ANTICIPATED ENVIRONMENTAL IMPACTS AND ITS MITIGATION MEASURES

6.1 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.

6.2 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 DG set (80 kW/100 KVA -1 no.), 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 D.G. Set etc. and during operation phase, the source of noise will be due to the operation of machineries and transportation.

6.3 SOURCE OF AIR POLLUTION AND MITIGATION

6.3.1 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.

6.3.2 During Operation Phase

The vehicular traffic generated due to the proposed project is negligible as compared to the total traffic on Aizwal 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 D.G set. 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 DG set (80 kW/100 KVA - 1 no.), 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. • The DG sets will be housed in an inbuilt acoustic enclosure and will be provided with adequate stack height of 3.2 m (as per the norms of CPCB) so that the emissions are well within the norms.

	• 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. • Since the project is near the National highway 54, so the tail pipe emissions from material handling will be insignificant to that of road itself.

A detail study for Air Quality prediction has been carried out using AERMOD software which is primarily an air dispersion model and LANDFILL GAS EMISSION MODEL (LANDGEM) to estimate the gaseous emissions from the proposed landfill site. The result of this study has been elaborated in a separate section which is mentioned at the end of this chapter.

6.4 SOURCE OF WASTE WATER AND MITIGATION

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

6.4.1 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	• The waste water generated will be treated in a

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.	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.

6.4.2 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 10 KLD which will be met from bore well (1 nos.) • Uncontrolled discharge of storm water may cause flooding of the area.	• Daily demand of 10 KLD which will be met from bore well (1 nos.) as well as from nearby surface water. As the rain in the project area is significant (annual average rain fall is 2080 mm) predominantly surface water will be used. • The storm water drains have been designed in line with the peak intensity of rainfall which will help in minimizing the problem of flooding.

• 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 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.

6.4.3 Rain Water Harvesting Scheme

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

6.5 IMPACT ON LAND ENVIRONMENT AND MITIGATION

6.5.1 During Construction Phase

The proposed project will be developed on the land of UD&PA department and private land owner. 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 shrubs and weeds type of wild vegetation which grows during the rainy season and is used as fodder for the animals. • Waste will be generated from the various construction activities.	• There will be permanent change in the land use pattern. The site will be used as a treatment facility for 125 TPD Municipal Solid waste of Aizwal district.At present the site is not used for any grazing purpose. • 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.

6.5.2 During Operation Phase

IMPACT	MITIGATION
• The proposed project is 125 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.

6.6 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.

6.6.1 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 6.1:

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
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 D.G. Set etc.	• 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 D.G. sets used will be environmentally acceptable with minimum noise. • Ear plugs will be provided to the workers.

6.6.2 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 equipments of the power plant
- Noise due to vehicular movement inside the plant premises and on the NH 54.

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. • D.G set is proposed to be housed in an inbuilt acoustic enclosure. • 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 provided to the workers.

6.7 IMPACT OF SOIL ON ENVIRONMENT AND MITIGATION

6.7.1 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.

6.7.2 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.

6.8 IMPACTS ON ECOLOGICAL ENVIRONMENT

6.8.1 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 in a 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. However, species like Callosciurus erythraeus, Muntiacus muntjak, Sus scrofa, Gallus gallus, Chalcophaps indica, Pycnonotus melanicterus flaviventris, etc are found which may fall prey to hunting and poaching by the construction workers.

AQUATIC ECOLOGY

Impact on Flora

The survey indicated that there is no major river except three 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 only five species of fish could be collected from the three streams of the study area. Though the presence of other species like Devario alquipinnatus, Badis badis, Amblyceps mangois etc were reported by the local people. The study area is fairly rich in faunal species but the impact could not be stated as these streams do not flow inside the Proposed Project Site. However, these fishes may fall prey for fishing during construction by the workers. Human excreta and sanitary waste of the workers during construction should not be dump or discharge into these streams which may have adverse impacts on the aquatic ecosystem.

Impact on amphibian and aquatic avifauna

The study recorded only two common amphibian species viz., Cyanophlyetis and Rana limnocharis, and only one aquatic bird Achedo atthis which are both common in other places and so the impact could be considered as negligible.

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. Some species such as Callosciurus erythraeus, Muntiacus muntjak, Sus scrofa, Gallus gallus, Chalcophaps indica, Pycnonotus melanicterus flaviventris were recorded from the proposed site. These species will be temporarily affected and may be migrated to nearby areas.

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.

6.8.2 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.

6.8.3 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.

6.8.4 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.

6.9 SOCIO-ECONOMIC IMPACT

Positive Impacts

- The project is a mandatory project for the well being of the people of Aizwal 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.

