2017
Inter. Year	2032
Final Year	2045

Population Data for the last 5 Decades			
Year			**Population**
1991			35599
2001			47137
2011			57011

Computation of Incremental Difference			
Year	Population	Increase in Popul.	Remarks
1991	35599		
2001	47137	11538	
2011	57011	9874	

Average increase in Population **10706**

Estimation of Population in the Design Yrs.			
Description	**Year**	**Increment Factor**	**Projected Population**
	2011	**0**	**57011**
	2012	0.1	58082
	2013	0.2	59152
	2014	0.3	60223
	2015	0.4	61293
Base Year	2016	0.5	62364
Base Year	**2017**	**0.6**	**63435**
	2018	0.7	64505
	2019	0.8	65576
	2020	0.9	66646
	2021	1	67717
	2022	1.1	68788
	2023	1.2	69858

	2024	1.3	70929
	2025	1.4	71999
	2026	1.5	73070
	2027	1.6	74141
	2028	1.7	75211
	2029	1.8	76282
	2030	1.9	77352
	2031	2	78423
Inter. Year	**2032**	**2.1**	**79494**
	2033	2.2	80564
	2034	2.3	81635
	2035	2.4	82705
	2036	2.5	83776
	2037	2.6	84847
	2038	2.7	85917
	2039	2.8	86988
	2040	2.9	88058
	2041	3	89129
	2042	3.1	90200
	2043	3.2	91270
	2044	3.3	92341
Final Year	**2045**	**3.4**	**93411**

Incremental Increase Method

Incremental Increase Method

P_n = $P_1 + nx + (n(n+1)y)/2$

$n = (P_2-P_1)/10$; Value of 'n' is taken as a decade

Where, P_2 = Year of projection; and

P_1 = Year of latest census

Year	Population	Increase in Popul.	Incremental Increase
1991	35599		
2001	47137	11538	11538
2011	57011	9874	-1664
Total Increase		21412	9874
Average Increase		10706	4937

Estimation of Population in the Design Years			
Description	Year	Increment Factor	Projected Population
	2011	**0**	**57011**
	2012	0.1	58353
	2013	0.2	59745
	2014	0.3	61186
	2015	0.4	62676
	2016	0.5	64215
Base Year	**2017**	**0.6**	**65804**
	2018	0.7	67443
	2019	0.8	69130
	2020	0.9	70868
	2021	1	72654
	2022	1.1	74490
	2023	1.2	76375
	2024	1.3	78310
	2025	1.4	80294
	2026	1.5	82327
	2027	1.6	84410
	2028	1.7	86542

	2029	1.8	88723
	2030	1.9	90954
	2031	2	93234
Inter. Year	**2032**	**2.1**	**95564**
	2033	2.2	97942
	2034	2.3	100371
	2035	2.4	102848
	2036	2.5	105375
	2037	2.6	107952
	2038	2.7	110578
	2039	2.8	113253
	2040	2.9	115977
	2041	3	118751
	2042	3.1	121574
	2043	3.2	124447
	2044	3.3	127369
Final Year	**2045**	**3.4**	**130340**

Adopted Design Population

Adopted Design Population				
	Base Year	**Inter. Year**	**Final Year**	**Remarks**
	2017	2032	2045	
Incremental Method	65804	90954	130340	**Average of two modes of calculation is taken as the design population for the scheme**
Arithmetic Method	63435	77352	93411	
Design Population	**64620**	**84153**	**111876**	

: Geometric Method and Graphical method has not taken into consideration of design population because it gives the result on higher side.

ANNEXURE 3

PHYSICAL & CHEMICAL CHARACTERISATION OF WASTE

Waste Characteristics as per 2011 Census	Quantity (MT/day)	Percentage (%) of Waste
Bio-degradable Waste	4.02	38.10 %
Recyclable Waste	6.55	41.09 %
Inert Ash & debris	2.78	20.81 %
Total	**13.35**	**100%**

Quantity and Characterization of MSW in Lunglei

PRIMARY WASTE GENERATION SURVEY DATA

A) Analysis Of Household Waste Generation Survey Data

Category - LIG

Sl. No.	Ward No.	Name of the Respondent	Residential Address	Household Size			Total Quantity of Waste (gms) - Days							Average (7 Days) Quantity of Waste per day (in g)
				Adults	Children	Total	1	2	3	4	5	6	7	
1	1	R.T.Dela	Chanmari	1	2	3	700	720	910	820	700	755	720	761
2	11	V.L.Sawma	Chanmari	2	1	3	850	850	850	835	890	700	840	831
3	14	C.Rema	Chanmari	2	1	3	710	675	550	625	810	890	600	694
4	3	Joela	Chanmari	2	2	4	500	510	700	520	920	870	610	661
5	3	Imanuela	Chanmari	4	1	5	710	725	610	700	750	720	800	716
6	3	Bialrinamma	Zobawk	2	2	4	700	825	700	610	810	750	720	731
7	3	Lalmalsuma	Zobawk	2	1	3	715	860	700	790	750	610	765	741
8	3	Lalthlahlova Saito	Zobawk	2	1	3	720	760	710	650	620	550	850	694

Sl. No.	Ward No.	Name of the Respondent	Residential Address	Household Size			Total Quantity of Waste (gms) - Days							Average (7 Days) Quantity of Waste per day (in g)
9	4	B.Lalthlengliana	Zobawk	4	2	6	830	750	700	700	750	800	650	740
10	4	C. Damvea	Zobawk	3	3	6	750	710	625	810	520	630	610	665
						40								**7234**

Per capita waste generation = 7234/40 = 400 gpc Category–

MIG

S.No.	Ward No.	Name of the Respondent	Residential Address	Household Size			Total Quantity of Waste (gms)							Average (7 Days) Quantity of Waste per day (in g)
				Adults	Children	Total	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	
1	3	Siamliana	Rahsi Veng	4	2	6	1125	1610	1525	1550	1450	1520	1165	1421
2	3	C. Sawma	Rahsi Veng	3	2	5	1975	1900	1950	1870	1775	1810	1900	1883
3	2	V.L.Tluanga	Rahsi Veng	3	2	5	1505	1250	1400	1235	1735	1500	1700	1475
4	2	H.L.Bela	Rahsi Veng	4	2	6	1025	1310	1500	1420	1310	1700	1520	1398
5	3	Martina	Rahsi Veng	7	2	9	1430	1450	1220	1310	1010	1200	1020	1234
6	2	Lalnunhlui	Rahsi Veng	4	1	5	1120	1320	1060	1400	1100	1210	1010	1174
7	2	Lalariatpuia	Electric Veng	6	4	10	1160	1925	1310	1060	1750	1450	1400	1436
8	2	R. Lalthawmawia	Electric Veng	11	1	12	1520	1610	1700	1320	1020	1750	1200	1446
9	2	Lalrinliani	Electric Veng	5	4	9	1600	1570	1540	1710	1050	1000	1150	1374
10	2	Lalchhuanawma	Electric Veng	3	4	7	1450	1210	1220	1150	1270	1000	1255	1222
						74								**14063**

Per capita waste generation =14063/74 = 450 gpc

Category– HIG

Sl. No.	Ward No.	Name of the Respondent	Residential Address	Household Size			Total Quantity of Waste (gms)							Average (7 Days) Quantity of Waste per day (in g)
				Adults	Children	Total	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	
1	2	C.T. Mawia	Chanmari	8	-	8	1750	1600	1410	1310	1500	1845	1625	1577
2	2	Tawia	Chanmari	4	2	6	1735	1780	1575	1530	1810	1700	1715	1692
3	2	Liankunga	Chanmari	5	2	7	1150	1500	1900	1650	1725	1710	1600	1605
4	1	K.Z.Sanga	Chanmari	5	1	6	950	930	820	1200	1040	1200	1070	1030
5	10	K.L.Rinliana	Chanmari	4	2	6	700	810	850	880	720	810	830	800
						33								**6704**

Per capita waste generation = 6704/5= 500 gpc

MIG	**400**	
HIG	**450**	
LIG	**500**	
Average	**450**	**gpc**

Therefore, average per capita generation from residents is 450 gms. / Day.

B) Analysis of SabziMandi, Fruit Markets Waste Generation Survey Data

Sl. No.	Contact person	Name of Market	Telephone no.	Address / Ward No.	Name of Association	Quantity of waste generated per day (g)
1	Thanzami	Vegetable market,Lunglei	9862325809	Diakkawn/ 2	No	7200
2	Rinmawia	Vegetable market,Lunglei	9863490861	Diakkawn	No	7310

Total waste generated from 2 shops = 14510 gms. = 14.51 kg

Total no. of shops = 2

Waste generated from 2 shops = 0.014 tonnes

Therefore, per capita waste generation = 0.014 x 10^6 / 14510 x 1.1 = 0.87 gpc.

C) Analysis of Waste Generation Survey Data from schools

S.No.	School Name	Address	Waste generated per day (gms.)				
			Total	Biodegradables	Recyclables	Inert Waste	Other
1	St. John's HSS	Venglai, Lunglei	15950	2500	150	1000	0
2	St. Maria Gorrettis	Venglai, Lunglei	16300	2500	100	3000	0
			32250	gms			
			32.25	kg			

Total number of students and staff per school= 200

Therefore, per capita waste generation = 32250 / 200x 2 = 80.62 gpc.

D) Analysis of Waste Generation Survey Data from hotels

S.NO.	Name of the Hotel	Contact No.	Address / Ward No.	Capacity of Hotel (No. of rooms)	Average occupancy of Guests per day	Quantity of Waste in Peak Season (gms.)
					In Peak Season	**Total**
1	Mizo Hotelpui	9862385186	Electric/ 2	8	8	2100
2	Hotel Cloud 9	9862416135	Electric/ 2	8	7	1500
					15	
						3600 gms
						3.60 kg
						0.0036 tons

Therefore, per capita waste generation = 3600 / 15 = 240 gpc.

