ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR

INTEGRATED MUNICIPAL SOLID WASTE MANAGEMENT PROJECT

AT

BORAGAON SITE

GUWAHATI, ASSAM

Prepared by

Guwahati Waste Management Company Private Limited (GWMCPL)

April 2008

CONTENTS

EXECUTIVE SUMMARY

1.0 INTRODUCTION

To implement an integrated approach to Solid Waste Management Practices in Guwahati, GMC got prepared Detailed Project Report for solid waste management of the Guwahati city and got it approved for the grant of Rs. 3516.71 Lakhs under "Jawahar Lal Nehru National Urban Renewal Mission (JNNURM)" Scheme of Ministry of Urban Development, Govt of India.

Thereafter to assist GMC in selecting a suitable developer/ private operator for implementing the Integrated MSW management project on BOOT basis, GMC has appointed Infrastructure Development Corporation of Assam Limited (IDCAL) as a Project Management Consultant for the project. IDCAL is a company incorporated under Joint Venture between IL&FS and Guwahati Metropolitan Development Authority (GMDA). For project implementation, a Special purpose vehicle (SPV) in name of Guwahati Waste Management Company Private Limited (GWMCPL) has been setup by IDCAL and all the project related activities and clearances has been housed in the name of SPV.

The proposed integrated solid waste management project shall consist of the following components:

1. **Primary collection of MSW:** Door-to-Door collection of MSW is to be implemented.
2. **Transportation of MSW:** After collection MSW will be transported in the closed/covered vehicles to the processing and disposal site at Boragaon.
3. **Processing and Disposal of MSW:** MSW is to be processed for energy recovery before final disposal into landfill site. Only inerts or processing rejects to be land filled which is to be in range of 20-30% of total waste transported to the site. Processing and disposal site is to be developed at Boragaon. Processing complex would comprise of the following:
    i. **RDF Plant to handle 500TPD MSW**: Mixed MSW would be converted into Refuse Derived Fuel (RDF) in the RDF Plant.
    ii. **Compost Plant to handle 50 TPD of Organic waste:** Organic components of MSW segregated during RDF Process will be treated in the compost plant to produce manure.
    iii. **Power Plant**: Power Plant boiler will be fed with the 180 Tonne per day of RDF having CV in range of 2500-2800 Kcal/kg and 57 TPD of biomass, up to the limit laid as per MNRE Policy/ guidelines to use supplementary fuel for such plants as fuel and will generate 6 MW of electricity.

    The Project has two-way integration – integration of all aspects of management of MSW as well as integration of processing technologies so as to result into minimum inerts to the disposal site (landfill).

The processing complex & disposal facility (Sanitary Landfill Facility) is proposed to be set up at Boragaon site, which is along the national highway 37 bypass (NH-37) towards the northeast of Guwahati and 12 km away from the city centre.

2.0 REQUIREMENTS FOR ENVIRONMENTAL CLEARANCE

As per Environmental Impact Assessment Notification dated September 14, 2006 to set-up common municipal solid waste processing and disposal facility, prior environmental clearance is required to be obtained. As per schedule I of the notification, the proposed project falls under Item 7 (i) and will fall under Category B requiring clearance from the State Level Environment Impact Assessment Authority (SEIAA).

Since in Assam, the SEIAA is yet to be notified, hence proposed project requires prior environmental clearance from Ministry of Environment and Forest, GoI.

GMC has initially prepared the EIA report for setting up compost Plant and landfill in the MSW management facility. Considering economic viability and feasibility of project, IDCAL with consent of Guwahati Municipal Corporation & MoUD, has proposed to add two components i.e RDF Plant and Power plant along with the existing components of the project.

Thereafter M/s GWMPCL, has revised the Environmental Impact Assessment (EIA) report based on the base line data generated by IIT Guwahati along with the Environmental Management Plan (EMP) and Disaster Management Plan (DMP) for the proposed project.

The purpose of this Environmental Impact Assessment (EIA) study is to provide information on the nature and extent of environmental impacts arising from the construction and operation activities of the proposed project.

A EIA study report has been prepared for this project based the secondary information collected from the published sources, reconnaissance survey, primary socio-economic survey and environmental monitoring of air, noise, soil, ground water and surface water in the study area. The baseline data was generated on meteorology, air quality, noise levels, ground and surface water quality, land environment including soil quality, land use pattern, biological environment and the socio-economic status. The meteorological data for complete year has also been collected to know the prevailing seasonal conditions. Identification & prediction of significant environmental impacts due to the proposed integrated waste processing facility with an Environmental Impact statement followed by delineation of appropriate impact mitigation measures in an Environmental Management Plan are included in the EIA Report.

3.0 SALIENT FEATURES OF PROJECT

The Salient features of the project for processing & disposal of MSW at Boragaon site are provided below:

Total Project Cost:	Rs.110 Crores
Land area:	24.12 Hectares or 180 bighas
MSW processing capacity	500 TPD
Power generation capacity	6 MW
Water Requirement:	2000 m3/day
Source of water:	Ground Water/Surface Water

4.0 SITE LOCATION & DESCRIPTION

The proposed site for Integrated MSW Processing & disposal facility development is located at Boragaon and accessible from National Highway37 at distance of 1 km. The proposed site is 12 kms from city centre. The site is surrounded by Meghalaya hills on the south and the Phatasil hills on the east side. Variable topography is observed in the area. It located close to a small stream, Mora nalha, which is streaming from Garchug village and thereafter joining the Dipar beel at about 1.5 km from the proposed site. The coordinates of the proposed site are:

Latitude	:	26° 06.872'' N
Longitude	:	91°40.896 ''E
Site Elevation	:	46.9m above MSL

5.0 PROJECT UTILITIES/AMENITIES

Fuel /End Products/By products

The proposed integrated waste management facility will have a capacity to process 500 TPD of mixed MSW producing 180 Tonne per day of RDF having CV in range of 2500-2800 Kcal/kg and 57 TPD of biomass, up to the limit laid as per MNRE Policy/ guidelines for use as supplementary fuel in such plants will be used as fuel to generate about 6 MW of Electricity. Compost Plant of 50TPD capacity to treat the organic component of waste would also be the part of integrated facility along with development of sanitary landfill to accommodate inerts and processing rejects.

Water

The proposed power plant will be provided with water-cooled condenser for condensing the exhaust steam from turbo generator. The water requirement for the proposed project would be around 2000 m3/day and would be met from groundwater or surface water.

Power

The total RDF used will be about 180 Tonne per day from MSW, which will be fired in power plant boiler along with 57 TPD of biomass up to the limit as per MNRE policy/Guidelines for use as supplementary fuel to generate 6 MW of electricity. The boiler will generate about 27.76 TPH.of steam. The total electricity generated after in house power use will be stepped up to 11 KV grid substation at Garchuk.

Road & site drainage

All roads in the plant area will be well-designed bitumen roads and will be of 4 m wide with 1m wide berm on each side. For effective storm water drainage, final finished road will have a camber of 1 in 60 and water bound macadam surface will have a camber of 1in 40.

Surface drainage will be designed based on the maximum rainfall intensity prevalent in the area over the last 50 years. All the building would be provided with a plinth protection all round, sloped towards the side drain. The side drain will be connected to the main drain on either side of the road.