6.9.1 Anticipated Negative Impacts

- Small scale resettlement and rehabilitation activities are involved in this project as the proposed site is partly Private land (10 hectares) and partly government land (5 hectares).
- Other losses like problem in accessibility and community linkage, health and safety during and after construction, and temporary change in demographic configuration are mitigable with minor to negligible residual impacts.

6.10 IMPACTS DUE TO CONSTRUCTION CAMP AND IMMIGRATION OF WORKERS

6.10.1 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.

6.10.2 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.

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

6.10.4 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.

6.10.5 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.

6.10.6 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.

6.10.7 Transports and Storage of Materials

The construction material primarily will consist of aggregate, sand, cement, bitumen, lubricating oil and fuel for vehicle and construction equipments. 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.

6.11 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.

6.12 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.

6.13 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.

6.14 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.

6.15 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.

6.16 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.

6.17 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.

6.18 Prediction of Impacts due to Air Pollution

6.18.00 General

Prediction of impacts is the most important component in environmental impact assessment process for deriving quantitative contribution of pollutants from the proposed project in the surrounding region. Several mathematical/statistical techniques and methodologies are available for predicting impacts due to developmental activities on physico-chemical, ecological and socio-economic components of environment. The quantitative impacts derived from prediction are also essential to delineate pragmatic environmental management plan (Pollution control measures) for implementation during construction and operation phases of proposed activities for minimizing the adverse impacts on environmental quality.
Mathematical models are the best tools to quantitatively describe cause-condition-effect-relationship between source of pollution and different components of environment. In case, mathematical models are either not available or it is not possible to identify/validate models for a particular situation, predictions are arrived at through available scientific knowledge and judgments.

The mathematical model used for carrying out predictions in the present study included, AEROMOD which is primarily an air dispersion model and LANDFILL GAS EMISSION MODEL (LANDGEM) to estimate the gaseous emissions from the proposed landfill site.

6.18.01 Objective

The air dispersion modeling study aims at highlighting the potential air quality impacts associated with the operational phases of the proposed project on the surrounding environment (i.e. Air Sensitive Receptors – ASRs) during operations.

The other key objective of this air dispersion modeling study is that it to propose recommendations (if required) concerning possible mitigation measures in order to reduce the likely air quality impact of the proposed project.

The air dispersion modeling work carried out for the operational phase of the proposed development was carried out based on the information available in this stage of the development and is based on various assumptions.

6.18.02 Scope

The scope of the air dispersion modeling/assessment includes air quality impacts due to emissions from land fill sites during the Year 2011, 2016, 2021 and 2026 in the adjoining areas. Parameters include CO, NOx, SO2 and PM. The hourly and 8-hourly concentration averages have been computed for CO, whereas for all the other pollutants 24-hourly

averages have been computed and compared against the relevant National Ambient Air Quality Standards (NAAQS).

6.18.03 National Ambient Air Quality Standards

The Ministry of Environment and Forests (MoEF) has established a number of air emission and air quality standards. Compliance to these standards is being monitored by the Central Pollution Control Board (CPCB) along with the respective State Pollution Control Board (SPCB). On 16th November 2009, CPCB has notified new National Ambient Air Quality Standards, in exercise of its powers conferred under Section 6 and Section 25 of the Environment Protect Act, 1986.

Table 6.1: National Ambient Air Quality Standards

Pollutant	Time-Weighted Average	Concentration in Ambient Air	
		Industrial, Residential and other rural area	Ecologically Sensitive Area (Notified by Central Government)
SO_2 ug/m^3	Annual*	50	20
	24 hours**	80	80
NO_x ug/m^3	Annual*	40	30
	24 hours**	80	80
PM_{10} ug/m^3	Annual*	60	60
	24 hours**	100	100
$PM_{2.5}$ ug/m^3	Annual*	40	40
	24 hours**	60	60
Lead ug/m^3	Annual*	0.50	0.50
	24 hours**	1.0	1.0
CO ug/m^3	8 Hours**	2000	2000
	1 Hour**	4000	4000
O_3 ug/m^3	8 Hours**	100	100
	1 Hour**	180	180
NH_3 ug/m^3	Annual*	100	100
	24 hours**	400	400

Source: Gazette of India, Part II-Section-3-Subsection (i)

* Annual Arithmetic Mean of minimum 104 measurements in a year taken twice a week 24-hourly at uniform interval.

** 24-horly / 8-hourly values or 0.1 hourly monitored values shall be complied with 98% of the time in the year. However, 2% of the time, it may exceed but not on two consecutive days.