E) Analysis of Waste Generation Survey Data from restaurants

S.NO.	Name of the Restaurant	Contact No.	Address / Ward No.	Average occupancy per day	Quantity of Waste in Peak Season (gms.)
1	E & C Restaurant	9862341289	Electric/ 2	50	2500
2	4 Sister Restaurant	9862116997	Electric/ 2	45	2200
3	Exotic	9612377137	Electric/ 2	50	2800
				145	**7500 gms**
					7.50 kg
					0.0075 tons

Therefore, per capita waste generation = 7500 / 145 = 51.72 gpc.

F) Analysis of Waste Generation Survey Data from hospitals

S.NO.	Name of Hospital	Capacity in Beds (Nos)	Average arrival/admission of patients / Day	Waste Quantity Per Day (in gms.)			
				Total Waste Quantity Per Day	Solid Waste	Biomedical Waste	Other Waste
1	Civil Hospital	60	15	1130	130	1000	0
2	Faith Hospital	10	3	2115	115	2000	0
			18		245 gms		

Therefore, per capita waste generation = 245 / 18 = 13.61 gpc.

Summary of Per Capita Generation

S.No.	Source / Area	per capita (gpc)	Base
1	Household	190	Residents
2	Sabzi Mandi	0.87	Design population
3	Schools	80.62	Students & staff
4	Hotels	240	Guests
4	Restaurants	51.72	Customers
5	Hospitals, clinics, dispensaries	13.61	Patients

OFFICE OF THE DIRECTORATE OF URBAN DEVELOPMENT & POVERTY ALLEVIATION DEPARTMENT AIZAWL: MIZORAM

LAND AVAILABILITY CERTIFICATE

This is to Certify that the Urban Development & Poverty Alleviation Department, Government of Mizoram has enough plot of Land for the project of **'Solid Waste Management System for Lunglei Town'**

(JOSEPH H. LALRAMSANGA)
Director
Urban Development & Poverty Alleviation Department
Government of Mizoram
Aizawl: Mizoram

Director
Urban Dev. & Poverty Alleviation
Govt. of Mizoram

Government of Mizoram

OFFICE OF THE DIRECTORATE OF URBAN DEVELOPMENT & POVERTY ALLEVIATION DEPARTMENT AIZAWL: MIZORAM

NON DUPLICATION CERTIFICATE

This is to Certify that the project **'Solid Waste Management System for Lunglei Town'** has not been proposed/sanctioned for funding under any other scheme of the State/Central Government/North Eastern Council (NEC) or any other funding agencies.

(JOSEPH H. LALRAMSANGA)
Director
Urban Development & Poverty Alleviation Department
Government of Mizoram
Aizawl: Mizoram

Director
Urban Dev. & Poverty Alleviation
Govt. of Mizoram

OFFICE OF THE DIRECTORATE OF URBAN DEVELOPMENT & POVERTY ALLEVIATION DEPARTMENT AIZAWL: MIZORAM

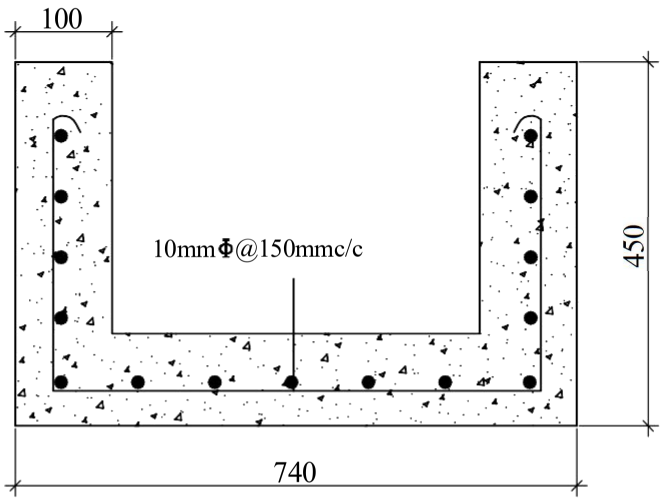
STONE QUARRY AVAILABILITY CERTIFICATE

This is to Certify that **Stone Quarry** is available for the project of **'Solid Waste Management at Lunglei Town'**

(JOSEPH H. LALRAMSANGA)
Director
Urban Development & Poverty Alleviation Department
Government of Mizoram
Aizawl: Mizoram

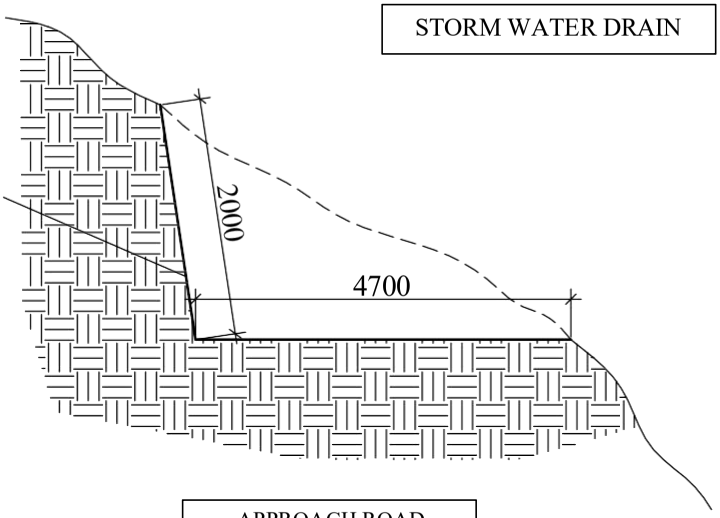
Director
Urban Dev. & Poverty Alleviation
Govt. of Mizoram

DRAWING

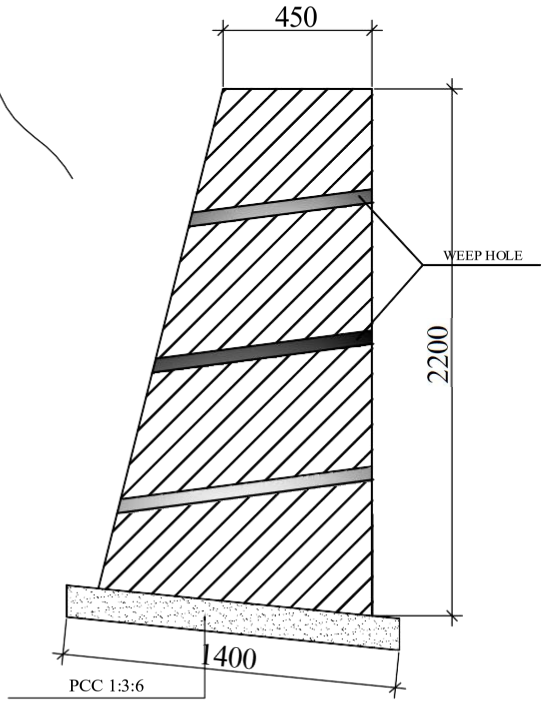


STORM WATER DRAIN

Proposed
approach road
(L = 135m)



APPROACH ROAD



PROPOSED R/WALL

Notes:
1. All dimension are in millimeter unless otherwise specified.
2. Drawing may be read in conjunction with the Estimate.
3. Modifications/Changes may be made as directed only by the Engg-in-charge at site

STORM WATER DRAIN, APPROACH ROAD & R/WALL

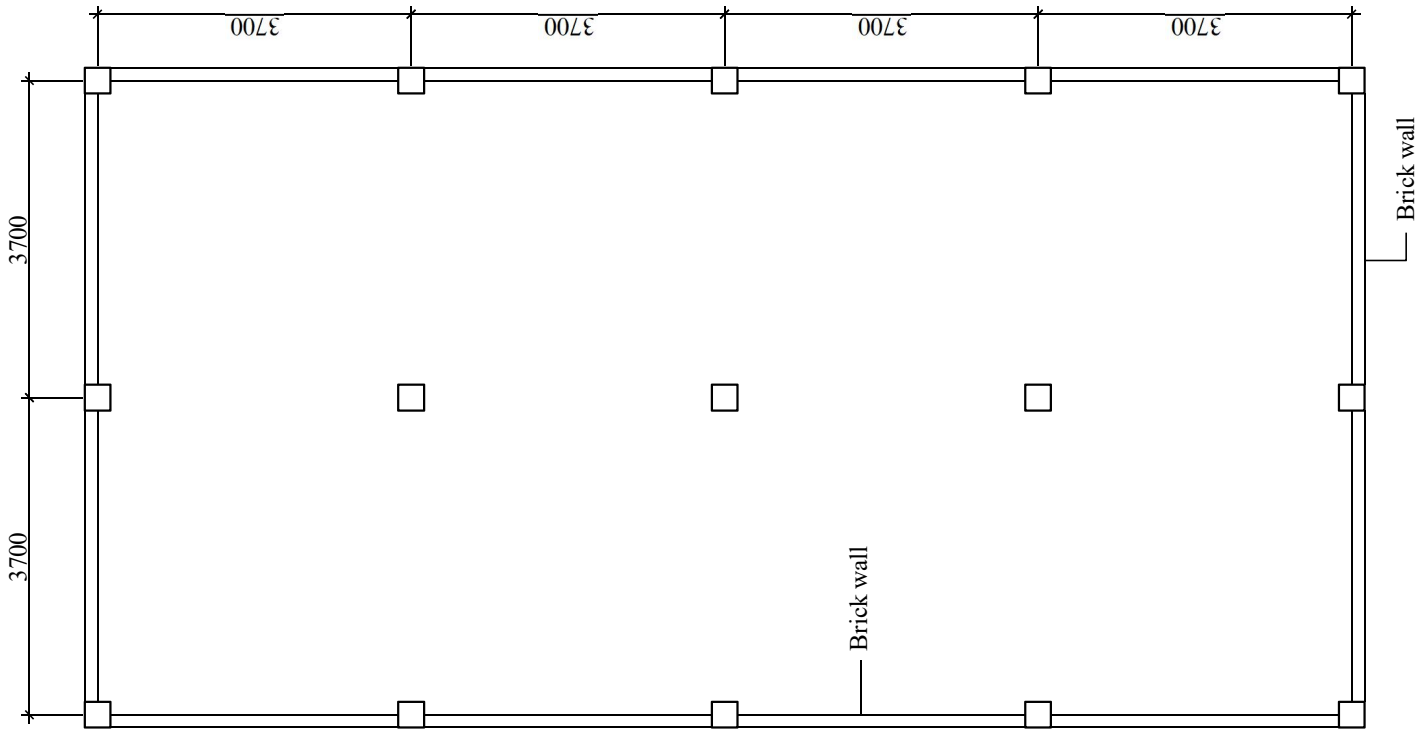
TITLE : ELEVATION

dated : JULY 2017

Scale : NTS

PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.