6.0 ENVIRONMENTAL SETTING OF THE STUDY AREA

The baseline environmental status was assessed based on primary and secondary data collected through on-site field observations and obtained from agencies such as Indian Meteorological Department, Geological Survey of India, State Ground Water Department, State Pollution Control Board, Census of India and Local Forest Department. The following environmental components were focused at during this study:

- Air Environment (Meteorology, Ambient Air Quality, Noise Levels, Traffic Pattern, etc.)
- Water Environment (Quality and Quantity of Surface and Groundwater sources)
- Land Environment (Geology, Hydrogeology, Landuse, Solid Waste generation and characteristics)
- Ecological Environment (Terrestrial and Aquatic Flora & Fauna)
- Socio-Economic

The baseline status collated from analysis of secondary and primary data is summarized in the Table E-1 below.

Table E-1: BASELINE ENVIRONMENTAL STATUS

Attribute	Baseline status
Meteorology	The meteorological data were obtained from the regional meteorological center located at Airport, Borjhar. The meteorological parameters include, wind speed, wind directions and other information, viz. humidity, rainfall, temperature. The annual average temperature observed of maximum mean daily is 29.5 °C and that of minimum mean daily temperature is 19.7 °C. During the study period, the inversion levels (up to 150 to 200m) were observed to be very low, and the prevailing wind direction is observed to be from North-East and East.
Ambient Air Quality	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. The pollutant concentration levels of NOx, SO2, and RPM (PM_{10} & SPM were measured. It was observed that while the concentration levels of NOx and SO2 were well within the prescribed limits at all locations, the SPM & RPM concentrations exceeded the limits at two locations
Noise Levels	Noise monitoring was carried out at different locations at and around the site. The noise levels at day & evening time noise levels recorded at the junction of NH-37 and the access road were found to exceed the noise standards due to heavy traffic.
Water Quality	The assessment of water quality in the study area was done and compared with the drinking water standards prescribed by CPCB. After studying the drainage pattern of the study area and proximity to the site, 2 samples of surface waters were collected, one is, from Mora nalha at the Garchug (passing through the proposed site) and the second is, from the water body near the project site. The physico-chemical parameters are well within the prescribed limits for the drinking water standards. Three ground water samples were collected from the existing sources. One is, from IASST towards east of the site, Second is, from a residence in Paschim Boragaon towards the north of the site, and the third is, from the Maghuwapara village towards the south of the site. The water quality with respect to almost all was observed to be of good and acceptable quality except for the concentration of iron which was found to be very high.

Attribute	Baseline status
Ground water Availability	The aquifer in the area is composed of brownish soil mixed with loose sand. The average depth to groundwater is about 7 to 15m. Groundwater flow is generally west
Soil Quality	To assess the baseline soil quality in the study region, four soil samples were collected and analyzed at three locations. The surface soil at the proposed site is silty brown, mixed with fine grained sand. The soil being mostly loose sandy for a significant depth has more water contaminant filtering capacity. The share of oxygen and silica content in the soil is more compared to others, however, other macronutrients, nitrogen, phosphorus and potassium have been found in very insignificant amount. The depth of rock in the area is over about 100m. The soil is observed to be having high cation exchange capacity and low soluble ions. The soil is slightly acidic with low nitrogen and phosphate
Socio-economy	The study area is scarcely populated and because of wetland and forested (hills) steep slopes, there are no proper roads and other amenities of life. Around the site, few numbers of small villages like Devchatal, Pamahi, Maghuwapara, Garchug and Pashim Boragaon are situated. The land adjoining the site for integrated waste management facility is acquired by LIC and tea industry. In the study area maximum number of people are found to be engaged as "other workers" in economic activity like Government/Private service, teachers, factory workers, commerce etc. negligible population is involved in agricultural activities.

7.0 ENVIRONMENTAL IMPACT ASSESSMENT & ENVIRONMENTAL MANAGEMENT PLAN

Environmental impact due to the construction and operation stages of the project were predicted quantitatively using models such as ISCST3, which is a steady-state Gaussian plume model, is used to assess pollutant concentrations around the power plant, highway noise level model for noise impacts. Impacts were also evaluated qualitatively using engineering judgment and best management practices.

Adequate environmental management measures will be incorporated during the entire planning, construction and operation stages of the project to minimize the adverse environmental impacts and assure sustainable development of the area.

The impacts during the construction phase will be temporary in nature. This summary details the pollution sources and mitigation measures proposed for the project.

7.1 AIR ENVIRONMENT

During the construction phase, operation of construction equipments and vehicles will be the main sources of pollution. A dust control plan will be implemented and regular maintenance of vehicles and equipment will be carried out.

During the operation phase, the main sources of pollution shall be boiler stack emissions, emissions from RDF plant, fugitive dust and odor emissions from waste handling and processing and emissions due to vehicular movement. Adequate mitigation measures shall be implemented. Emissions from waste handling areas shall be controlled by provision of covered areas, proper ventilation. Herbicides will be sprayed to discourage further decomposition of MSW. The RDF plant shall be provided with adequate dust control systems such as cyclones, bag filters to control the dust emissions. The boiler will be provided with adequate stack height of 65 m and an ESP shall be provided to reduce the PM emissions. NOx emissions shall be controlled by admission of secondary air and maintaining temperature balance. A gas recirculation system shall be provided to reduce CO formation. Dioxins and Furans shall be controlled by extensive segregation to ensure complete removal of chlorinated compounds, controlling PM emissions and appropriate furnace design. In addition to this, a High Performance dioxin removal device (Activated Carbon Packed Column) shall be provided.

7.2 NOISE ENVIRONMENT

During the construction phase, adequate mitigative measures such as controlled time of construction, job rotation etc. will be implemented.

During the operation phase, the sources of noise emissions shall be equipments such as shredders, boilers, generator etc and vehicular movement. Noise enclosures shall be provided wherever possible and workers shall be provided with earplugs.

7.3 WATER ENVIRONMENT

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 or any surface water body.

During the operation phase, activities responsible for the impact on the surface waters are, uncontrolled discharge of surface waters, leakage from the engineered drainage systems, runoff from the raised landfill areas, deposition of air pollutants and removal of vegetated areas. During this phase, these activities may cause significant change in the surface water quality.

Approximately 2000 m3/day water from groundwater or surface water will be utilized for plant operation. Effluent generated from the process will be treated adequately and disposed off into the near by stream.. Spill over from the process would be collected and treated prior disposal.

The effluent generated from the MB unit regeneration waste and boiler blow down will be discharged after suitable treatment. Filter backwash water and cooling tower blow down will be discharged after treatment. The small quantities of leachate generated will be collected in the sump and treated in Effluent Treatment Plant.

7.4 LAND ENVIRONMENT

The proposed project will be developed on the existing waste disposal site; hence, no change in the land-use of the site due to the proposed project is anticipated. With the site development for the proposed plant, green belt of 2.5 m to 3.0m around the periphery of project site would be developed and other aesthetic changes would be made at the plant site, there by creating overall positive impact on the aesthetics of the site.

During operation phase of the project, the rejects from waste segregation system/RDF plant. Will be disposed at the landfill site, which is about 20-30% of total MSW. The fly ash generated will be supplied to local brick manufacturing units. The bottom ash from the power plant shall be supplied to low cost housing units or disposed off at landfill.

7.5 ECOLOGICAL ENVIRONMENT

Deepar beel is an ecologically sensitive area is about 1.5 km from the site. It has been declared as one of the Ramsar Site and is recognized as wetland of national importance. The beel is the natural habitat of many species of birds, various aquatic life and vegetation. However, as this is located at a distance of about 1.5 km, the impact of the plant on this area will be negligible. The mitigative measures for air emissions as well as waste water treatment will further reduce the possibility of impact on Deepar beel.

