Environmental Management Plan

7.1 Structure of EMP

Environmental Management Plan (EMP) is the key to ensure a safe and clean environment. The desired results from the environmental mitigation measures proposed in the project may not be obtained without a management plan to assure its proper implementation and function. The EMP envisages the plans for the proper implementation of mitigation measures to reduce the adverse impacts arising out of the project activities. EMP has been prepared addressing the issues like:

- Pollution control/mitigation measures for abatement of the undesirable impacts caused during the construction and operation phase of the project.
- Details of management plans (landscape plan, solid waste management plan etc)
- Institutional set up identified/recommended for implementation of the EMP
- Post project environmental monitoring programme to be undertaken

7.2 Site Selection Criteria and Mitigation Measures

The dumping site used by Municipal Council had been proposed for onsite development of municipal solid waste management facilities has been evaluated on the basis of criteria as per CPHEEO table – 7.1. All the features as described in the criteria proposed by CPHEEO have been investigated for the chosen site. The identified area of the site (leaving 100 m distance from the river) does not have any negative parameters to be rejected based on evaluation criteria. Hence the site has been taken for detailed investigation and mitigation measures are proposed in next section.

Table 7.1: Site Selection Criteria and Mitigation Measures

Components	Specified limits as per CPHEEO manual	Aizawl Municipal Solid Waste Site condition	Measures
Lake or pond	More than 200 m from landfill	No	
River/ Canal	More than 100 m from landfill	No river or canal is/around the site. However there are two small seasonal streams are	In order to avoid water contamination necessary measurements like cemented floor for windrows, leachate collection system, proper

			cemented drainage network for composting plant and leachate treatment system should be established (please refer EMP) Additionally, a frequent monitoring system to check the water quality of canal should be incorporated.
Flood plain	More than 100 years	No	
Highway	More than 200 m from state or national highway	**Yes**	National highway NH-54 is approx 2 Km away from proposed site.
Habitation	More than 500 m	**Yes**	There is no habitation within 4 km radius of proposed site. Proper fencing and boundary wall will restrict the solid waste within the site. Moreover, green belt improves the aesthetic look. Additionally some measures to control dust and odour have already given in management plan.
Public parks	More than 300 m	Yes	There is no nation park within 4 km radius of proposed project site.
Critical Habitat Area	No habitation of endangered or protected species	No	No such species in project area.
Wetlands	Not to be in wetland	No	No such species in project area.
Ground water table	More than 2 m	Yes	Yes it's more than 2 meter.
Airport	More than 20 km	Yes	The nearest Airport is Lengpui, 32 Km from the city.
Water supply well	More than 500 m	No	There is no water supply well within 10 km of radius.
Coastal regulation zone	Not within CRZ	No	No Such area.
Unstable zone	Not within landslide/ fault zone area	Yes	The project site fall in seismic zone v.

Table 7.2: Site Selection Criteria and Mitigation Measures (As per MSWMH2000)

SL N.	Specified as per MSWMH 2000 rule	Aizawl Municipal Solid Waste Site condition
1	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.	Responsible department is UD&PA, in Aizawl very recently (in November 2010) Municipal Council has been formed but till date it is not functioning properly.
2	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 organisations for obtaining the necessary approvals and clearances.	All the environmental issues have been considered no sensitive feature has been identified. Required statutory clearance shall be taken prior to start of construction work.
3	The landfill site shall be planned and designed with proper documentation of a phased construction plan as well as a closure plan.	It has been planed accordingly.
4	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 proposed site is adjacent to existing dumping site. Composting unit has been proposed to establish as a part of Municipal Solid Waste Management Facility.
5	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.	It is planned.
6	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 proposed facility is only for Municipal Waste. Biomedical waste of the Aizawl city will be handled separately.
7	The landfill site shall be large enough to last for 20-25 years.	The proposed land fill site is for 15 years.
8	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.	No such sensitive area withn a arduous of 10 km. There is no human settlement within radius of 4 km of proposed project site.
9	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.	A buffer zone of no-development has been proposed within boundary of

		500 meters
10	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.	The nearest Airport is Lengpui, 32 Km from the city.