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PLATFORM AND SEPARATION

TITLE :
PLAN

dated :
JULY 2017

Scale : NTS

PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.

Notes:

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PLATFORM AND SEPARATION

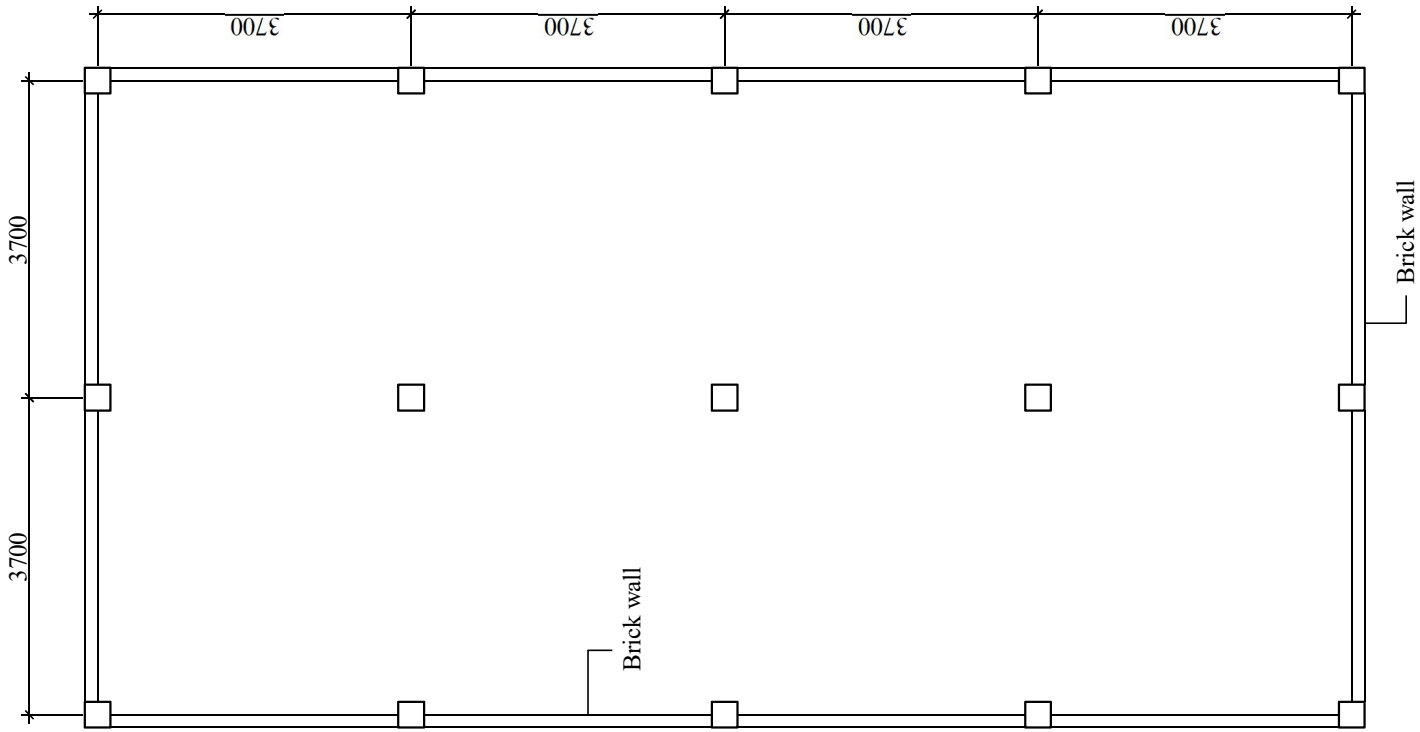
TITLE :
ELEVATION

dated :
JULY 2017

Scale : NTS

PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.



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COMPOSTING BED AND SHED

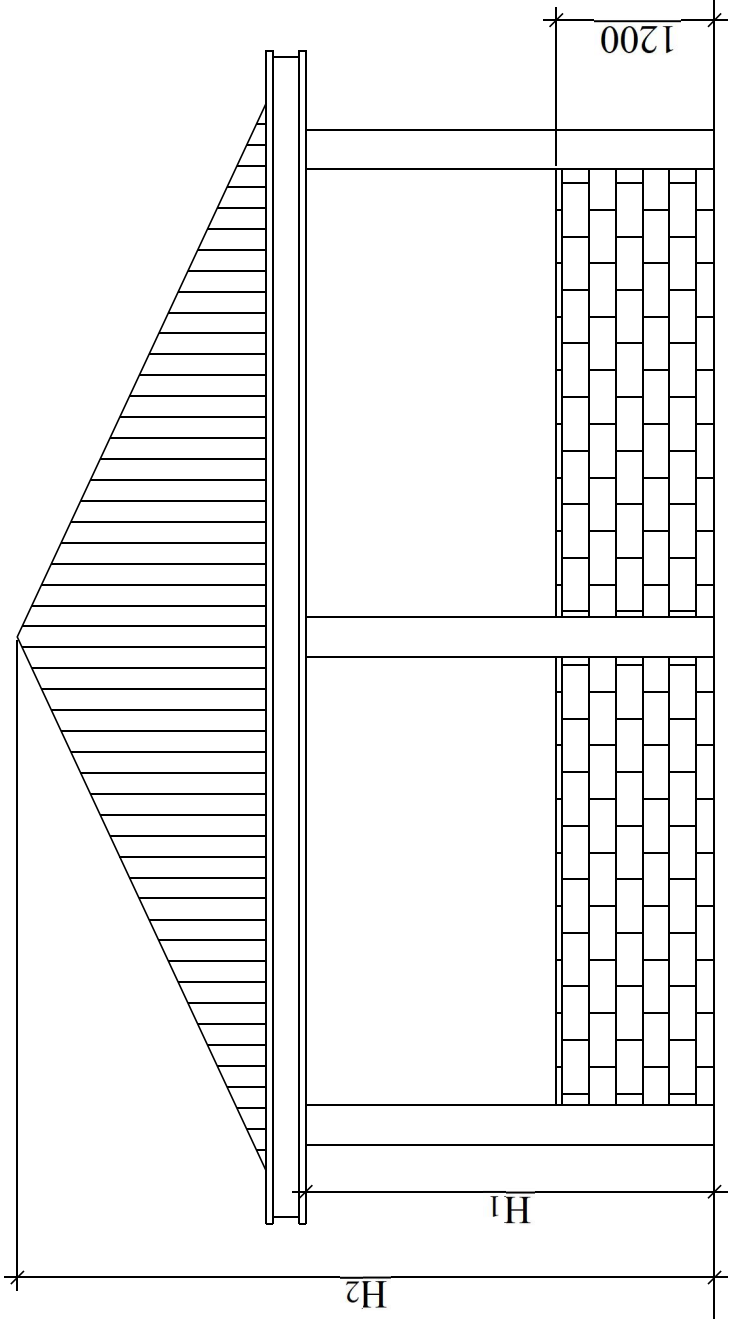
TITLE :
PLAN

dated :
JULY 2017

Scale : NTS

PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.