The existing land cover and physiognomy support plant species typical of habitats and having a low plant diversity and simple structure. During the construction stage; there will be removal of shrubs and herbs at the site. It will be temporary and the proposed peripheral greenbelt will provide a much better habitat for those species than earlier.

The impact on ecological environment is suitably compensated and mitigated adopting comprehensive EMP.

7.6 SOCIO ECONOMIC ENVIRONMENT

The proposed project will lead to employment generation and will have a positive impact on the socio economic environment. Preference to local population shall be given in employment opportunities. Adequate mitigation measures will be put in place or implemented to reduce odor emissions and disease vectors from proposed site.

8.0 ENVIRONMENTAL MANAGEMENT SYSTEM

For the effective implementation of the EMP, an Environmental Management System (EMS) will be established at the proposed project. The EMS will include the following:

- An Environmental Management cell
- Environmental Monitoring Program
- Personnel Training
- Regular Environmental Audits and Corrective Action
- Documentation – Standard operating procedures Environmental Management Plans and other records.

9.0 RISK ASSESSMENT & DISASTER MANAGEMENT PLAN

For the effective & safe implementation Municipal Waste Processing project, it is important to identify associated safety hazards and carry out a basic risk assessment; an effective risk assessment & disaster management plan has been proposed as part of EIA report. Risk assessment & disaster management plan includes:

- Critical aspects including safety culture, training and awareness, relationships and training of contractor staff and many others.
- Safety measures, possibility of accidents either due to human errors and/ or due to equipment/ system failure.
- Disaster management and response plan to minimize the adverse impacts due to an unfortunate incident and disaster Management aspects.

10.0 CONCLUSION

All possible environment aspects have been adequately assessed and necessary control measures have been formulated to meet statutory requirements. Thus implementing the proposed project will not have any appreciable negative impacts. Moreover, the landfill area requirement will reduce significantly as the about 75% to 80% of solid waste will be converted into usable form and only inerts (20-25%) would be sent for disposal at landfill site. This would save upon the future requirements of area for land filling. Generation of green power would be an added advantage.

CHAPTER 1
GENERAL

1.0 BACKGROUND

Growth and development of economy triggers expansion in urbanization. This often induces migration of population from rural & semi urban areas to big towns and cities. Unless a proper planning is undertaken well ahead of time, the uncontrolled growth in urbanization could cause a strain to the municipal infrastructures like water supply, sewage and solid waste disposal causing public health problems.

Like most urban cities Guwahati, the capital of Assam and the biggest city in North East India, is facing these problems. The geographical location and the topographical features (i.e. hilly terrain with heavy rainfall throughout the year) of Guwahati City have further compounded these problems.

In India, it is now mandatory for all urban and local bodies to comply with the 'Solid Waste Handling & Management Rules, 2000'. Solid Waste Management (SWM) includes all activities that seek to minimize the health, environmental and aesthetic impacts of solid wastes.

To implement an integrated approach to Solid Waste Management Practices in Guwahati, GMC got prepared Detailed Project Report for solid waste management of the Guwahati city and got it approved for the grant of Rs. 3516.71 Lakhs under "Jawahar Lal Nehru National Urban Renewal Mission (JNNURM)" Scheme of Ministry of Urban Development, Govt of India.

Thereafter to assist GMC in selecting a suitable developer/ private operator for implementing the Integrated MSW management project on BOOT basis, GMC has appointed Infrastructure Development Corporation of Assam Limited (IDCAL) as a Project Management Consultant for the project. IDCAL is a company incorporated under Joint Venture between IL&FS and Guwahati Metropolitan Development Authority (GMDA).

For project implementation, a Special purpose vehicle (SPV) in name of Guwahati Waste Management Company Private Limited (GWMCPL) has been setup by IDCAL and all the project related activities and clearances has been housed in the name of SPV (GWMCPL).

The proposed project addresses the mandatory provision made in Municipal Solid Waste Management and Handling rules 2000, which necessitates proper treatment and disposal facilities for MSW and restrict land filling to non biodegradable, inert and other waste that are not suitable for either recycling or biological processing. MSW Rules 2000, encourage processing of waste and states that land filling of mixed waste shall be avoided unless the same is found suitable for waste processing.

As per the Environment Impact Assessment (EIA) notification of the Ministry of Environment & Forests (MoEF), dated 14th September 2006, all the projects related to the "Common Municipal Solid Waste Management Facility" need to obtain the

environmental clearance from the State Level Environment Impact Assessment Authority.

The proposed project falls under Item 7 (i) (Common Municipal Solid Waste Management Facilities) of schedule I as per Environmental Impact Assessment Notification dated September 14, 2006. The project will fall under Category B.

Since In Assam, at State level there is no state Environment Impact Assessment Authority (SEIAA), hence proposed Integrated MSW management project shall require prior environmental clearance from the Central Government in the Ministry of Environment and Forest.

1.1 OBJECTIVE

The objective of EIA Report is to present an evaluation of environmental and social impacts of the Integrated MSW management project with supporting information on baseline environment to assist GMC/developer to take an informed view on environmental and social sensitivity of the project and the level of required mitigations measures to meet environmental and social norms of the GoI. The report also details the environmental monitoring programme that should be put in operation during construction and operation phases of the project to provide a timely feedback on the adequacy of recommended mitigation measures.

1.2 SCOPE

The scope of the study is to envisage the environmental changes anticipated due to the proposed project. To assess the environmental attributes of study area, core area of 10 km radius around the proposed project site is considered.

Following are the important elements of the assignment:

- Investigations with respect to requirement of project clearance under EIA Notification, 2006
- Identify all significant construction and operation phase activities that can lead to negative environmental impacts in terms of air pollution, water pollution, visual intrusion, community severance, impacts on vegetation and land degradation
- Undertake quantitative/qualitative assessment of environmental impacts to provide requisite understanding of such impacts to all stakeholders and identify environmental management measures that will restrict the negative impacts to an acceptable level during the construction and operation of the project provide the environmental management program with clearly assignable responsibility and monitoring mechanism.

1.3 METHODOLOGY

The Environmental and Social Assessment Report has been prepared following the steps listed below:

1.4.1 Familiarization with the Project

At the initial stages of the project, a site visit and reconnaissance survey was undertaken. Based on the findings of the survey, the data requirement and gaps were identified. The baseline data was collected from various secondary data sources. Air quality monitoring, noise levels, traffic volume study, soil and water sample analysis was carried out as per the environmental regulations relevant for MSW processing and disposal site

1.4.2 Identification of Impacts

Based on the existing site conditions observed from the survey works and sample analysis, environmental scoping has been carried out and all relevant environmental and social issues requiring investigations during the EIA were identified. All significant negative impact was earmarked for environmental mitigation measures. The existing environmental and infrastructure conditions in the adjacent localities were also reviewed to identify the possible shortcomings in the project.

1.4.3 EMP and Environmental Monitoring

In order to mitigate the negative environmental and social impacts, mitigation measures were identified. The detailed plan for the management of environmental components was then formulated in the form of an Environmental Management Plan (EMP). Environmental monitoring requirements to ensure effectiveness of recommended environmental measures and compliance with environmental standards together with the institutional arrangements for their implementation were recommended. Evaluation of impacts after considering the mitigation were evaluated using the rapid impact assessment matrix method. It has been shown in the report that the suggested mitigation measures can bring down the adverse negative impacts to the minimum level to create such facilities that are in harmony with the environment.