7.3 Management of Municipal Solid Wastes (Accordance with MSW rules 2000)

S.no	Parameters	Management (As per MSW rules-2000)
1.	**Collection of municipal solid wastes**	1. Littering of municipal solid waste shall be prohibited in cities, towns and in urban areas notified by the State Governments. To prohibit littering and facilitate compliance, the following steps shall be taken by the Aizawl Municipal Council. a. Organizing house-to-house collection of municipal solid wastes through any of the methods through community bin collection (central bin), house-to-house collection, collection on regular pre-informed timings and scheduling by using bell ringing. (without exceeding permissible noise levels); b. Devising collection of waste from slums and squatter areas or localities including hotels, restaurants, office complexes and commercial areas; c. Wastes from slaughter houses, meat and fish markets, fruits and vegetable markets, which are biodegradable in nature, shall be managed to make use of such wastes; d. Bio-medical wastes and industrial wastes shall not be mixed with municipal solid wastes and such wastes shall follow the rules separately specified for the purpose; e. Collected waste from residential and other areas shall be transferred to community bin by small vehicles; f. Horticlutural and construction or demolition wastes or debris shall be separately collected and disposed off following proper norms. Similarly, wastes generated at dairies shall be regulated in accordance with the State laws; g. Waste (garbage, dry leaves) shall not be burnt; h. Stray animals shall not be allowed to move around waste storage facilities or at any other place in the city or town and shall be managed in accordance with the State laws. i. The municipal authority shall notify waste collection schedule and the likely method to be adopted for public benefit in a Aizawl City

		j. It shall be the responsibility of generator of wastes to avoid littering and ensure delivery of wastes in accordance with the collection and segregation system to be notified by the municipal authority.
2.	Segregation of municipal solid wastes	In order to encourage the citizens, municipal authority shall organise awareness programmes for segregation of wastes and shall promote recycling or reuse of segregated materials. The municipal authority shall undertake phased programme to ensure community participation in waste segregation. For this purpose, regular meetings at quarterly intervals shall be arranged by the municipal authorities with representatives of local resident welfare associations and non-governmental organizations.
3.	**Storage of municipal solid wastes**	Municipal authorities shall establish and maintain storage facilities in such a manner as they do not create unhygienic and insanitary conditions around it. Following criteria shall be taken into account while establishing and maintaining storage facilities, namely :- a. Storage facilities shall be created and established by taking into account quantities of waste generation in a given area and the population densities. A storage facility shall be so placed that it is accessible to users; b. Storage facilities to be set up by municipal authorities or any other agency shall be so designed that wastes stored are not exposed to open atmosphere and shall be aesthetically acceptable and user-friendly; c. Storage facilities or 'bins' shall have 'easy to operate' design for handling, transfer and transportation of waste. Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be printed white and those for storage of other wastes shall be printed black; d. Manual handling of waste shall be prohibited. If unavoidable due to constraints, manual handling shall be carried out under proper precaution with due care for safety of workers.
4.	**Transportation of municipal solid wastes**	Vehicles used for transportation of wastes shall be covered. Waste should not be visible to public, nor exposed to open environment preventing their scattering. The following criteria shall be met, namely:-

		a. The storage facilities set up by municipal authorities shall be daily attended for clearing of wastes. The bins or containers wherever placed shall be cleaned before they start overflowing; b. Transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal, is avoided.
5.	**Processing of municipal solid wastes**	Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to minimize burden on landfill. Following criteria shall be adopted, namely:- a. The biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of wastes. It shall be ensured that compost or any other end product shall comply with standards as specified in Schedule-IV; b. Mixed waste containing recoverable resources shall follow the route of recycling. Incineration with or without energy recovery including pelletisation can also be used for processing wastes in specific cases. Municipal authority or the operator of a facility wishing to use other state-of-the-art technologies shall approach the Central Pollution Control Board to get the standards laid down before applying for grant of authorisation.
6.	**Disposal of municipal solid wastes**	Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, land-filling shall be done following proper norms. Landfill sites shall meet the specifications as given in Schedule –III.