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COMPOSTING BED AND SHED

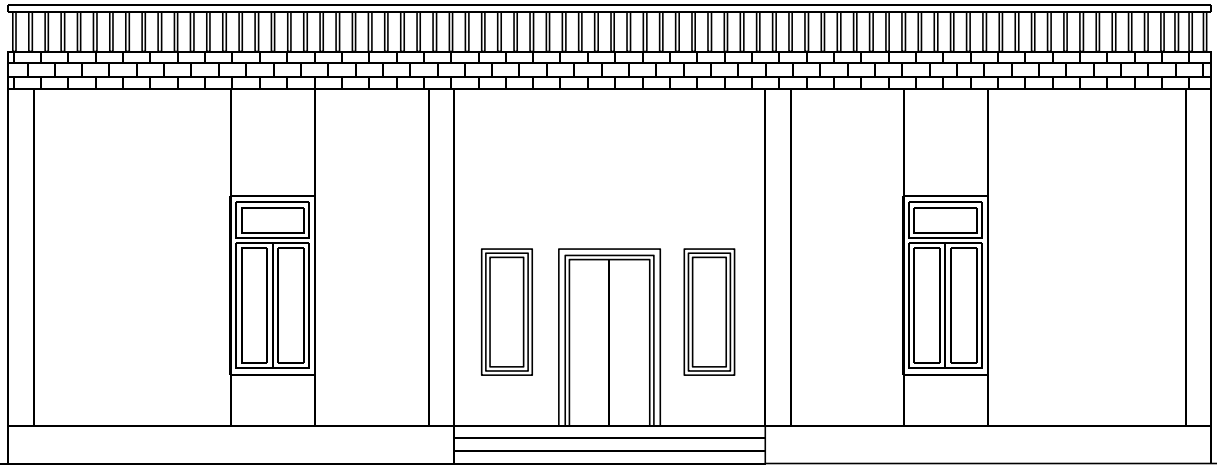
TITLE :
ELEVATION

dated :
JULY 2017

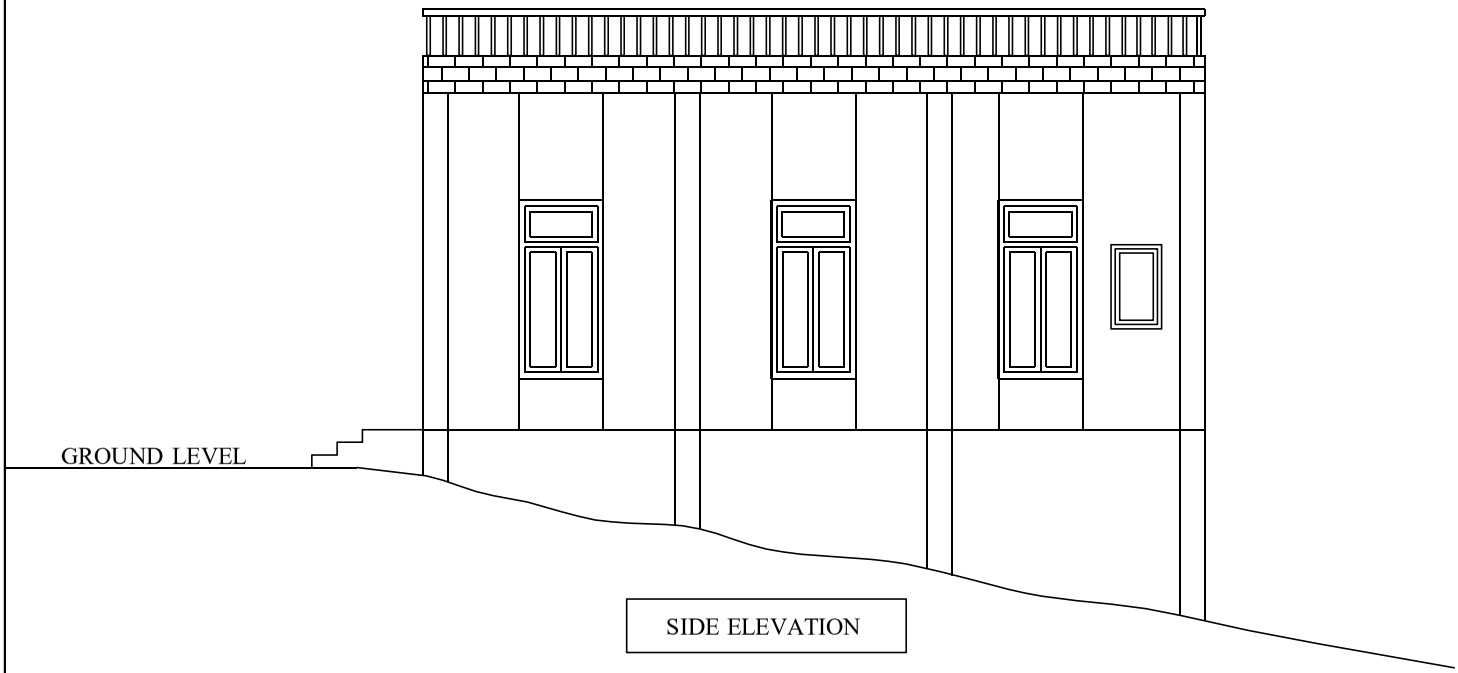
Scale : NTS

PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.



FRONT ELEVATION



SIDE ELEVATION

RECYCLING SHED

TITLE : ELEVATION

dated : JULY 2017

Scale : NTS

PREPARED BY :

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Notes:

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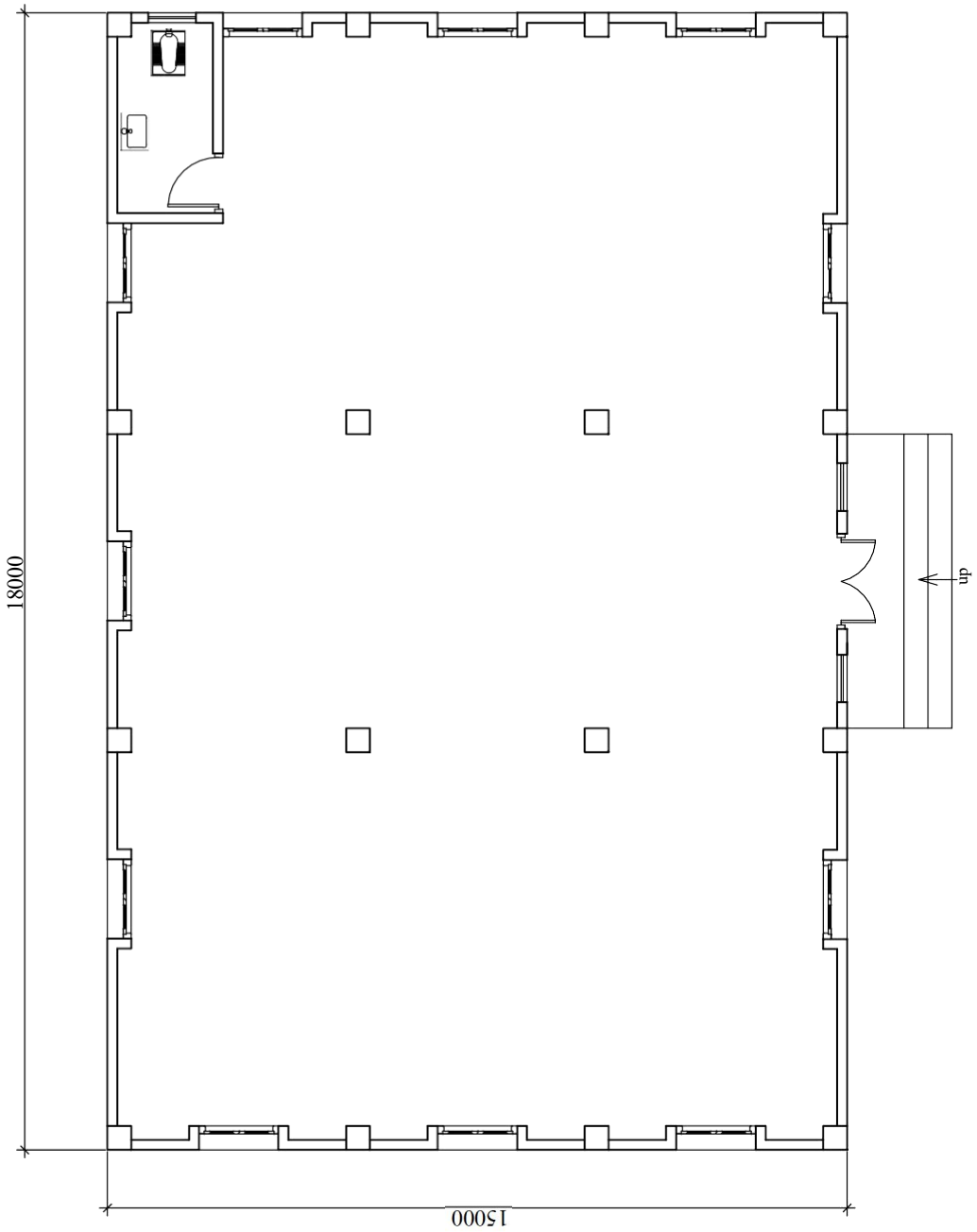

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STORM WATER DRAIN, APPROACH ROAD & R/WALL

TITLE :
ELEVATION

dated :
JULY 2017

Scale : NTS

PREPARED BY :

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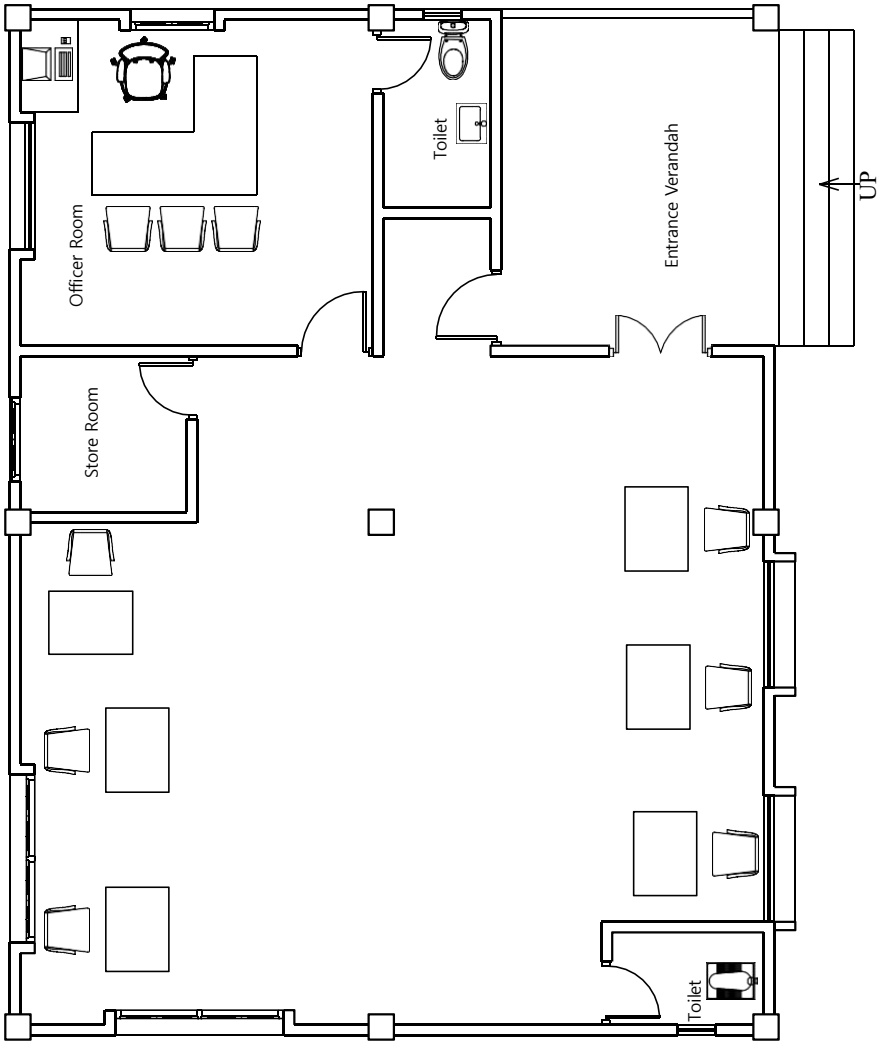