1.4 STRUCTURE OF THE REPORT

The Report is organized in nine chapters. Introduction is presented in **Chapter 1** The introduction provides a background to the project and describes the objective of this document. The methodology adopted for the assignment and organization of the report is also presented in this chapter.

Chapter 2 presents the project description to provide a comprehensive understanding of the project. In this chapter existing land use and various sensitive issues of environmental concern are also discussed.

Chapter 3 presents site-specific details of the proposed facility. This section also provides site suitability analysis and land use of Guwahati city.

Chapter 4 Describes the existing Legal and Administrative Framework for Environment & MSW management in India.

Chapter 5 gives the detail of existing environmental status. This section provides an overall description of the existing environmental status in the study region including meteorology, air quality, noise levels, ground and surface water quality, land environment, land use pattern, biological environment and the socio-economic status. It also contains baseline information on ambient air quality, noise level, water and soil quality of the project area.

Chapter 6 describes the assessment of possible environmental impacts of the Integrated MSW Management Project on the environment. It also includes the analysis of impacts on the environmental and social aspects of the project site as a result of the proposed development before mitigation.

Chapter 7 is the key chapter of the report and presents the mitigation steps to be taken to reduce the potential negative impacts on all the major valued environmental components. Most of these measures essentially need to be adopted in order to bring down the adverse negative impacts to the minimum level to create such facilities that are in harmony with the environment.

Chapter 8 covers the environmental management Plan and monitoring requirements to implement environmental mitigation measures and to assess their adequacy during project implementation.

Chapter 9 covers the Risk Assessment & Disaster Management Plan during project implementation.

CHAPTER 2

DESCRIPTION PROPOSED INTEGRATED MUNICIPAL SOLID WASTE MANAGEMENT PROJECT AT GUWAHATI

2.1 CITY PROFILE

Guwahati city, the capital of Assam, is located on the south bank of river Brahamputra towards the south-eastern side of Kamrup district and bounded by 26°5' N to 26°12' N latitudes and 91°34' E to 91°51' E longitudes. It is 54.75m above the msl covering about 24km in east-west direction and about 9km in the north-south direction. Since long time, Guwahati has remained the center of trade and commerce for the entire North-eastern India. The city of about 2.5 million population is now sprawled over an area of 264sq.km of which, about 216 sq.km is within the municipal limits and is demarcated by Guwahati Municipal Corporation (GMC) into 60 wards. However, the master plan for the city covers an area of 313sqkm. Guwahati being the gateway of the northeast, is undergoing rapid urbanization, increasing the urban population day by day. The master plan also covers Amingaon and North Guwahati to the northern side of the Brahmaputra.

The general topographic features are hilly and it is sandwiched between the ground elevations ranging from about 41m near Brahamputra towards north to 575m towards Meghalaya hills constituting the southern boundary of the city. The Brahmaputra river has a peak flow of about 65,500 m3/sec and flows from east to west. On the other side, that is, east, the area slopes down from a hill range having a ground elevation of 182m to a valley having elevation of 49m inside the area. Within this area, there are Phatasil-hill and Sarania-hill ranges at around 358m and 250m elevations, respectively, including Neelanchal (Kamakhya) hills in the middle at about 303m elevation, also a few low-lying pockets with elevation of about 49m towards west.

The typical characteristics of the city which surrounded by very high hills causing severe drainage problems leads to severe flooding in most of the parts especially in heavy monsoon. The city receives an annual rainfall of 152 to 324cm, with fairly heavy rains from May to October. The minimum of mean daily minimum temperature has been recorded as 11°C during January and the minimum of maximum has been recorded as 32.2°C during August of the year. The humidity prevails throughout the year. During the late winter month, February and the pre-monsoon period, March-April, the humidity is low ranging between 71-78% in the morning and 50-57% in the evening. The high humidity ranging from 76 to 94 % is observed during July and August.

2.2 PROJECT NEED

Solid waste management has been an issue of major concern since the last two decades. Even then, the current waste management systems are collapsing under the

pressures mainly caused by unmitigated urban growth. The solutions to the waste management adopted in developed countries have either little or no relevance to local conditions in developing countries particularly in India. With the onset of the population explosion in Guwahati, the quantum of MSW generation has also considerably increased. The present scene in waste management, displays an array of problems, including low collection coverage, irregular collection services, open dumping, burning and the handling and control of informal waste picking or scavenging activities. The safe and reliable long-term disposal of solid waste is a vital component of integrated waste management. In times gone by, *landfills* have been the most common, environmentally and economically acceptable method of disposal of solid waste. Even with the implementation of recycling and waste-to-energy treatment to reduce it, disposal onto *landfills* remains a significant component of an integrated waste management strategy (Tchobanoglous et al. 1993).

Municipal Solid Wastes (Management and Handling) Rules 2000 has made MSW management the responsibility of urban local bodies (in particular, municipal authorities), which includes the segregation of waste at the source for 'cleaner composting' and 'recycling'. The MSW management and handling notification makes it obligatory for the municipalities to restrict land filling to *non-biodegradable inert waste,* and other wastes that are *not suitable either for recycling or for biological processing.* With this in mind, the guidelines also prohibit to dump the *biodegradable component* of the waste into the landfills.

Until recently, the disposal site was at Sachhal, Narangi road about *5 km* away from the city center. Due to poor management, the site is posing as a severe nuisance in terms of odour, mosquito and fleas. The situation further worsens in rainy season. The daily approximate generation of solid waste in Guwahati is very less compared to that of other cities in India. The collection system is not efficient enough to collect the entire solid waste load generated. Landfills can cause a multitude of problems, viz. water contamination, noise pollution, air pollution, health problems, vermin, erosion, blowing trash and dirt, of which the most adverse is a negative impact on the growth and development of the area. If the ground and surface waters are contaminated by the landfill, no alternate water supplies are available to the residents. Also, no proper dumping procedure is followed to prevent the problems. This has actually given rise to the nuisance caused by birds, fleas and cattle. Burning of waste is also observed here leading to air pollution. Another important point noticed is that the wastes from Jalukbari and Maligaon was not disposed off to the site because of their distant locations from Sachhal as transportation cost involved was too high. The area was gradually encroached by rag pickers and others, making it difficult to manage the waste.

In view of these problems and the presumption that the older landfill in the city would soon create great problems; the site was closed to avoid further problems. The dumping operation following the closure of the Sachhal site has been temporarily shifted to a small piece of land near the proposed landfill at Garchug. GMC has identified another site, which is located at *Paschim Boragaon* near Garchug, in order

to shift the entire disposal operations and to provide suitable waste processing facility i.e. compost Plant, RDF Plant and Power Plant facility.

The proposed project of setting up a Municipal Solid Waste (MSW) management facility at Boragaon in itself is a project for environmental and social betterment of Guwahati, the capital of Assam.

2.3 PROJECT CONTOURS

The proposed integrated solid waste management project shall consist of the following components:

- **Primary collection of MSW:** Door-to-Door collection of MSW is to be implemented.