6.18.04 Air Quality Dispersion Model

Computer aided mathematical models are being used to predict the increase in air pollutants concentration on ambient air quality due to any increase in the emission load in the atmosphere. For the proposed project, computations of 1-hourly, 8-hourly and 24-hourly average ground level concentrations due to emissions of CO, NOx, SO2 and PM were carried out using AERMOD model, which is a recommended model by USEPA for prediction of air quality from point, area and line sources. It is based on Gaussian dispersion which incorporates the Pasquile-Gifford (P-G) dispersion parameters for estimating horizontal cross wind and vertical dispersion. Further, Total Landfill gas, Methane (CH_4), CO_2 and Non Methane Organic Carbon (NMOC) was done using LandGEM software.

6.18.05 LandGEM:

LandGEM is based on the gas generated from anaerobic decomposition of landfilled waste which has a methane content between 40 and 60 percent. LandGEM is considered as a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being included in LandGEM along with defaults for conventional landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. It has also a provision for introducing Field test data when available.

6.18.06 AERMOD:

In AERMOD software, the land fill site is characterized as volume source. After drawing the land features, digital elevation model is prepared and its data is used for simulation purposes..

The model, simulates the effect of emissions from area sources on neighborhood air quality and identified discrete receptors. The model is an hour-by-hour steady state Gaussian model which takes into account the following special features:

- Terrain adjustments.
- Gradual plume rise.
- Buoyancy-induced dispersion, Complex terrain treatment
- Consideration of partial reflection.
- Plume reflection off elevated terrain.
- Building downwash.
- Partial penetration of elevated inversions is accounted for.

The impacts of primary air pollutants are predicted using AERMOD model, which has been selected keeping in view the terrain around the proposed project site. This model is widely recognized as predictive tool in impact assessment for air environment. The model has been applied with hill terrain, gradual plume rise and buoyancy induced dispersion options in the present study.

The model with the following options has been employed to predict the cumulative ground level concentrations due to the proposed emissions from land fill sites.

- Area being rural, rural dispersion parameters was considered.
- Predictions have been carried out to estimate concentration values over the discrete receptors located at a distance of 100 m , 500m and 1 km from the centre of the land fill site.
- Cartesian receptor network with mountain terrain was considered.
- Emission rates from the area sources were considered as constant during the entire period.
- The ground level concentrations computed are as basis without any consideration of decay coefficient.
- Calm winds recorded during the study period were also taken into consideration.
- 24-hour mean meteorological data extracted from the meteorological data of February 2011 has been employed to compute the mean ground level concentrations to study the impact on study area. The model flow chart is presented in figure 2.