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SITE OFFICE

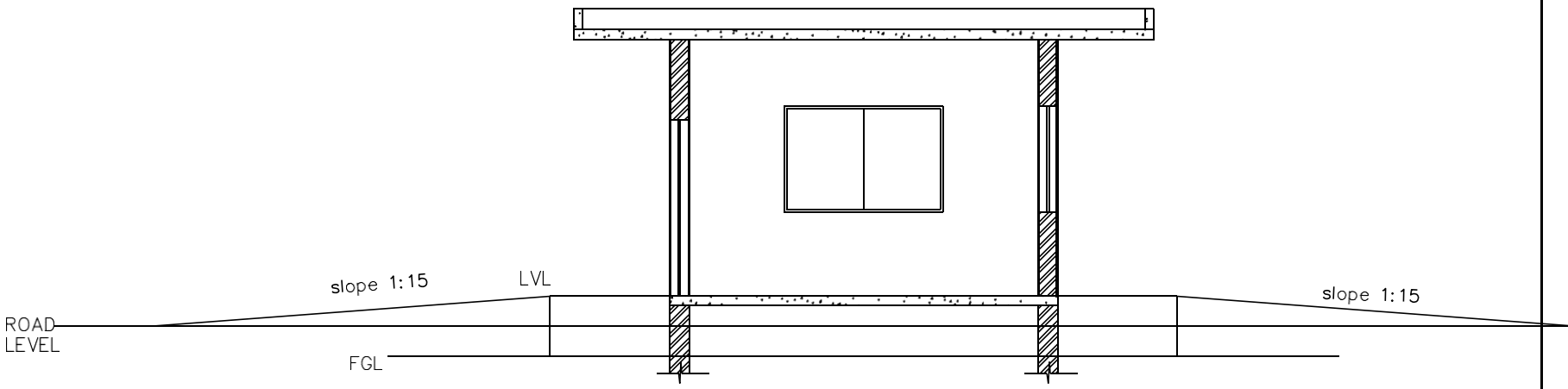
TITLE :
FLOOR PLAN

dated :
JULY 2017

Scale : NTS

PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.



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WEIGH BRIDGE

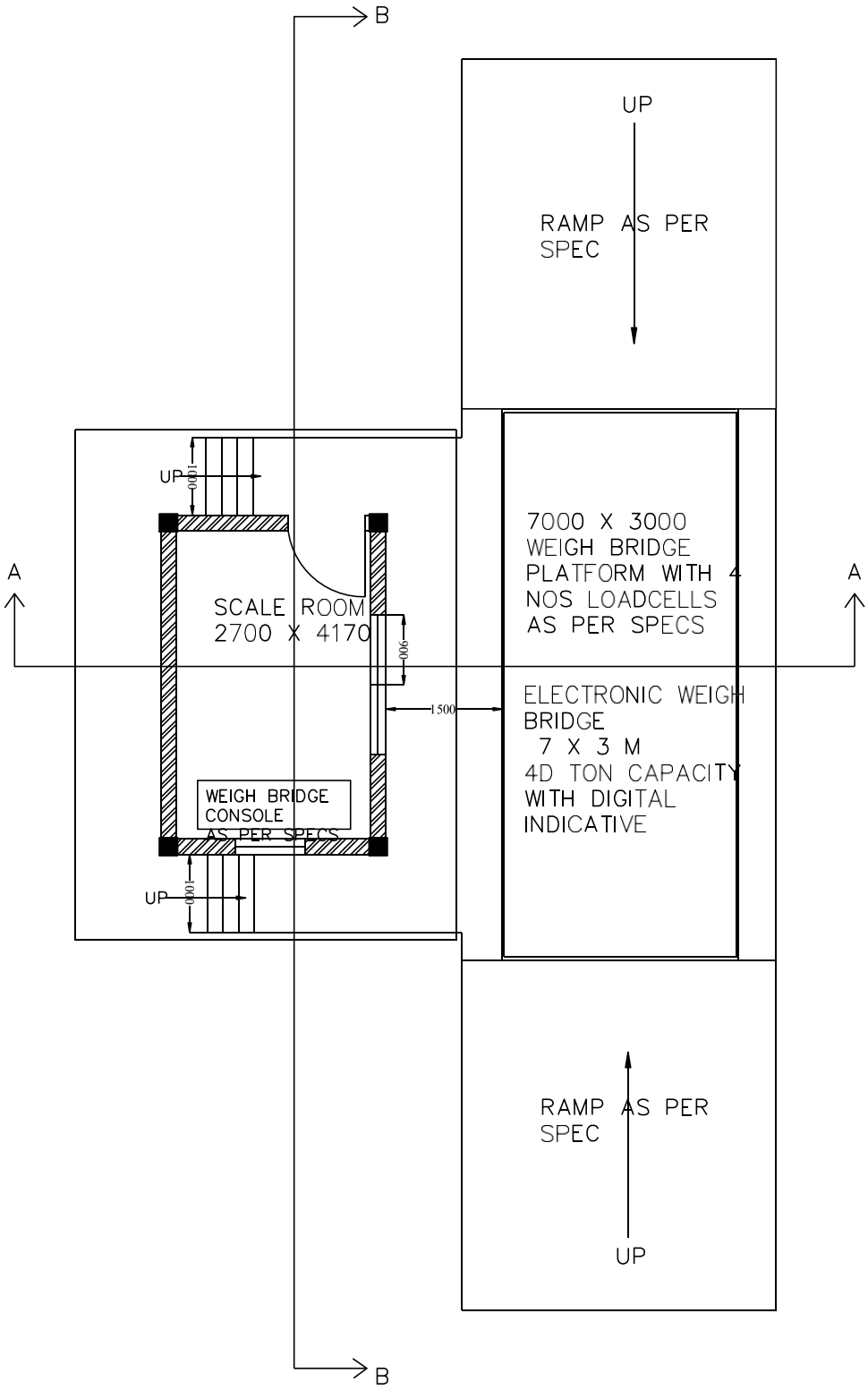
TITLE :
SECTION BB

dated :
JULY 2017

Scale : NTS

PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.



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WEIGH BRIDGE

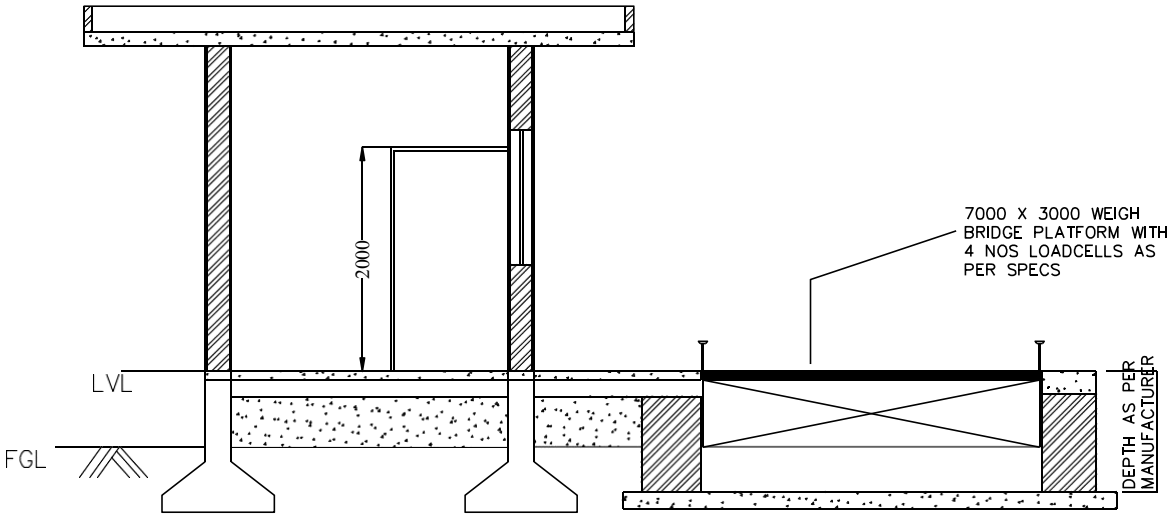
TITLE : PLAN

dated : JULY 2017

Scale : NTS

PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.