7.4 Proposed environmental mitigation measures

It is imperative to identify the potential impacts likely to occur due to the proposed project at an early stage and their mitigation measures are suggested in order to ensure environmentally sustainable development. A comprehensive approach was adopted for

screening out the potential environmental impacts pertinent to the proposed project of municipal solid waste management facility. Significant impacts related to site selection, design, construction and operation & maintenance phases of the proposed project were identified. The major impacts due to different project activities and their mitigation measures have been identified in Chapter 6. As described in chapter 2 the project has three main components:

- Segregation Plant
- Composting Plant
- Landfill and

All these components have some adverse environmental impacts. To control these adverse environmental impacts and to increase the project benefits effective EMP for each component is required separately.

7.5 EMP for Municipal Solid Waste Management Facility:

The significant impacts of different stages (Pre-construction, construction and operation & maintenance phases) of the proposed MSW management facility on different components of environment were identified and their mitigation measures are given below:

7.5.1 Air Quality:

Air quality of the project site and neighboring areas will be affected due to the project activities. Impacts on air quality on different stages of the project and environment management plan for these impacts are given below:

A. Pre-construction Phase:

During pre- construction phase, only the site preparation activities will be carried out. Trees will be cut down (as significant number of trees present within project boundary); no structures needs be demolished at project site. These activities will generate dust. Following management measures shall be used to mitigate dust emission:

- Excavation work will be sprayed with water.
- Workers will be provided with masks for protection against the inhalation of dust and be trained in its use.
- The contractor will take every precaution to reduce the level of dust at the sites involving earthwork, by frequent sprinkling of water.
- Activities causing dust will not be carried out on excessively windy days.

Institutional Responsibility:- Design Supervision Management Consultant (DSMC)/ Contractor.

B. Construction Phase:

During construction of MSW management facility dust and exhaust gases of vehicular emissions may be generated. Management measures proposed are:

Gaseous Emissions

- All vehicles, machinery, equipment and generators used during construction activities shall be in good condition and shall be properly tuned and maintained by the contractor and confirm that pollution emission levels comply with the relevant requirements of SPCB.
- Open burning of any waste from contractor's camps shall be strictly banned.

Dust Emission

The majority of dust problems caused by the construction of the project will be mitigated by implementation of a few simple procedures by the contractor:

- The contractor will take every precaution to reduce the level of dust along construction sites involving earthwork, by frequent sprinkling of water.
- The Contractor will confirm that all crushers used in construction shall conform to relevant dust emission control legislation. Clearance for siting shall be obtained from the SPCB (if it is required to establish). Alternatively, only crushers licensed by the SPCB shall be used.
- Construction activities causing dust will not be carried out on excessively windy days.
- Unsealed routes for earthmoving equipment and general transport will be regularly sprayed with water during dry weather.
- Excavation work will be sprayed with water.
- Construction workers will be provided with masks for protection against the inhalation of dust and be trained in its use.

The management measure shall include agreed timings for movement of construction vehicles in agreement with the local population.

Institutional Responsibility:- Design Supervision Management Consultant (DSMC)/ Contractor.

C. Operation & Maintenance Phase:

The operation phase of this facility will involve movement of waste collection & transfer vehicles and machinery, segregation of waste, composting, fugitive dust & odour

emission from waste handling in landfill site, which may result in generation of odour, dust and gaseous emissions.

The management measures for different air pollutants are given below:

Odour:

- Maintaining buffer zone and plantation around the facility.
- The waste should not be stored for more than 24 hours at site. If the waste is stored more than 24 hours the stockpile height should not exceed 3 meters and the area of waste stockpile should have provision for odour control.
- Vehicles carrying solid waste shall be covered.
- It is preferable that the container and bins used for collection of wastes should be of closed type so that the waste is not exposed and thus the possibility of spreading of disease through flies and mosquitoes is minimized.
- Collection system should be properly supervised so that quick and regular removal of waste from the dustbin is practiced.
- Compost plant should have some provision for odour control.
- Waste to be promptly disposed of in appropriate cells of landfill, covered with soil to control release of hazardous gases and unpleasant odour emitting emissions.