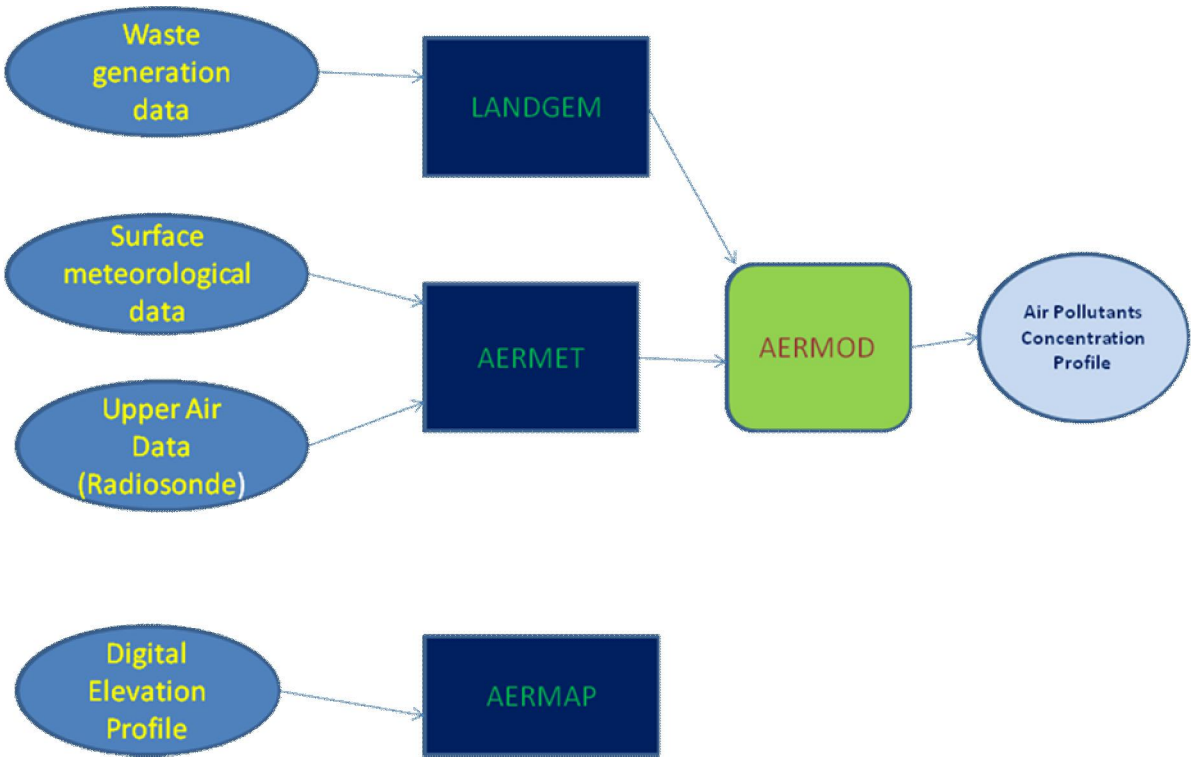

Figure 6.1: Model Flow Chart

6.18.07 Meteorological Data

The primary factors affecting dispersion of pollutants are wind and stability. The winds are caused by differences in pressure between areas of the atmosphere. Differences in pressure cause air to move from high-pressure areas to low-pressure areas. Wind speed can affect the pollutant concentration in a selected area. In general, the higher the wind speeds, the lower the pollutant concentration. The winds dilute pollutants and rapidly disperse them throughout the near areas. In the present case, meteorological data collected during February month has been used for prediction of the impacts. The wind rose plots are given in figure 6.2 below. It reveals that the predominant wind in this region is north westerlies with few instances of northerly and north westerlies as well.

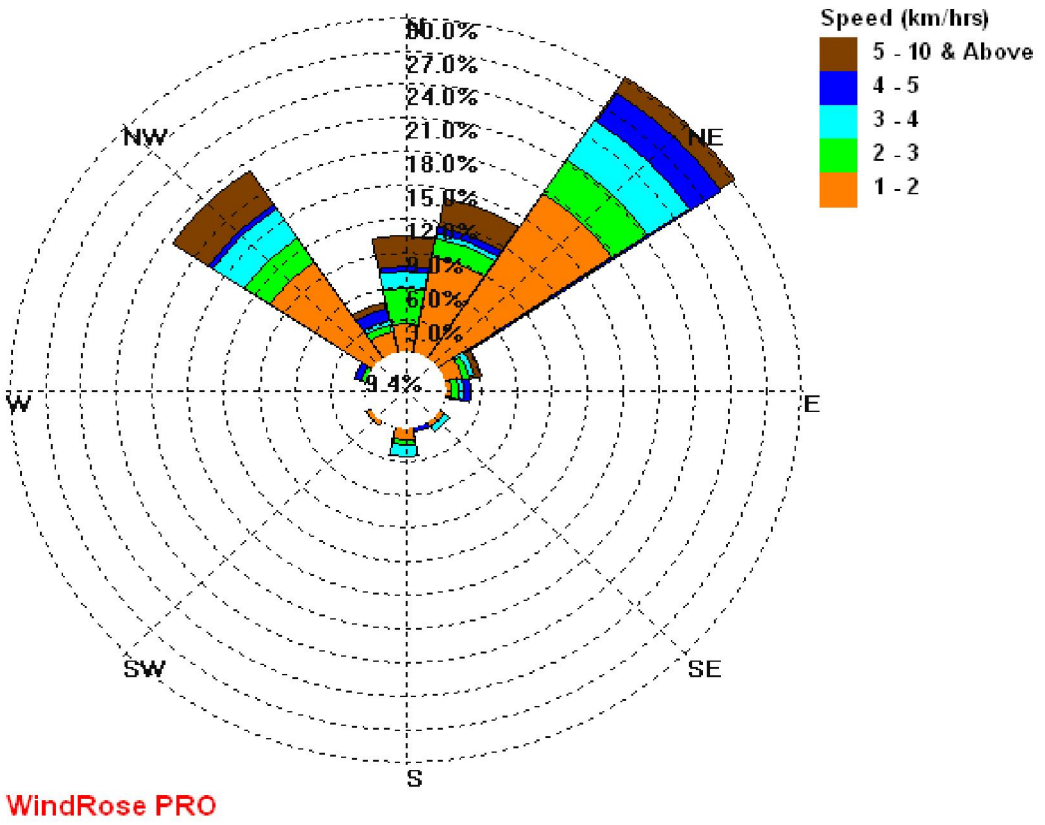

Figure 6.2: Wind rose plot of the area during February months

Receptors

Ambient air quality was monitored at six stations. Selection of Air quality monitoring station was done as per MoEF guidelines for conducting EIA study. One station was set up at the project site (core Zone) and two are in upwind direction and three are in down wind direction of the project site. All the stations were not obstructed by hills or any such structures. High volume samplers were used to collect/measure the air pollutant concentration data at 24 hours averaging periods for a period starting from 9th February to 17 February, 2011 at all the stations.