Notes:

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3. Modifications/Changes may be made as directed only by the Engg-in-charge at site

WEIGH BRIDGE

TITLE :
SECTION AA

dated :
JULY 2017

Scale : NTS

PREPARED BY :

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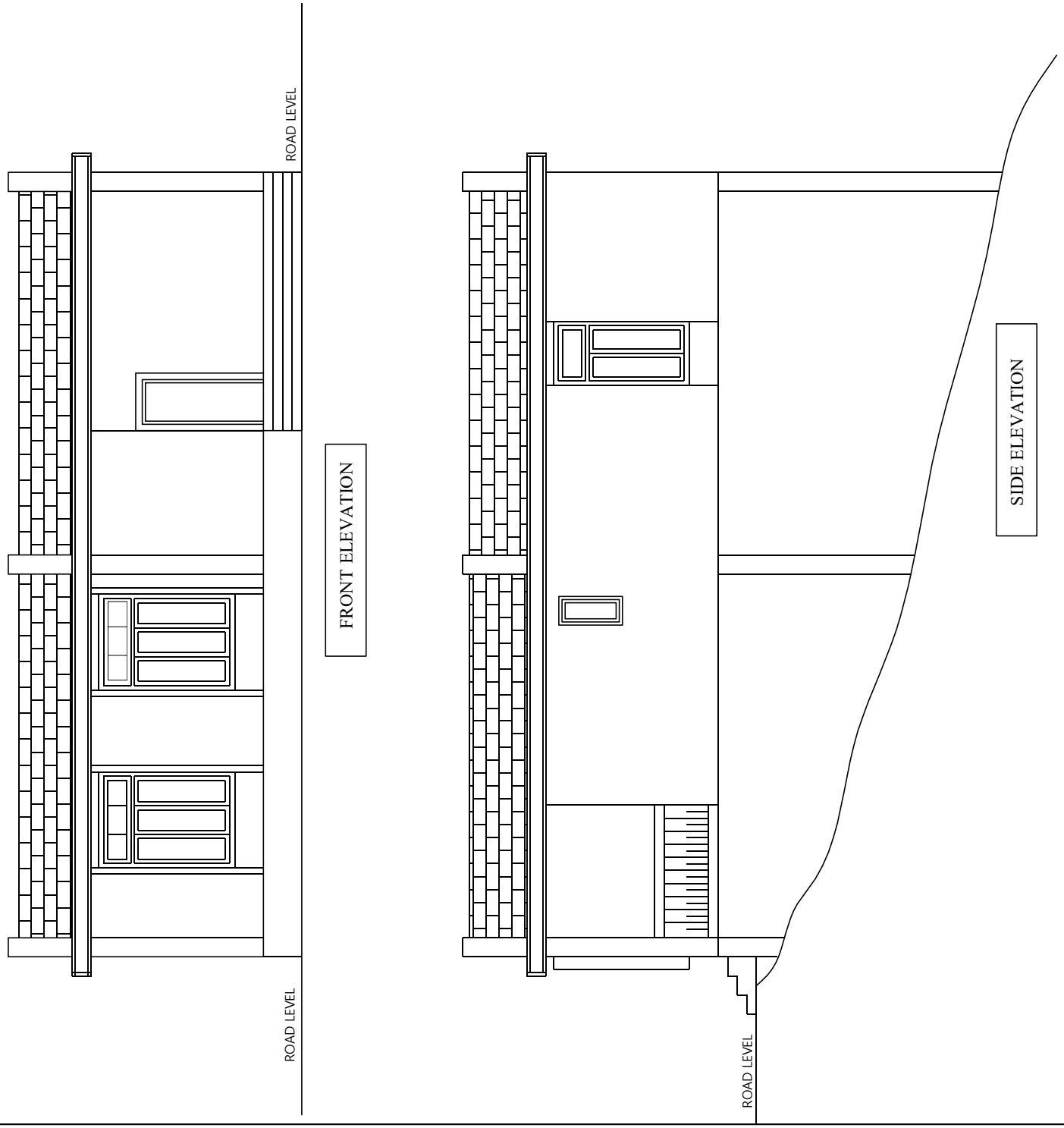

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SITE OFFICE

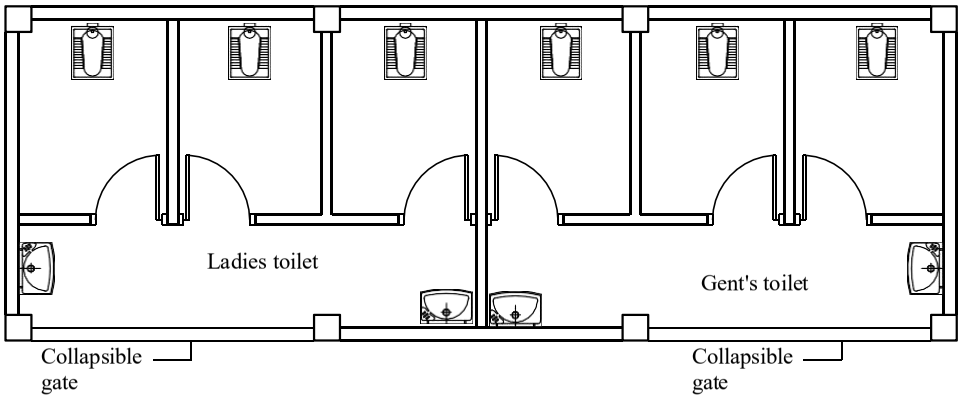
TITLE :
ELEVATION

dated :
JULY 2017

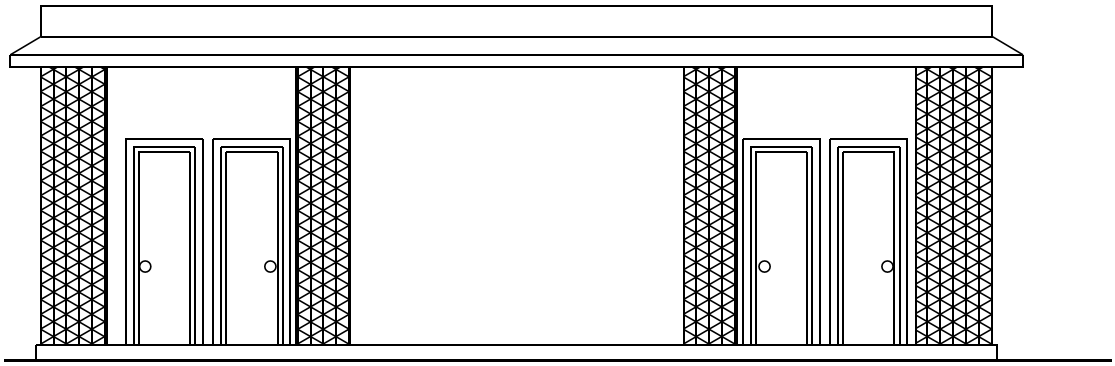
Scale : NTS

PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.



PLAN



ELEVATION

Notes:

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2. **Drawing may be read in conjunction with the Estimate.**
3. **Modifications/Changes may be made as directed only by the Engg-in-charge at site**

PUBLIC TOILET

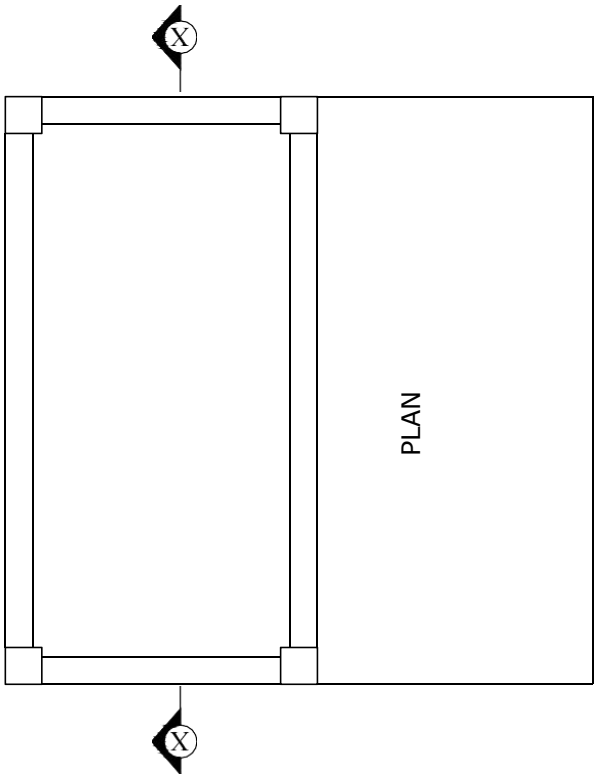
TITLE : PLAN & ELEVATION

dated : JULY 2017

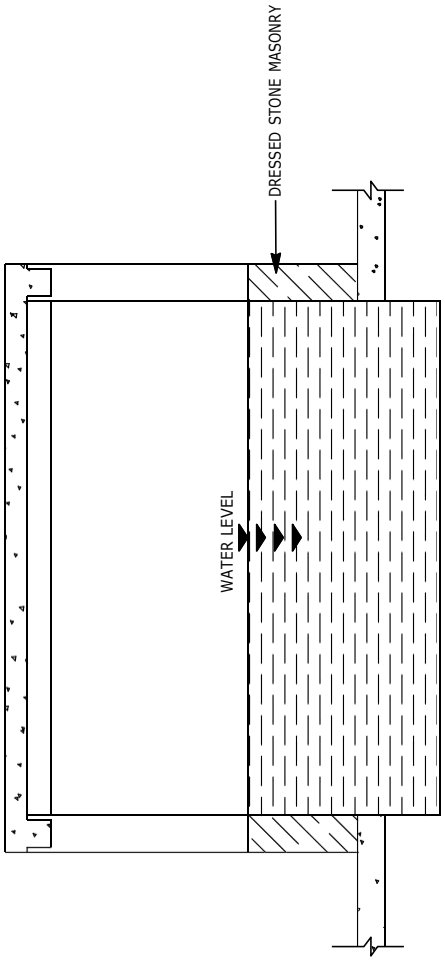
Scale : NTS

PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.