1. **Transportation of MSW:** After collection MSW will be transported in the closed/covered vehicles to the processing and disposal site at Boragaon.
2. **Processing and Disposal of MSW:** MSW is to be processed for energy recovery before final disposal into landfill site. Only inerts or processing rejects to be land filled which is to be in range of 20-30% of total waste transported to the site. Processing and disposal site is to be developed at Boragaon. Processing complex would comprise of the following:
    - **RDF Plant to handle 500TPD MSW**: Mixed MSW would be converted into Refuse Derived Fuel (RDF) in the RDF Plant.
    - **Compost Plant to handle 50 TPD of Organic waste:** Organic components of MSW segregated during RDF Process will be treated in the compost plant to produce manure.
    - **Power Plant**: Power Plant boiler will be fed with the 180 Tonne per day of RDF having CV in range of 2500-2800 Kcal/kg and 57 TPD of biomass, up to the limit laid as per MNRE Policy/ guidelines to use supplementary fuel for such plants as fuel and will generate 6 MW of electricity. At project site RDF plant is to be designed to handle 500 TPD of mixed MSW, Compost Plant to handle 50 TPD of organic & green waste and Power plant to generate 6 MW of electricity using 180 TPD of RDF & 57 TPD of biomass as a fuel. However, any activity aimed at development will have repercussions on the environment, both positive and negative. An environmental and social impact assessment of the proposed integrated processing and disposal facility at Paschim Boragaon, has been carried out.

2.4 DEVELOPMENT PLAN FOR IMPLEMETATION OF INTEGRATED WASTE MANAGEMENT FACILITY

In Guwahati, 24.12 ha of land has been allocated for the development of integrated waste management facility. In line with the approved project DPR, the development of the proposed facility comprises of the following steps:

- **Project Site Development:** It comprises of construction of RCC retaining wall of 8m Height (above HFL) around the periphery of land to be developed as sanitary landfill and soil fill up to 8m in the remaining area at the slope of 1:3. This would lead to the prepared elevated surface area on which Processing plants & Power Plant are to be developed.

- **Management of MSW Collection & Transportation and Biomass:**

  Door to Door collection has been proposed as component of project. MSW will be transported in closed/covered vehicles. It is expected there will be 125 incoming trucks to bring in 500 TPD of Mixed MSW and about 12-15 trucks for bringing 57 TPD of biomass at project site. Truck will normally enter the plant during the timings as approved by local authorities during day and night timings. Truck will enter the main gate through "entrance side" and proceed to the weighbridge.

  Incoming trucks will be weighed with tare weight reference and net weight of material will be computed by electronic weighbridge. Tare weight inventory of all the trucks will be maintained.

  Depending upon the type of material, MSW or Biomass, each truck will be directed for unloading mixed MSW and biomass. Mixed MSW will be unloaded in RDF plant pit and biomass will be unloaded in the storage area earmarked for the same. After unloading, the truck will proceed to the "exit side" of the main gate on the basis of "weightment slip". It is expected that 15 trucks will get cleared per hour.

- **Compost Plant:** It is proposed to develop 50 TPD compost plant to process segregated organic waste, collected directly from hotels, restaurants, vegetable markets etc and transported separately to the site.

- **RDF & Power Plant**: The facility also include MSW processing plant to convert MSW to RDF and power plant. The integrated MSW to RDF processing plant is being designed on following major parameters:

  The plant will be designed to process MSW of capacity 500 TPD (Tons per Day) and in the initial period would be processing about 350 tons of MSW, which would generate around 180 TPD of Refuse Derived Fuel in the form of fluff. The fluff is expected to have a gross calorific value (GCV) of **2,500 kcal/kg** to **3,000 Kcal/kg** of fluff. The plant is also being designed to use about 57 TPD of biomass having an average gross calorific value (GCV) of 2,500 kcal/kg to 3,000 Kcal/kg.

RDF fluff quantity of 180 TPD and Biomass quantity of 57 TPD is available for firing in a specially designed boiler to generate high pressure / high temperature steam. The steam generated from the boiler is expected to generate about 6,000 kW of power. The RDF plant is expected to operate for 330 days in a year. The power plant will be operating throughout the year except for 15-20 days during which period the Boiler will be taken up for inspection and maintenance. This means that the power plant will be potentially available for power generation for about 345 to 350 days.

Salient features of Integrated MSW Processing & disposal facilities are being described in subsequent sections:

2.5 COMPOST PLANT FACILITY

The entire MSW received at the site will be processed in RDF & compost Plant depending upon their characteristics It is proposed to develop 50 TPD compost plant to process organic waste, which is to be segregated during RDF Plant process and green & hotel waste transported separately to the site as one of the component of integrated facility along with 500 TPD RDF Plant and 6 MW Power plant based on RDF and 57 TPD of Biomass and sanitary landfill. In addition, provision for handling additional quantity of MSW in future times has also been proposed with subsequent decrease of use of biomass when appropriate amount of waste is available to generate the designated quantity of electricity. The processing facilities are also planned to provide storage of compost and process rejects requiring land filling during the monsoon.

The design of the compost plant is based on the concept for open windrow aerobic composting of organic (biodegradable) component of solid waste. The complete process of MSW Composting can be summarized as follows:

a. Material Intake systems

- Reception of raw MSW
- Visual inspection of waste
- Weighing of vehicle

b. Pre-processing System

- Manual Sorting of inert and removal of rejected material to landfill on the tipping platforms
- These platforms will also facilitate the ragpickers to remove the recyclables
- Sorted material moved to compost pad to form windrows by JCBs

c. Yard management activities

- Periodic turning of windrows
- Inoculums and water spray to accelerate the digestion process
- Process Monitoring & Controlling activities

d. Material Stabilization

- After two turnings, shifting of material to stabilization area, from the compost pad using a backhoe unit and dumper.
- After two weeks stabilization, feeding of material to coarse segregation section

e. Coarse Segregation Section

- After stabilsation, material is taken to trammels for intermediate screening using a skid steer loader. This is completely automated section with single point feeding. A RCC structure with 6m high AC roofing and concrete flooring is required for placement of coarse segregation equipments.
- Over sized rejects (+35 mm) to be sent to landfill
- Over sized rejects (+16 mm) comprising of undigested organic matter and inert material could be used as mask for windrow covering.
- Undersized material (-16 mm) stocked in Curing section godown

f. Curing Section

- Material is stored here for 15 days for further stabilisation and moisture control
- A RCC structure with 9.5m high AC roofing and concrete flooring is required for storage of material.
- Some additives as rock phosphate may be added at this stage to improve quality of final product.

g. Refinement Section

- Cured material is fed to a drag feeder conveyor which in turn gradually feeds the same to the Trommel Screen 6/4 mm at a controlled rate
- A two storied RCC structure with 5.25m high floor and concrete flooring is required for placement of refine section equipments.
- Over sized rejection (+ 6 mm) to be ground and mixed in curing section.
- Impurities such as glass, plastic, leaves, inerts etc. are removed

- Under sized fine compost to be enriched with useful microbes, herbal extracts (optional)

h. Grinding Section for recovery of organic compost

- Grinding Section ensure recovery of material which is otherwise rejected from the Plant.
- Grinded material will be added to the curing section material and passed through the refinement section to recover organic compost.
- A strong RCC structure with 1.5m high floor is required for placement of grinding section equipments.

i. Packing and Storage System

- Final product (Compost) to be stacked in finished goods godown.
- Compost to be picked up by marketing agency for distribution in market.

The composting unit also has a lab to achieve efficient composting various process parameters must be periodically monitored and controlled in time. During Composting, some liquid / concentrated wastewater may percolate through the MSW due to leaching, known as Leachate. For environmental reasons the leachate should not be allowed to percolate in the soil or ground waters. To avoid this, proper impermeable concreting of the compost pad is undertaken and a peripheral drains are provided to collect the leachate generated during the process. Collected leachate finally leads to a R.C.C. tank provided in the adjoining landfill site. The air borne litter is controlled by providing a dense green belt around the plant. In green belt creepers are provided to act as green curtain.