Table 6.2: Locations near the Project site for monitoring

Sl. No.	Date of Monitoring		Location
1	09/10.02.2011	LANDFILL-	At The Proposed Landfill Site Tuirial, Aizawl District
2	15/16.02.2011	LANDFILL-	Airfield, Near Lianthanga's residence, Tuirial
3	14/15.02.2011	LANDFILL-	Vaitlangsam Ram Dr. Lalruanga's g arden,Tuirial
4	15/16.02.2011	LANDFILL-	Near Landfill site, NH-54, Tuirial
5	16/17.02.2011	LANDFILL-	Airfield, Near Paper Mill, Tuirial
6	16/17.02.2011	LANDFILL-	Bamboo Link Road, Tuirial

The Background concentrations at six different sites:

The observed concentrations during the months of February when the measurements of different pollutants were carried out are presented below in figure 6. 3.

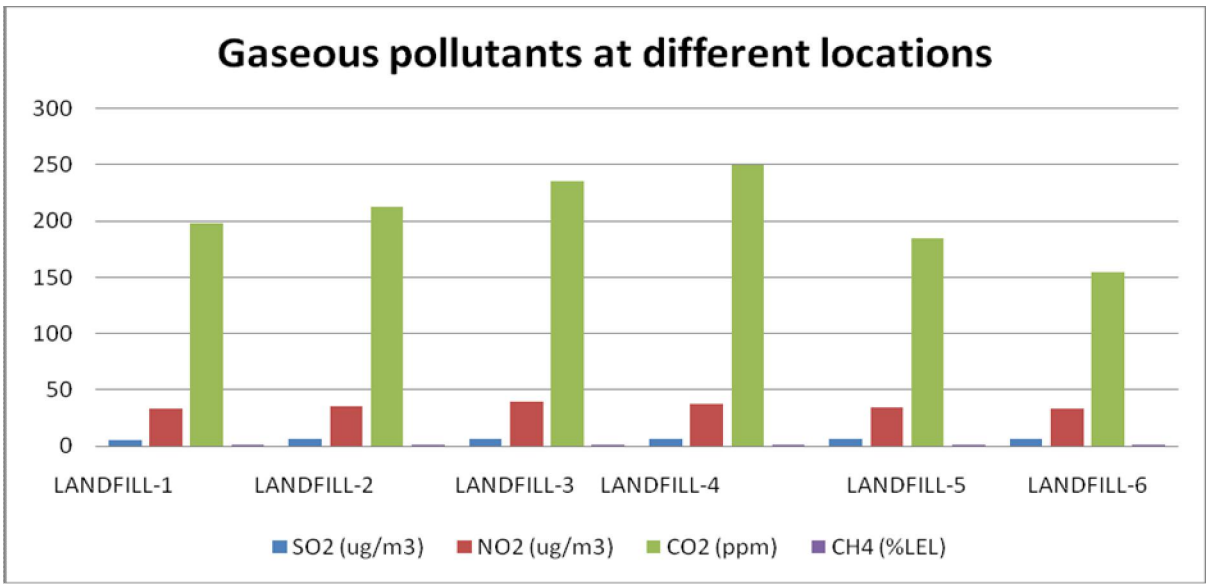

Figure 6.3: Gaseous pollutants' concentrations at different locations near study site.

Predicted GLC due to Landfill sites on the adjoining areas

The predicted emissions from the land fill sites estimated from LandGEM model is presented in Figures 6.4 to 6.6 The prediction of maximum ground level concentration of gaseous pollutants at the locations in and around land fill sites is presented in figures 6.7 to 6.9.