Dust and gaseous emissions:

- All vehicles, machinery, equipment and generators used during project activities shall be in good condition and shall be properly tuned and maintained by contractor in order to minimize the exhaust emission.
- Emissions from waste handling areas shall be controlled by provision of covered areas, proper ventilation and by maintaining negative pressure. Herbicides will be sprayed to discourage further decomposition of MSW.
- Water spray system shall be provided around the Site.
- Internal unpaved roads and transportation roads will be sprayed with water to minimize dust.
- Tree plantation on the completed section of the landfill site as well as around the project site should be carried out to reduce the dust emission and minimize adverse aesthetic impact
- Monitoring of the operational performance of the various mitigation /enhancement measures will be carried out as a part of this project.
- Monitoring of various air quality parameters shall be carried out to check the effectiveness of EMP.

Institutional Responsibility:- Design Supervision Management Consultant (DSMC)/ Contractor and after commissioning Aizawl Municipal Council/SIPMIU.

7.5.2 Water Quality:

Project activities will affect the quality of surface as well as ground water. The suggested management plan for water quality and quantity is as follows:

A. Pre-construction Phase:

During pre-construction phase the contractor shall ensure following:

- The proposed site is located in hilly area, so proper embankment design shall be prepared to prevent flooding in rainy season.
- The contractor will arrange the water primary work of pre-construction such as site clearance and construction purpose.
- The contractor will need to comply with the requirements of the state Ground Water Department before extracting ground water and seek their approval for doing so.
- Contractor can use the nearby stream, water which are not in use by community or identified to fill up for the project, but in that case, before using any surface water, contractor will inform the concerned authority/ user (if any) . To avoid disruption / disturbance to other water users, the contractor will extract water from fixed locations.
- The contractor will not be allowed to pump from any irrigation channel and other surface water bodies used by local community.
- Contractors shall design sewage treatment facility for treatment of liquid waste generated from labour camp, wastewater, leachates from Landfill and compost plant.

Institutional Responsibility:- Design Supervision Management Consultant (DSMC)/ Contractor.

B. Construction Phase:

During construction phase the contractor shall ensure the following:

- Contractor will ensure that no construction materials like earth, stone, ash or appendage disposed off so as not to block the flow of water of any water course, and cross drainage channels.
- In addition to the design requirements, the contractor will take all required measures to prevent temporary or permanent flooding of the site or any adjacent area. The Contractor will not excavate beds of any stream/ canals/ any other water body for borrowing earth for embankment construction.
- Contractor will ensure that construction materials containing fine particles stored in an enclosure such that sediment-laden water does not drain into nearby watercourse.
- The contractor will ensure that all construction vehicle parking location, fuel /lubricants storage sites, vehicle, machinery and equipment

maintenance and refueling sites will be located away from any source of surface water.

- Contractor will ensure that all vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the water. Oil interceptor/grease chamber shall be provided for vehicle parking, wash down and refueling areas. Field storage will be in proper bunded areas.
- In all fuel storage and refueling areas, if located on agricultural land or areas supporting vegetation, the topsoil will be stripped, stockpiled and returned after cessation of such storage. Contractor will arrange for collection, storing and disposal of oily wastes to the approved disposal sites. All spills and collected petroleum products will be disposed off in accordance with MoEF and MPCB guidelines.
- Proper drainage system (open or closed) should be prepared to meet the water requirement.
- The project area shall be protected by proper embankment to prevent flooding.
- Proper separate drainage pattern should be prepared to divert the flood water/rain water.

Institutional Responsibility:- Design Supervision Management Consultant (DSMC)/ Contractor.