To control odour the sanitizer is added at the concrete pad. Sanitizer suppresses the odour generating from the waste. This control also helps in creating a workable environment for the people working at the sorting station.

There are various other systems, which are required to be incorporated for trouble free working of the plant, e.g.

1. Diesel filling facility (for material handling equipment)
2. Vehicle washing facility
3. Staff quarters
4. Electrical sub station
5. Internal roads
6. Green belt
7. Boundary wall
8. Open drains

2.6 RDF PLANT

RDF plant will be designed to process MSW of capacity 500 TPD (Tons per Day) and in the initial period would be processing about 350 tons of MSW, which would generate around 180 TPD of Refuse Derived Fuel in the form of fluff. The fluff is expected to have a gross calorific value (GCV) of **2,500 kcal/kg** to **2,800 Kcal/kg** of fluff.

The plant is also being designed to use about 57 TPD of biomass having an average gross calorific value (GCV) of **3,000 kcal/kg** to **3,500 Kcal/kg.** RDF fluff quantity of 180 TPD and Biomass quantity of 57 TPD is available for firing in a specially designed boiler to generate high pressure / high temperature steam. The steam generated from the boiler is expected to generate about 6,000 KW of power.

2.6.1 MSW to RDF conversion process description

A) The conversion process of Municipal Solid Waste (MSW) into Refuse Derived Fuel (RDF) involves the following operations:

i) Homogenization

ii) Size Reduction

iii) Drying

iv) Segregation

v) Densification (optional)

B. The schematic process flow diagram for conversion of MSW to RDF is given below in Figure 2.1

C. MSW is collected, transported to Plant site by the GWMCL. Care would be taken to avoid the mixing of the following types of wastes in MSW:

i) Construction waste

ii) Hospital Waste

iii) Slaughter House waste

iv) Drainage silt

v) Green Waste generated (in bulk quantity) vegetable-Fish markets / Big Hotels

D. The Tipper Trucks or the Lorries would supply the garbage in two/three shifts. The Trucks are then weighed at the weighbridge station before they unload in the two MSW storage pits each having holding capacity of 600 MT.

E. One of the pits will be used for unloading the incoming material. After unloading the MSW will be sprayed with Herbal pesticide in the receiving pit. On the periphery of

the pit a pipeline will be laid. This pipeline will have special devices, which will spray the herbal insecticide in the form of mist. Normally quantities sprayed will be 1.5 Liter/Ton of MSW with 1% concentration. The cost implication of this herbal insecticide will be Rs.2.50 to Rs.3 per MT of garbage.

F. As the raw MSW received at site is dumped into the storage pits, any yard segregation is not envisaged. The overhead crane with grab bucket picks up MSW and put it on the "Vibrating Feeders".

G. At this stage, as the garbage travels on the main conveyer belt, odd sized objects are picked up manually.

H. The constituents segregated at this stage are mostly lengthy textiles, large twigs and woody pieces, thermocol, any stray dead animal and consumer durables. The dead animal and consumer durables (hardly noticed in MSW) are put into trolleys and periodically taken out from the processing system and suitably disposed off.

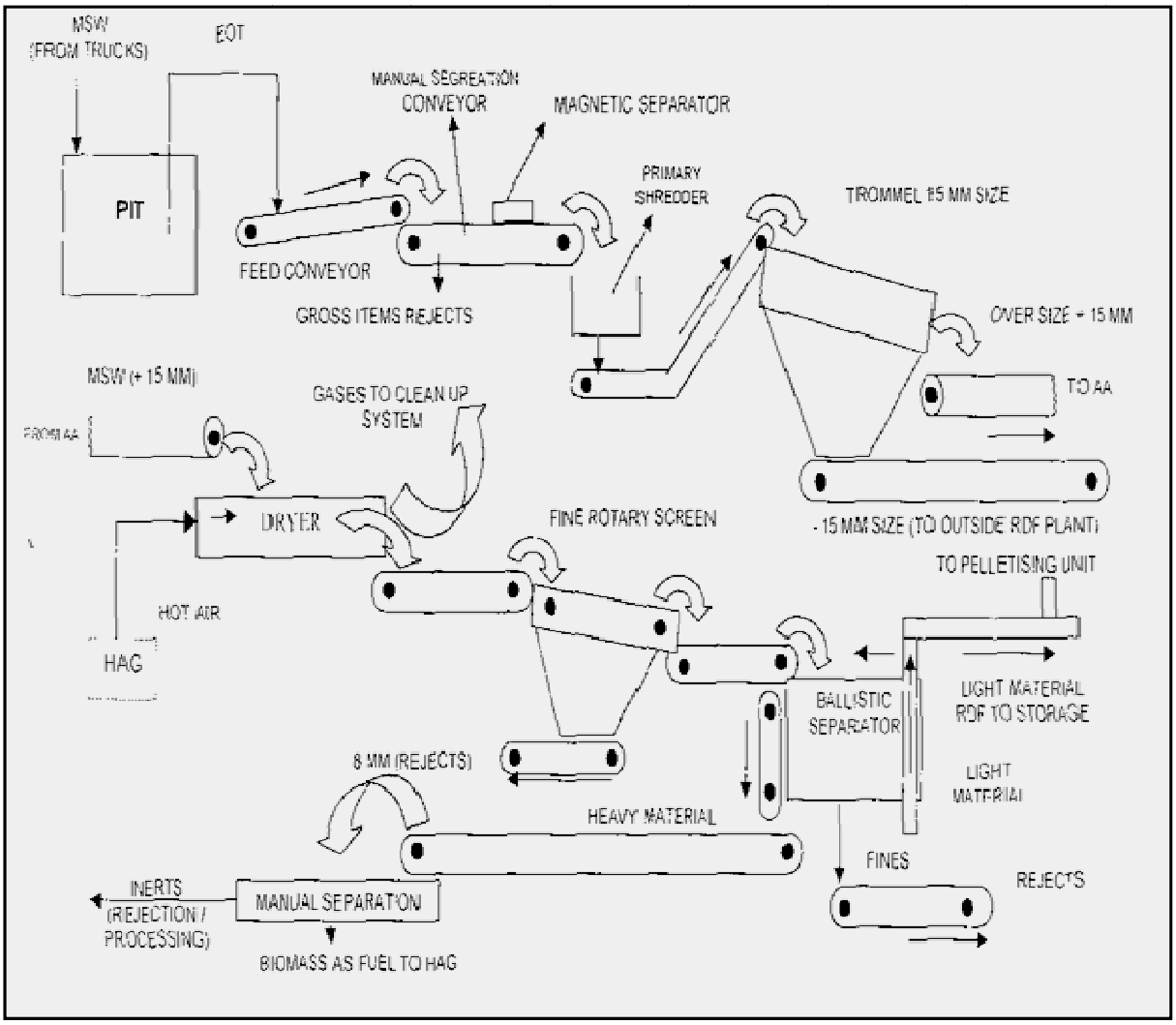
I. The MSW after inspection is fed into a de-dusting cum pre-drying system to remove dust/sand/earth (10 mm particle size) in a **Fines Separation Rotary Screen** in which hot air is injected.

J. After the fines separation, MSW is fed into another **Rotary Screen** to classify the material into two fractions: Over size + 150 mm and Undersize –150 mm.