GRAPHS **Landfill Name or Identifier:** Aizwal_Landfill

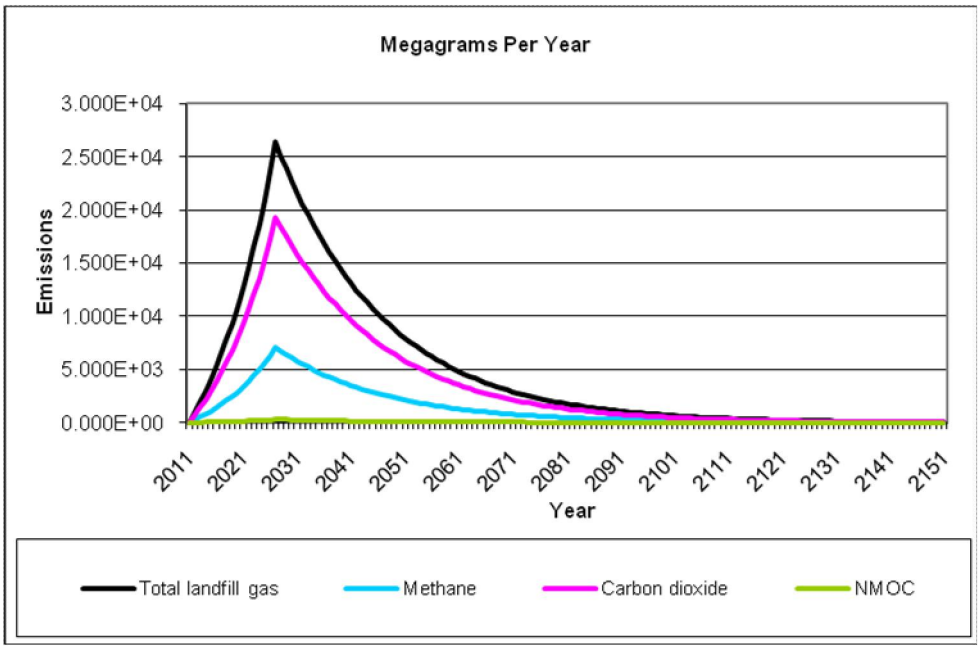

Figure 6.4: Emission estimate in Megagram/year

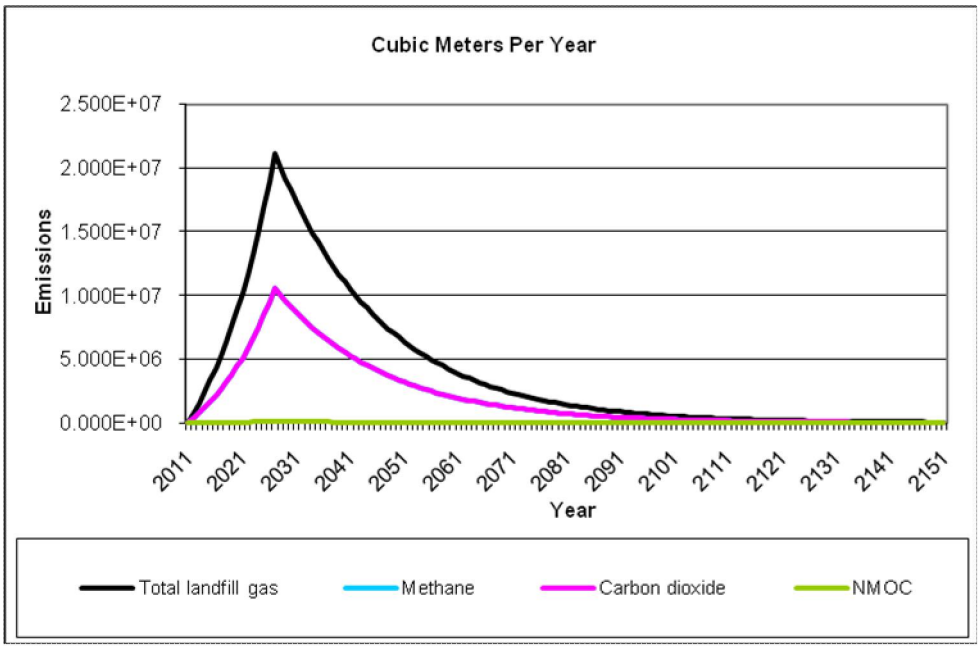

Figure 6.5: Emission Estimates in Cubic Meter/year

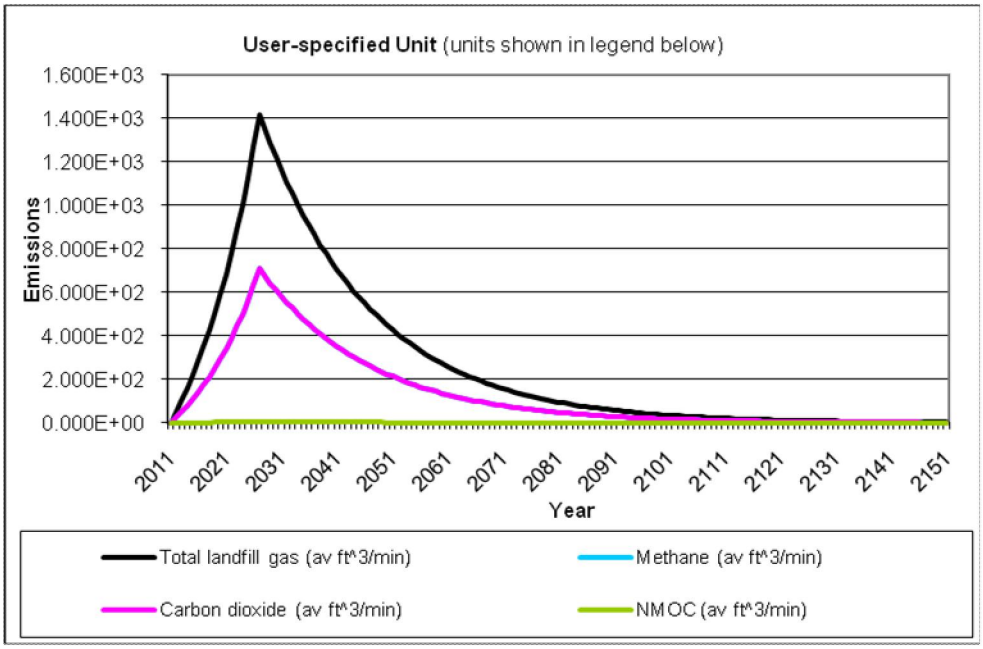

Figure 6.6 : Emission Estimates in ft^3/min

It is evident from the plots the gaseous pollutant concentrations increases with the time