PLAN



ELEVATION

Notes:

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WATER STORAGE TANKS

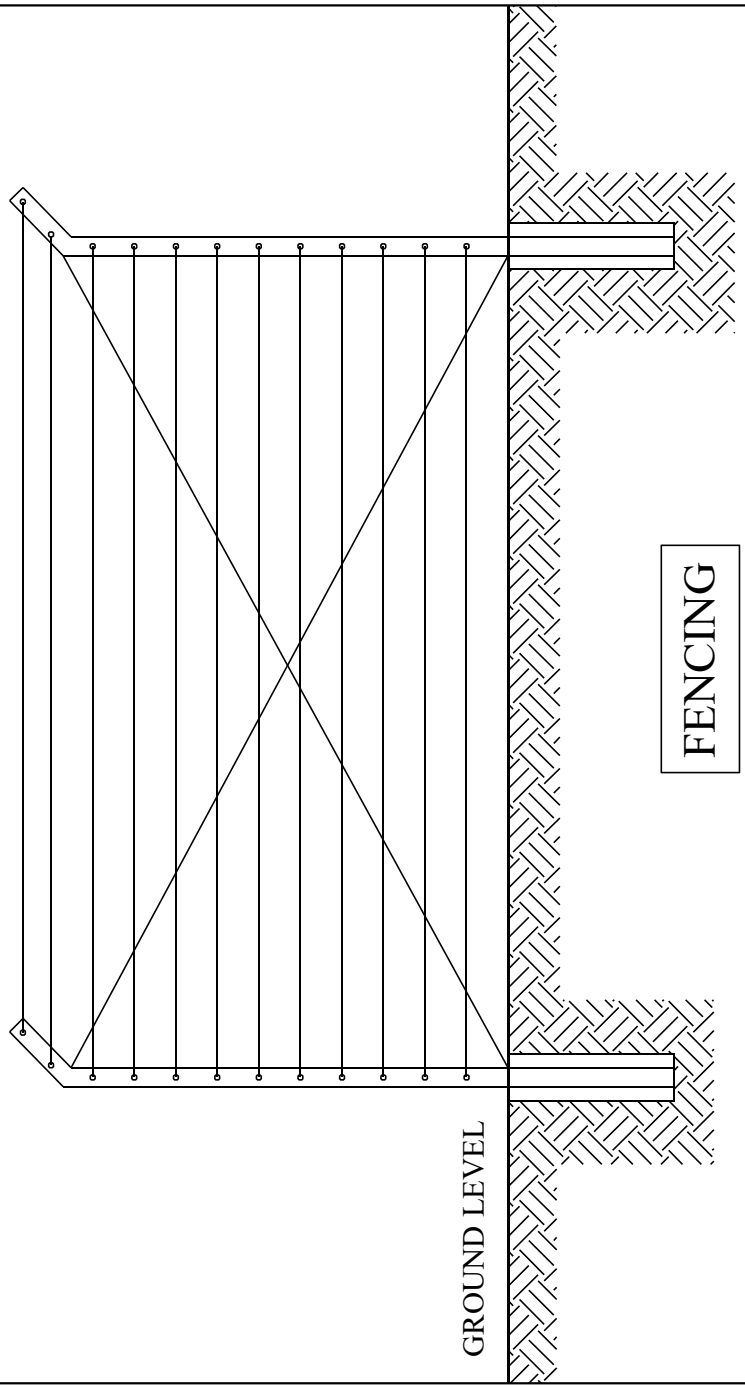
TITLE :
PLAN & ELEVATION

dated :
JULY 2017

Scale : NTS

PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.



Notes:

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3. Modifications/Changes may be made as directed only by the Engg-in-charge at site