K. Undersize fraction (- 150 mm) will primarily contain organic matter and is directly fed through a belt conveyor in to the **Rotary Dryer.** The Oversize fraction (+ 150 mm) is fed into a **Primary Shredder through a Magnetic Seperator** (to separate ferrous material) to reduce its size to -150 mm. The output from the **Primary Shredder** is then fed into Rotary Dryer

L. In the **Rotary Dryer** the material is dried by using Hot Air in a co-current manner. The hot air is generated in a fixed grate in a specially designed Hot Air Generator (HAG), in which woody biomass segregated from MSW is combusted. Suitable pollution control equipment will be incorporated in the HAG.

Fig 2.1 : Schematic Flow Diagram MSW conversion to RDF



M. The output from the Rotary Dryer is then fed into the Rotary Trommel to separate the fines through 8 mm screen. The fine fraction so separated has significant quantum of organic matter that is useful as a soil en-richer.

N. After the screening the material is subjected to Air Classification in a specially designed Ballistic Separator, in which the lighter components are entrained in the Air and collected separately. The heavy material such as stones, glasses falls through the classifier and are separated as Inerts. These inerts are then taken to a separate site where its constituents are further manually separated.

O. The light fraction thus separated comprises biomass, paper, textiles and other combustible material and is termed as Refuse Derived Fuel (RDF) Fluff, having an average GCV of 2,800 kcal/kg.

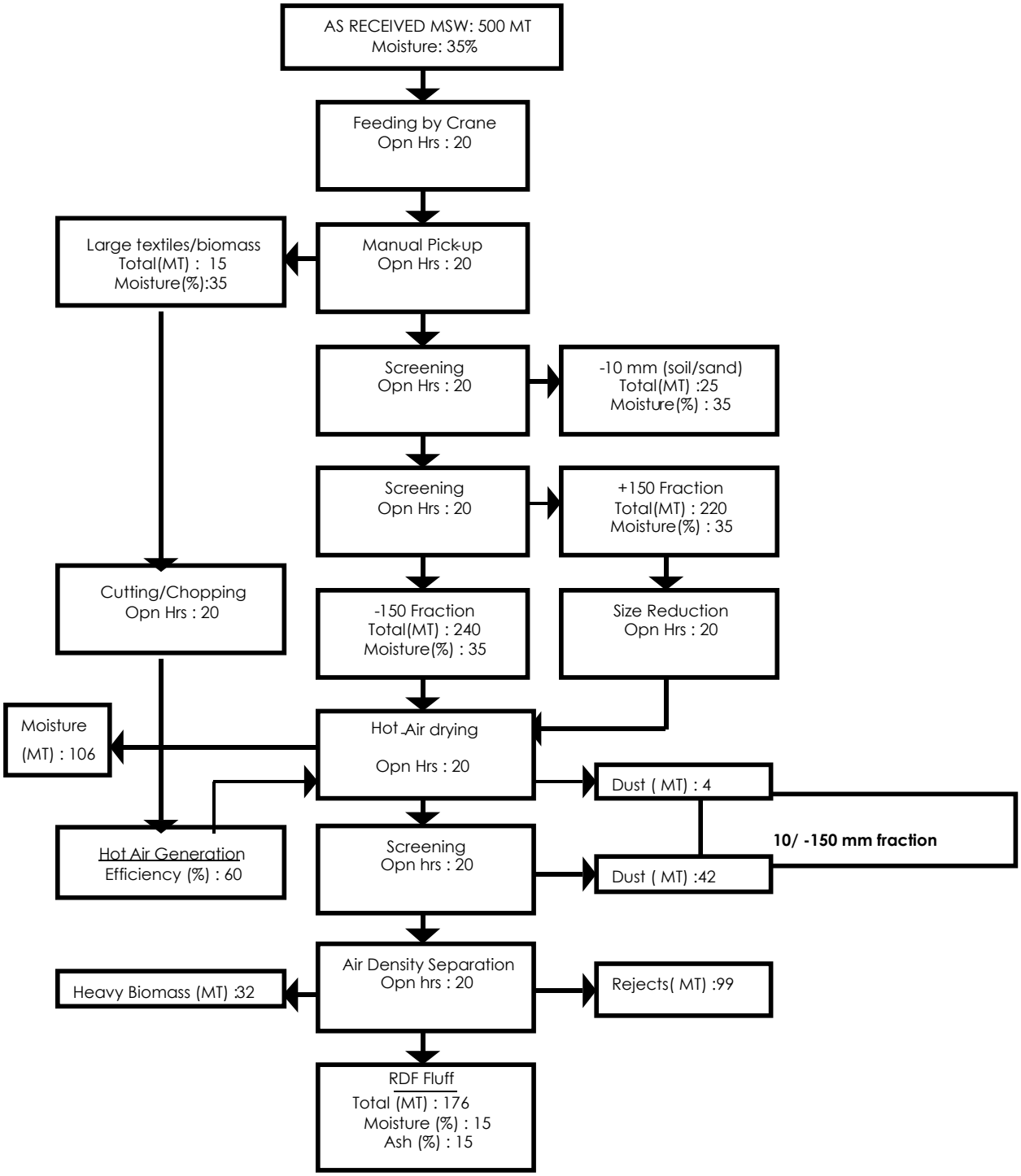
A description of the fluff and pellets produced from MSW combustibles, its proximate and ultimate analysis, and ash analysis is indicated in the **Table 2.1**. The materials flow & mass balance for MSW to RDF process is provided in **Figure 2.2**.

TABLE 2.1: DESCRIPTION OF RDF PELLETS

Description	Details
RDF type	Fluff 
Shape	Irregular
Size	150^{mm} X 150^{mm}
Bulk Density	100 kg/m^3
Proximate analysis	
Moisture	10 % - 20 %
Ash content	10 % - 20 %
Volatile matter	40 % - 60 %
Fixed carbon	10 % - 20 %
Ultimate analysis	
Moisture	10 % - 20 %
Mineral matter	15 % - 25 %
Carbon	35 % - 40 %
Hydrogen	5 % - 8 %
Nitrogen	1 % - 1.5 %
Sulphur	0.2 % - 0.4 %

Description	Details
Oxygen	25 % - 30 %
Gross Calorific Value of RDF (Avg)	2,800 kcal / kg
Ash Fusion Temperature	
Initial Deformation temperature	860 ^{o}C
Softening temperature	950 ^{o}C
Hemispherical temperature	1040 ^{o}C
Fluid temperature	1100 ^{o}C
Chloride Content	*0.04%*
Elemental Ash Analysis (% of Oxides)	
Silica	53.10%
Alumina	11.18%
Iron Oxide	4.87%
Titanium dioxide	0.89%
Calcium Oxide	13.15%
Magnesium oxide	2.90%
Sodium oxide	5.79%
Potassium oxide	1.56%
Sulphur trioxide	2.55%
Phosphorous pentoxide	1.43%

FIGURE 2.2: MATERIAL FLOW AND MASS BALANCE



2.7 POWER PLANT

The boiler is designed to fire RDF and biomass. Considering the power generation of 6 MW, Gross Calorific Value (GCV) of RDF in range of 2,500- 2,800 kcal/kg and of Biomass in range of 3,000-3,500 kcal/Nm^3, and a combined boiler efficiency of 74.8%, the steam generation will be about 27.76 TPH.