as the waste load increase and reaches its peak during 2026 after 15 years when the site will be filled and not remains useful for landfill. Further, it may be noted that the emissions will gradually decreases and will probably take 30- 35 years to return back to its current concentration scenario.

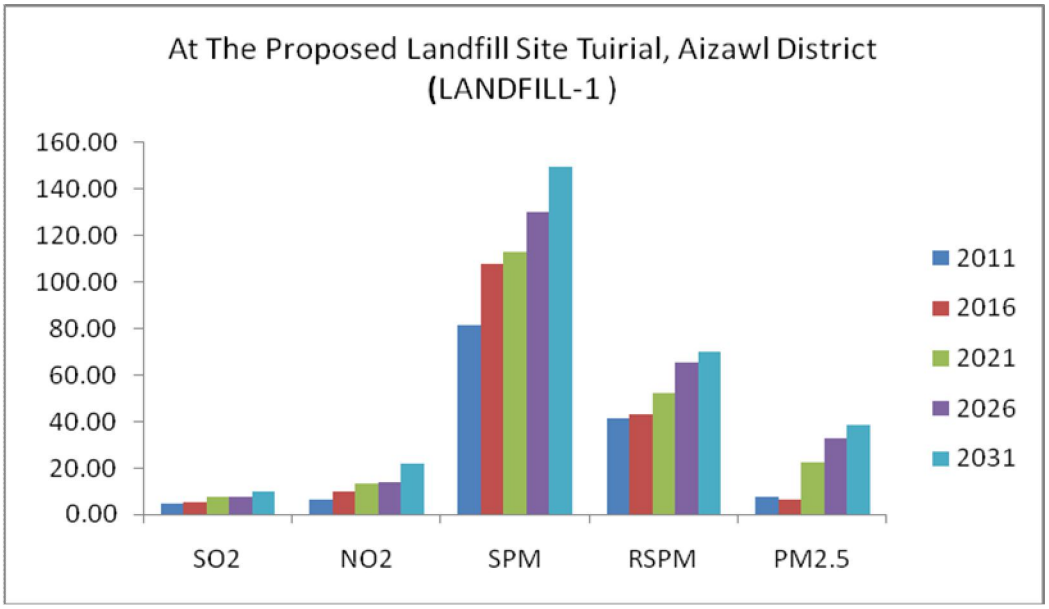

Figure 6.7: Predicted concedntrations for the next 20 years at Site 1.