G.I BARBED WIRE FENCING

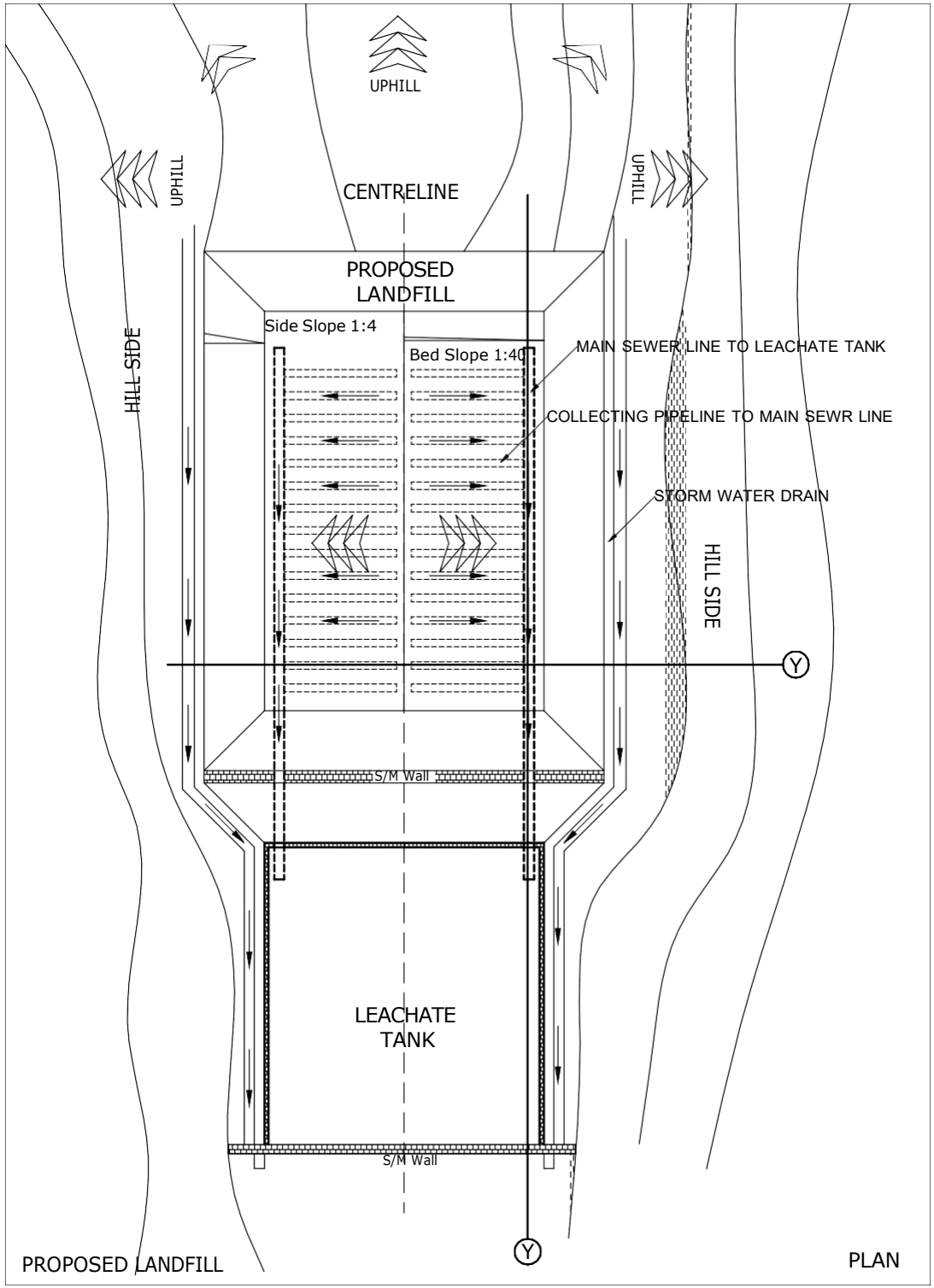
TITLE :
PLAN & ELEVATION

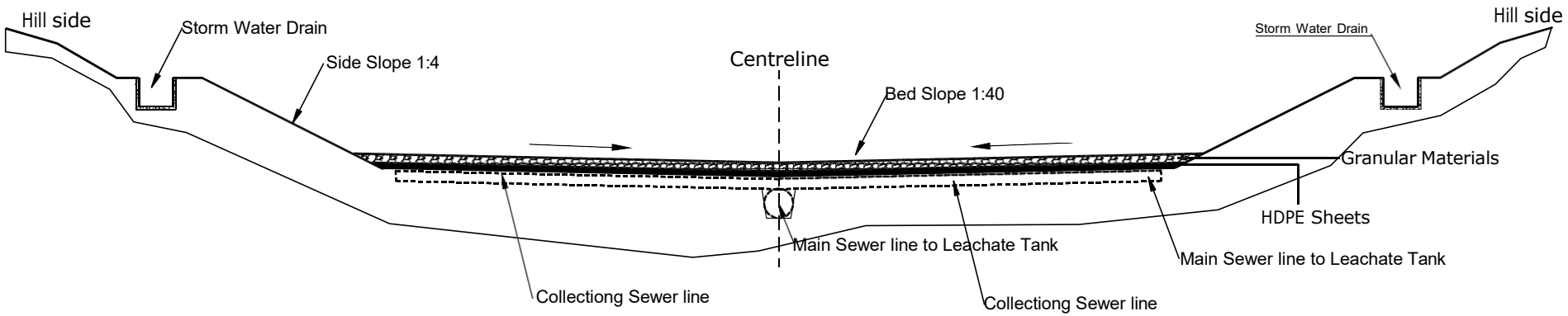
dated :
JULY 2017

Scale : NTS

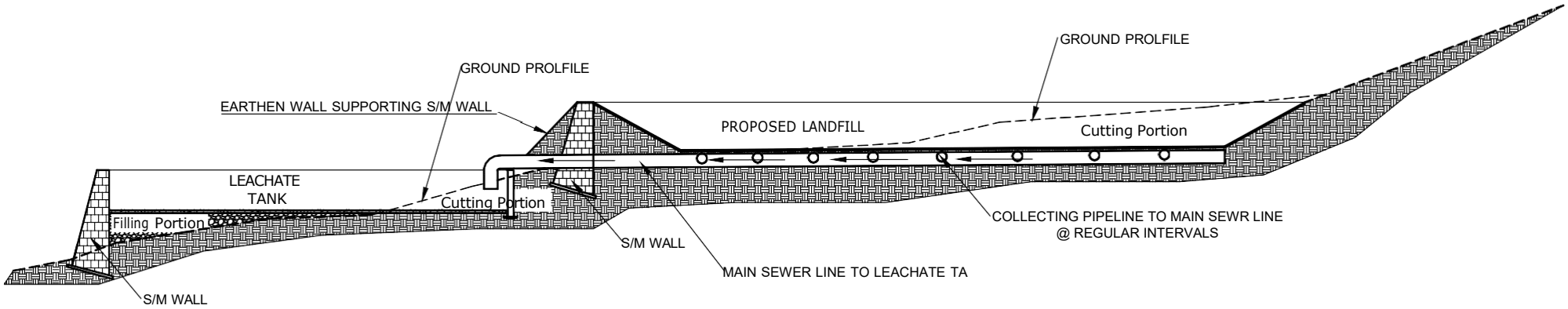
PREPARED BY :

UD & PA DEPARTMENT
GOVT. OF MIZORAM.


UPHILL
UPHILL
UPHILL
CENTRELINE
PROPOSED
LANDFILL
Side Slope 1:4
Bed Slope 1:40
HILL SIDE
MAIN SEWER LINE TO LEACHATE TANK
COLLECTING PIPELINE TO MAIN SEWR LINE
STORM WATER DRAIN
HILL SIDE
Y
S/M Wall
LEACHATE
TANK
S/M Wall
Y
PROPOSED LANDFILL
PLAN


Hill side
Storm Water Drain
Side Slope 1:4
Centreline
Bed Slope 1:40
Storm Water Drain
Hill side
Granular Materials
HDPE Sheets
Main Sewer line to Leachate Tank
Main Sewer line to Leachate Tank
Collectiong Sewer line
Collectiong Sewer line

SECTION AT-X


GROUND PROLFILE
GROUND PROLFILE
EARTHEN WALL SUPPORTING S/M WALL
PROPOSED LANDFILL
Cutting Portion
LEACHATE
TANK
Cutting Portion
Filling Portion
COLLECTING PIPELINE TO MAIN SEWR LINE
@ REGULAR INTERVALS
S/M WALL
MAIN SEWER LINE TO LEACHATE TA
S/M WALL

OFFICE OF THE
STATE LEVEL ENVIRONMENTAL IMPACT ASSESSMENT AUTHORITY
ENVIRONMENT, FORESTS & CLIMATE CHANGE DEPARTMENT
AIZAWL ::: MIZORAM

No.A.11011/1(A)/2022-SEIAA(EC)/8-11 Dated Aizawl, the 1st April, 2022

To

The Director,
Urban Development & Poverty Alleviation Department,
Govt. of Mizoram,
Mizoram New Capital Complex (MINECO).

Subj: Terms of Reference for Establishment of Solid Waste Management System at Lunglei.

Sir,

I. This has reference to your proposal No.SIA/MZ/MIS/67608/2021 dt.03.03.2022 submitted to SEIAA Mizoram seeking Terms of Reference (ToR) in terms of the provisions of Environmental Impact Assessment (EIA) Notification 2006 under Environment (Protection) Act, 1986. The project is for Establishment of Solid Waste Management System at Lunglei by Urban Development & Poverty Alleviation Department, Govt. of Mizoram.

II. The proposal for grant of Terms of Reference (ToR) to the proposed project was considered by SEAC Mizoram in its 11th Meeting dt. 17.03.2022 and 12th Meeting dt. 29.03.2022 and recommended for consideration by SEIAA Mizoram. Accordingly, the proposal along with recommendations of SEAC Mizoram was examined by SEIAA Mizoram and minutes detailing approved ToRs & other conditions have been uploaded in PARIVESH Portal.

III. In view of the above, SEIAA Mizoram hereby approved ToRs to the proposed project for preparation of Environmental Impact Assessment (EIA) Report and Environmental Management Plan (EMP). The ToRs for preparation of EIA & EMP report are as follows:

1. Project name and location (Village, District, State)
2. Site selection of the project- Nature of land- Agricultural (single/double crop), barren, Govt/private land, status of its acquisition, nearby (in 2-3 km.) water body, population, within 10km, other industries, forest, eco-sensitive zones.
3. Occupational health issues. Baseline data on the health of the population in the impact zone and measures for occupational health and safety of the personnel and manpower.
4. A 10 km. radius map (on survey of India toposheet) showing co-ordinates of project site, national highway, state highway, district road/approach road, river, canal, natural drainage; protected areas, under Wild Life (Protection) Act,

Urban Dev. & Poverty Alleviation Deptt.
5122

archaeological site, natural lake, flood area, human settlements (with population), industries, high tension electric line, prominent wind direction (summer and winter), effluent drain, if any and ponds etc. should be presented and impacts assessed on the same.

5. Layout plan/map of project site showing storage area, green belt area (33% of the project area), all roads, prominent wind direction, processing plant & other infrastructure, etc.
6. Detailed plan for construction of retaining wall to check dispersal of waste to other areas.
7. Fire Control Plan to check fire outbreak in adjoining areas. Open burning in landfill sites should be discontinued. Risk assessment and on-site emergency plan should be prepared.
8. Details of storm water/ leachate collection from the composted area.
9. Details of monitoring of water quality around the landfill site. Water analysis shall also include for nitrate and phosphate.
10. Details of the odour control measures.
11. Details of surface hydrology and water regime and impact on the drainage and nearby habitats/settlements (surroundings), water bodies/rivers/ ponds and mitigative measures during rainy season.
12. Status of ambient air quality and surface and ground water quality, soil type, cropping pattern, land use pattern, population, socio-economic status, anticipated air and water pollution.
13. Details of impact on water bodies/rivers/ ponds and mitigative measures during rainy season.
14. Submit the criteria for assessing waste generation. Any segregation of hazardous and bio-medical wastes.
15. Submit a copy of the land use certificate from the competent authority.
16. Details of one complete season AAQ data (except monsoon) with the dates of monitoring, impact of the project on the AAQ of the area (including H_2S, CH_4).
17. Submit a copy of the topography of the area indicating whether the site requires any filling, if so, the details of filling, quantity of fill material required, its source and transportation, etc.
18. Detail plan of Waste Management.
19. Details of protection from surface drainage, and action plan for measures to be taken for excessive leachate generation during monsoon period.
20. Details of impact on environmental sensitive areas.
21. Details of air emission, effluents generation, solid waste generation and their management.
22. Details of rehabilitation/compensation package for the project effected people, if any.
23. Details of various waste management units with utilities indicating size and capacity for the proposed project.

24. Methodology for remediating the project site, which is being used for open dumping of garbage.
25. Detailed Environment Monitoring Plan and Environment Management Plan with costs and parameters.
26. The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.
27. Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.
28. The draft EIA/EMP report as per above ToR shall be submitted to the State Pollution Control Board for public hearing and the issues raised by the public shall be incorporated in the Final EIA/EMP report.
29. Public hearing may also be conducted for the project in accordance with provisions of Environmental Impact Assessment Notification, 2006.
30. In addition, the following safeguards maybe included in the project:
    a) Timeline for shifting to zero landfill and 100% waste utilization, treatment and processing. Focus need to be on creation of waste to wealth.
    b) Retaining wall along the dumping site maybe built to check the dispersal of waste. Moreover, adequate infrastructure maybe created to avoid leakage of pollutants from dumped wastes through underground water.

IV. The above ToR should be considered for preparation of EIA-EMP Report.

V. The Consultants involved in preparation of EIA-EMP report should have accreditation from Quality Council of India/National Accreditation Board of Education and Training (QCI/NABET) as per EIA Notification 2006 and would need to include a certificate in this regard in the EIA-EMP reports prepared by them.

VI. The project proponent shall submit the detailed final EIA-EMP report prepared as per ToRs, to the SEIAA Mizoram for considering the proposal for Environmental Clearance within 4 years, as per EIA Notification amendment S.O.751(E) dated 17.02.2020.

VII. The prescribed ToRs shall be valid for a period of 4 years for submission of EIA-EMP reports.

Yours faithfully,

(R.S.SINHA)
Addl. Principal Chief Conservator of Forests
& Member Secretary, SEIAA Mizoram

Memo. No.A.11011/1(A)/2022-SEIAA(EC)/ 8-11 Dated Aizawl, the 1st April, 2022

Copy to :

1. P.S to PCCF (HoD), EF& CC Dept. and Chairman SEIAA Mizoram for kind information.
2. Prof. Lalnuntluanga, Member SEIAA Mizoram for kind information.
3. Conservator of Forests (P&D), EF&CC for kind information.
4. Chairman, SEAC Mizoram for kind information
5. Secretary SEAC Mizoram for information.
6. Member Secretary, Mizoram Pollution Control Board for kind information.
7. Officer-in-charge, Regional Office (NEZ), MoEF&CC, Shillong for kind information
8. Guard File

(R.S.SINHA)
Addl. Principal Chief Conservator of Forests
& Member Secretary SEIAA, Mizoram