C. Operation & Maintenance Phase:

During operation and maintenance phase of the landfill following precautions should be taken:

- It will be ensured that all drains are periodically cleared especially before monsoon season to facilitate the quick passage of rainwater and avoid flooding.
- Leachates collection system shall be fully operative to prevent the contamination of the ground water of the area. The leachate generated will be collected in the sump/Leachate collection tank and treated by recirculation method.
- To protect the windrows of compost plant from heavy rainfall, the windrow area shall have provision for quick cover.
- All windrow areas should be provided with an impermeable base made of concrete or of compacted clay.
- The base should be 50 cm thick having permeability less than 10 cm per second. The base must be provided with 1 to 2 percent slope and must be encircled by lined drains for collection of leachates/surface water runoff
- Provision of liners (a compacted clay layer) at the landfill site before the start of filling operations.

- Regular checking for functioning of leachates collection, treatment and disposal system.
- Regular monitoring of ground water from the site shall be carried out to check whether any contamination is present.
- The surface water run-off shall be collected and safely treated and disposed off to prevent accumulation of water and avoid breeding of flies, mosquitoes.

Institutional Responsibility:- Aizawl Municipal Council (AMC)/SIPMIU

7.5.3 Soil Quality:

The project site is located on un-used private forest land as well as government land belongs to UD&PA department. The activities of the project can affect the soil quality and change its properties. To mitigate the impacts on soil following precautions management shall be taken by the concern authority:

A. Pre-construction Phase:

The project site is present in low lying /hilly un-used private forest land. Construction of MSW management facility on this site will change the land use of the area. Since, it is the only site available with SIPMIU for the proposed project so some specific precautions shall be taken during designing phase.

- Proper landscaping and vegetation will have to be provided to minimize the impacts on the ecology of the area.
- Baseline study of soil physical & chemical properties shall be done.
- Precautionary measures should be designed to prevent the loss of top soil.
- Identify proper source for soil, required for embankment height and leveling of ground.

Institutional Responsibility:- Design Supervision Management Consultant (DSMC)/ Contractor.

B. Construction Phase:

The construction phase of the proposed facility will involve open excavations from landfill site and the possibility of silt run-off in case of rain. These operations may cause soil erosion. It may also affect the land value. During rainy period, the eroded soil will transform into slush, which can affect movement of construction vehicles and machinery. Following mitigation measures shall be taken to minimize the negative impacts due to soil erosion:

- Restore/Stabilize all the freshly cut surfaces around the borrow pits, steep slopes and along drainage channels as soon as possible.
- Planning construction activities in such a way so as to avoid cutting of erodible surfaces and earth movement in rainy season.
- Trimming down of slopes.
- The soil removed for landfill construction can be used for leveling of ground and preparing access roads.

Institutional Responsibility:- Design Supervision Management Consultant (DSMC)/ Contractor

C. Operation & Maintenance Phase:

Monitoring of the operational performance of the various mitigation/enhancement measures will be carried out as a part of this project. The indicators selected for monitoring include the survival rate of trees, status of rehabilitation of borrow areas, physico-chemical characteristics of soil etc.

Institutional Responsibility:- AMC/SIPMIU

7.5.4 Noise Quality:

Project activities on the site increase the noise level and affect the surrounding habitants. To control the noise pollution some measures should be taken in every phase of the project.

A. Pre-construction Phase:

During this phase, noise will be generated during demolition work(As minor demolition/removal of tree is required) only. This is short term activity and will not create any hazards/significant impact to the surrounding people.

B. Construction Phase:

The Contractor will confirm the following:

- All plants and equipment used in construction (including the aggregate crushing plant) shall strictly conform to the CPCB noise standards.
- All vehicles and equipment used in construction will be fitted with exhaust silencers.
- Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced.
- Limits for construction equipment used in the project such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A) (measured at one meter from the edge

of equipment in the free field), as specified in the Environment (Protection) rules, 1986.