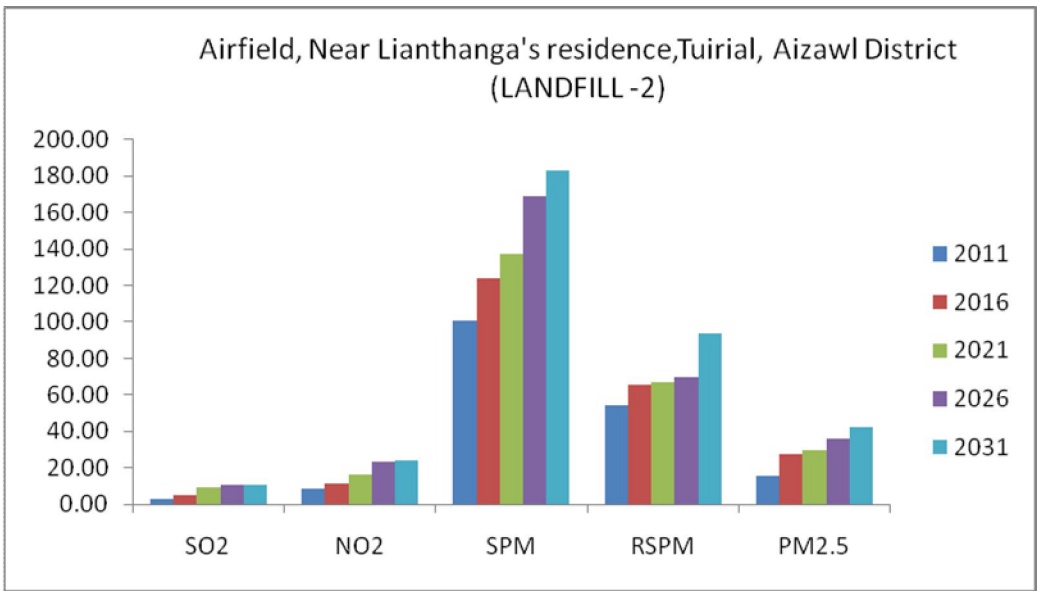

Figure 6.8: Predicted estimates for the next 20 years at site 2

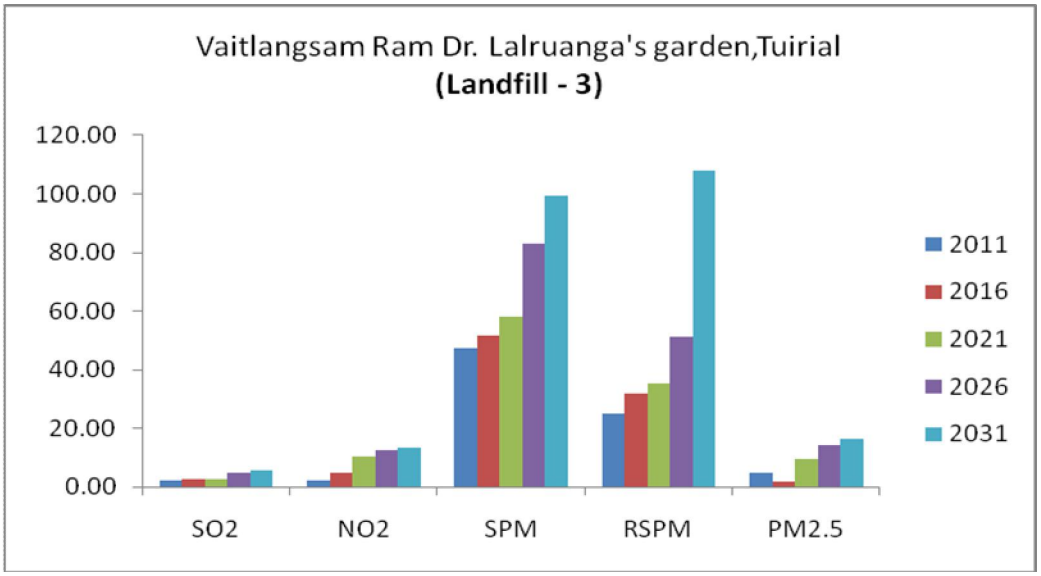

Figure 6.9: Predicted estimates for the next 20 years at site 3.

The plots reveal that the predicted concentration do increase with time because of the activities associated with the land fill site but its predicted concentrations over the next 15 to 20 years will remain below the NAAQS limit.

Conclusions

It is evident from the above results that in the existing scenario, pollution is well below the national limit. With the increasing urbanization and the development the need for landfill sites are all the more necessary. After the development of landfill site at the proposed site, it was observed that even with the increase in domestic waste, the overall air pollution scenario will not affect significantly. The contribution of few pollutants was noticed more than the national standards in year 2026 and 2031 when the landfill site will be full to its capacity. It is also observed that the emission from the completely filled landfill site will takes about next 30 years to come to the present level. In this regard the green plantation around landfill site will have significant effect min containment of gaseous pollutants emission from the sites.

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