- Maintenance of vehicles, equipment and machinery shall be regular.
- Providing residents/commuter with advance warning of construction activities.
- Where possible, confining noisy work to normal working hours in the day.
- Providing the construction workers with suitable hearing protection devices like ear plug and provide training them in its use.
- Restricting construction traffic movements during the night time

Institutional Responsibility:- Design Supervision Management Consultant (DSMC)/ Contractor

C. Operation & Maintenance Phase

During operation phase of the project the waste transporting vehicles, compactors etc will generate noise and affect the local residents/commuter. Below mentioned precautionary measures shall be followed by the operator:

- Noise pollution will be monitored as per monitoring plan at sensitive locations. Noise control programs to be enforced strictly.
- Ban use of pressure horns.
- Strict check of silencers and vehicles generating excess noise levels.
- Tree plantation act as noise barrier help in minimizing noise level in the surrounding.

7.5.5 Flora and Fauna

The project site is located adjacent to existing dumping site. Vicinity of site represents open forest area (private). No endangered species of flora and fauna is present in and around the site. But to prevent the damage to domestic flora and fauna some steps shall be taken while execution of the project.

A. Pre-construction Phase:

Significant numbers of trees are expected to be cut as the proposed site is in forest (open & private) forest area. The present area (partly) is being used for dumping of municipal wastes. There are sparse vegetation covers in the proposed project site.

B. Construction Phase

The contractor will take reasonable precaution to prevent his workmen or any other persons from removing and damaging unnecessary flora (plant/vegetation) and fauna (animal) around the site. The site is away from the city and very few domestic animals are present in and around the site (details has been given in chapter 5 ie**. 5.9 Biological Environment/Bio Assessment Study area**). There

will be no significant negative impact on these animals present at the site and in the vicinity of the area. There are no endangered species of animal or birds in the area, hence, no significant negative impacts are envisaged on the fauna.

C. Operation & Maintenance Phase

During operation and maintenance phase of the project the proper maintenance of the surrounding buffer zone or plantation shall be done. The site shall be properly fenced to avoid the entry of animals. The waste layer shall be covered with proper soil layer daily to avoid the growth of disease causing vectors and also to avoid the birds flock.

7.5.6 Social Environment:

During site selection for the municipal solid waste management facility a numbers of social factors have been taken in to account. A numbers of factors like aesthetics, diseases, odour etc affect the site selection for landfill site. The best site for landfill site has been selected viewing all the available site, away from the densely populated areas. The site is away from airport and the flight path as the birds on the site can cause flight accidents. The final selection of the site have been done by comparing:

- the environmental impacts;
- social acceptance; and
- transportation and landfilling cost

After finalizing the site a number of social factors have been taken into account during different phases of the project to prevent the degradation of social environment.

A. Pre-construction Phase:

During designing phase of MSW management facility all the following social factors are to be addressed:

- Elimination of source of health hazard;
- Substitution of hazardous processes and materials by those which are less hazardous;
- Geographical or physical isolation of hazards from vulnerable communities, for example, by land zonation;
- Use of engineering controls to reduce the health risk. For example, collection containers and bins shall be closed type so that spreading of disease through flies and mosquitoes is minimized;
- Adoption of safe working practices such as regular equipment maintenance;
- Designing of suitable personal protective equipment, such as rubber gloves.

- Surveillance and monitoring of site specific health hazards, general health status of local communities, location and functioning of health services
- Effective designing for maintaining the aesthetic look of the site.

B. Construction Phase

Contractor will provide:

- Protective footwear and protective equipments to all workers employed during construction.
- welder's protective eye-shields to workers who are engaged in welding works
- protective goggles and clothing to workers engaged in stone breaking activities and workers will be seated at sufficiently safe intervals
- Earplugs to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation.
- The contractor will not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form.
- The contractor shall do OHS monitoring, environmental health, water supply, sanitary system, drug supply, vector monitoring
- The contractor will ensure that the sewage system for the camp are designed, built and operated in such a fashion that no health hazards occurs to the workers.
- The contractor will provide garbage bins in the camps and regularly emptied and disposed off in a hygienic manner as per the comprehensive Solid Waste Management plan for the labor's camp

C. Operation & Maintenance Phase

During operation and maintenance phase the operator will ensure:

- Contractor will confirm routine medical examination, action oriented disease trend analysis, child growth monitoring, OHS monitoring, infant mortality monitoring, vector monitoring, casualty rates etc
- Contractor will ensure the aesthetic value of the site and its surrounding.
- Use closed container for transportation of waste to avoid the spreading of foul odour
- Hazardous waste shall be handle with extra care
- Daily coverage of waste by soil covers in landfill to prevent the growth of disease vectors.
- Spraying of insecticides, rodenticides etc. to control insects, pests and rodents proliferation in the Site.
- Regular check-up of workmen health and provision of necessary vaccinations to prevent the spread of any disease.

- To cope with any fire hazard due to gas combustion or due to failure of gas collection and disposal system fire extinguishers will be provided at the Site.
- An occupational Health & Safety Plan shall be prepared by contractor for operation of site and protection of workers & neighboring areas.
- The workers directly involved in collection and disposal activities should be provided with goggles, gum boots, hand gloves, mask, etc.

7.5.7 Labour Camp Management:

The contractor will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour at the location identified for such facilities in pre-construction phase.

The Contractor will provide these facilities within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, as per standards set by the Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996.

The Contractor will construct and maintain all temporary accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing.

The contractor shall also guarantee the followings:

- Supply of sufficient quantity of potable water in every workplace/labour campsite at suitable and easily accessible places and regular maintenance of such facilities.
- If any water storage tank is provided that will be kept at a distance of not less than 15 m. from any latrine, drain or other source of pollution.
- If water is drawn from any existing well, which is within close proximity of any latrine, drain or other source of pollution, the well will be disinfected before water is used for drinking.
- All such wells will be entirely covered and provided with a trap door, which will be dust proof and waterproof.
- A reliable pump will be fitted to each covered well. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once in a month.

Resident Engineer will be required to inspect the labour camp to ensure the compliance of the EMP.

The contractor shall ensure that

- the sewage system for the camp are designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent watercourses take place

- separate latrine and urinals, screened from those from men (and marked in the vernacular) are provided for women workers
- adequate water supply shall be there to all latrines and urinals
- all latrines in workplaces shall have properly designed septic tanks with soak pits and all latrines, and urinals are cleaned at least twice during working hours and kept in a strict sanitary condition
- The designs of septic tanks and soak pits shall be as per the manual on sewerage system prepared by CPHEEO. The designs shall be approved by Resident Engineer.
- The contractor will provide garbage bins in the camps and regularly emptied and disposed off in a hygienic manner as per the comprehensive Solid Waste Management plan for the labour/ contractor's camp approved by the Resident Engineer.
- Contractor will follow all relevant provisions of the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp.
- The site will be left clean and tidy, at the contractor's expense, to the entire satisfaction to the Resident Engineer.

7.5.8 Recommendation for Measures for Pollution Control

The following management measures have been formulated as mitigation measures to overcome any adverse environmental impact due to the project construction, operation and ultimate closure. The proposed measures are in conformity with the Municipal Solid Waste (Management and handling) Rules,2000 under Environment Protection Act 1986.

- A buffer zone of no development will be maintained around the landfill to isolate from adjoining areas. The landfill site will be boundary wall with proper gate and gate so that no person is exposed to health hazards of land fill. A bottom layer of non-permeable lining system at the base and walls of the waste disposal area to arrest leachate percolation to ground water will be provided.
- Incoming waste will be compacted in layers and covered with soil periodically.
- There will be provisions of leachate collection and treatment. There will be provision for prevention of runoff from landfill.
- Periodic health inspection of workers at the landfill site will be organized to put a check on occupational health hazards.
- Plantation of locally adopted non-edible perennial plants that are resistant to drought and extreme temperature and allowed to grow. The selected plant species to have the ability .to thrive on low nutrient soil with minimum nutrient addition.

- The landfill site will be boundary wall with proper gate and gate so that no person is exposed to health hazards of land fill.
- A bottom layer of non-permeable lining system at the base and walls of the waste disposal area to arrest leachate percolation to ground water will be provided.

7.5.9 Greenbelt Development

A green belt is provided to mitigate various emissions. Green belts are wide strip of trees and shrubs planted in rows to reduce air velocity thereby facilitating settling of the particular pollutant on the leaf surfaces and allowing absorption of the pollutant gases. It also serves to cool the atmosphere by transpiration from the leaf surfaces and also provide habitat for birds, reptiles and insects. Greenbelts are important habitats for birds and animals, which add to the aesthetic value of the environment. Generally, birds prefer to make their habitat, nest, on trees. Further trees provide shade and hiding place to wild life. The advantages of a green belt are given below:

- Greenbelt helps to restore the ecological balance.
- Greenbelt helps in prevention of soil erosion.
- Greenbelt helps to improve the aesthetics in the area.
- The greenbelt also diminishes noise pollution by absorbing high degree of noise due to their spongy foliar crown.

7.5.10 Selection criteria of Plant species for Green belt development

The selection of plant species for the development depends on various factors such as climate, elevation and soil. The pants should exhibit the following desirable characteristic in order to be selected for plantation.

1. The species should be fast growing and providing optimum penetrability.
2. The species should be wind-firm and deep-rooted.
3. The species should form a dense canopy
4. As far as possible, the species should be indigenous and locally available.
5. Species tolerant to air pollutants like SPM, SOx and NOx should be preferred
6. The species should be permeable to help create air turbulence and mixing within the belt

The pollutants namely dust/fugitive emissions, sulphur dioxide, smoke and carbon dioxide along with the noise pollution can be effectively curbed by planting the below mentioned specific floral species. The proposed plantation would include:

Table 7.3: List of Floral Species for Controlling

S.No.	**Sulphur Dioxide**	**S.No.**	**Dust/Fugitive Emissions**
1.	*Casuarina equisetifolia*	1.	*Ficus sp.*
2.	*Albizia lebbeck*	2.	*Azadirachta indica*
3.	*Acacia nilotica*	3.	*Tamarindus indica*
4.	*Azadirachta indica*	4.	*Butea monosperma*
5.	*Delonix regia*	5.	*Lagerstroemia speciosa*
6.	*Moringa oleifera*	6.	*Peltophorum sp.*
7.	*Eucalyptus sp.*	7.	*Pterocarpum sp.*
8.	*Morus Alba*	8.	*Tectona Grandis*
9.	*Psidium guauva*	9.	*Grevillea robusta*
10.	*Syzygium cumini*	10.	*Terminilia arjuna*
11.	*Zizyphus mauritiana*	11.	*Holoptelea integrifolia*
S.No.	**Smoke & Carbon monoxide**	**S.No.**	**Noise**
1.	*Alianthus excelsa*	1.	*Azadirachta indica*
2.	*Azadirachta indica*	2.	*Aegel mermelos*
3.	*Bougainvillea spectabius*	3.	*Cassia siamea*
4.	*Cassia fistula*	4.	*Albizzia procera*
5.	*Albizia lebbeck*	5.	*Carris carandas*
6.	*Delonix regia*	6.	*Peltophorum inerme*
7.	*Holoptelea integrifolia*	7.	*Saraca indica*
8.	*Moringa oleifera*	8.	*Syzygium cimunii*
9.	*Pithecellobium dulce*	9.	*Tamarindus indica*
10.	*Polyalthia longifolia*	10.	*Thivetia puruviana*
11.	*Derris indica*	11.	*Pongamia pinnata*
S.No.	**Plant Species for protection against strong winds**	**S.No.**	**For Roadside plantation**
1.	*Tabernaemontana coronaria*	1.	*Petophorum inerme*
2.	*Cadrella toona*	2.	*Pongamia pinnata*
3.	*Ficus religiosa*	3.	*Saraca indica*
4.	*Dalbergia sissoo*	4.	*Delonix regia*
5.	*Borassus flabellifer*	5.	*Azadirachta indica*
6.	*Hardwickia binnata*	6.	*Samania saman*
		7.	*Cassia nodosa*

		8.	*Baucinia Latifolia*
		9.	*Bauncinia variegate*
		10.	*Acacia auriculiformis*