The power cycle selected is Rankine Cycle with one regenerative heating. Based on the optimum cycle efficiency that can be achieved and consideration of cost, metallurgy, standard range of the turbine, operability, maintainability, taking into consideration the capacity of the power plant the following parameters are considered for the steam cycle.

2.7.1 Power Plant Technical Details

A. Process details

RDF and Biomass are fired in a boiler, which generates steam. The steam generated from the boiler is expanded in a steam turbine generator to generate electricity. The steam turbine will exhaust steam to a condenser where it is condensed to water. The cooling water required to condense the steam in the condenser is supplied from a cooling tower using cooling water pumps. The condensed water is supplied to the Deaerator via condensate extraction pumps. In the Deaerator the oxygen present in the "feed water to the boiler" is removed and also the feed water is heated. The steam for heating the feed water is supplied from the steam turbine extraction. The heated feed water is pumped into the boiler-using boiler feed pumps.

The Boiler will be capable of firing fluff of RDF and Biomass at the indicated flow rates available. The RDF will be non-uniform in size, properties may vary from season to season and calorific value may vary over a wide range. RDF on combustion will have components, which may cause corrosion and erosion of heating surface. Some compartments may cause agglomeration and fouling of heating surface. Presence of SO2 / NOx will cause acid dew point corrosion. Some components may lower the ash fusion temperature creating clinker formation on the grate. All these aspects will be taken into account while designing boiler for firing RDF. The critical components of the boiler is indicated below**:**

Generally RDF is fired in traveling grate type boiler, however the boiler manufacturer will be given the freedom to select his design for firing RDF, provided the technology is proven for firing RDF produced out of MSW generated in Indian cities/ towns. The grate will be multi louvered type with grate bars arranged across the direction of travel. Grate bars can be designed to swivel individually at right angles to the direction of travel. This will enable the grate to be self-cleaning type so that the fines will not block the holes in the grate bars and choke the supply of primary air. Grate bars will be of corrosion resistant and heat resistant cast alloy steel. Grate speed can be varied.

The RDF fluff generated from the RDF plant will be stored in a covered area adjacent to the boiler. The Boiler is located to the east of the RDF fluff storage area. The Fluff is transferred from this storage to a Belt feeder by a grab crane, which turn feed the boiler Receiving Hopper through a belt conveyor. The hopper will be sized for 10 minutes of RDF fluff usage. This chute supplies the RDF to a drag chain conveyor which in-turn distributes the fuel to feeding chutes of the boiler. Rotary type drum feeder, located below each feeding chute, controls the feed flow. High-pressure air will be used to spread the RDF uniformly across the grate.

The furnace will be water wall type. When firing RDF, the environment at the bottom of the furnace constantly changes between oxidizing atmosphere (excess oxygen than required for combustion) and reducing atmosphere (deficient oxygen than required for combustion). This will accelerate the corrosion of the membrane wall. Hence to reduce the corrosion the furnace bottom shall either be refractory lined internally with silicon carbide refractory or water wall coated with eutectic coating. Designing the furnace at with 2 sec retention and temperature of 850 Deg C after secondary air injection will ensure destruction of any Dioxin formed.

The Boiler will have a Gas re-circulation system to re-circulate the flue gas thus enabling the reduction in un-burnt carbon, reduction in the excess air required. Thus provision of a gas re-circulation system will increase the Boiler efficiency.

Combustion air is admitted in two stages. In the Primary stage the air is admitted below the grate / through sides. The secondary air is located above the grate to ensure better air penetration and turbulent mixing to for complete combustion. The admission of the secondary air will reduce the temperature of the combustion products thus lowering the formation of NO_x. The correct proportion of primary and secondary air will reduce CO formation. Super heater will be located either in the convective zone or provided in the radiant zone with baffle protection arrangement to avoid erosion of tubes.

Steam drum may be single drum of bi-drum type. The single drum is preferred over the bi-drum since maintenance and replacement of Boiler bank tubes may be difficult.

All other pressure parts like evaporator, economizer, etc will be designed similar to conventional boilers. Soot removal can be either by steam soot blowing or by continuous rapping and hammering of Superheaters, economizers, evaporators etc. Steam soot blowing is cheaper from investment point of view but the coils near the soot blower will have to be replaced frequently due to erosion by high-pressure steam.

The boiler is designed to fire RDF and biomass. Separate burners for biomass are provided on the furnace walls. **Other features of the boiler shall be similar to any other conventional boilers**

B. POWER PLANT DESIGN CONSIDERATIONS

The following design considerations will be taken care

i. Considering low ash IDT and fusion temperatures, the gas temperature and thus the heat transfer metal temperatures will be maintained sufficiently low. (Furnace heat release rates will be low, higher furnace size for same rating.)

ii. The grate where RDF would be fired need to designed specially for firing RDF to avoid clinker formation and will have heat resistant, wear resistant properties and longer life. The grate bars will be of cast alloy steel.

iii. The combustion will be to avoid formation of NOx, CO and Dioxin.

iv. Number of passes in the boiler may be decided keeping in view of the erosion properties of the ash in flue gas.

v. The pressure parts will be so designed that corrosion and erosion are avoided by avoiding high flue gas velocities and sharp changes in direction of flow. Maximum velocity will not exceed 5 m/sec.

vi. Super-heater tubes will only be of Stainless steel and seamless. No Carbon steel superheater tube will be used.

vii. Corrosion prevention in furnace walls is an issue and hence protective coating, high tube wall thickness or refractory lining for furnace walls will be provided. But the design will be to make it maintenance free.

viii. In view of the extensive dust deposits expected on tubes, the boiler will have an adequate cleaning system in place to remove combustion dust settled on boiler surface impairing heat transfer, which ultimately affects the steam generation. Steam operated soot blowers or mechanical cleaning devices in adequate numbers may be provided so that effective removal of dust is ensured.

ix. The minimum temperature of exit flue gas temperature may be limited to 150ºC considering sulphur content in the fuel.

x. It is important to keep SPM in flue gas as limited to 75 mg/Nm3, which is much below the CPCB requirement. Number of fields in ESP will have one spare field, so that even in case of one field down condition SPM levels are maintained at 75 mg/Nm3.

xi. Suitable sealing arrangement will be provided in the fuel feeding system and the stoker/traveling grate for preventing cold air ingress into the furnace.

xii. A Chimney of height 68 m will be provided according to the regulatory requirements.

xiii. The fluff will be stored near the boiler. The fluff will be transported to the Boiler receiving hopper through belt conveyors. The receiving bin will be sized for 10 minutes requirement of fluff. From the receiving hopper the fluff will be fed to the boiler-traveling grate through boiler chutes, rotary feeders and high-pressure air for spreading.

C. DESIGN DATA FOR BOILER

The main fuels for boiler will be RDF and Biomass.

Design steam generation	:	28 TPH
Normal steam generation	:	27.76 TPH (for 6 MW power generation)
Pressure	:	46 bar (a)
Temperature	:	435 ± 5 ºC

Feed water temperature

Entering economizer	:	105 ºC
Control range	:	60% to 100% MCR load of boiler,
RDF Fuel available	:	180 TPD
Biomass quantity	:	57 TPD

The steam turbine will be horizontal, single uncontrolled extraction (bleed off) condensing type. The turbine is designed for main steam parameters of 45 bar (a) at 430ºC to generate 6 MW at Generator terminals.

Design operating parameters and Specified Datasheet

Steam Turbine Inlet Pressure, Bar	45 bar a
Steam Turbine inlet temperature	430 ± 5 Deg. C
Steam quantity at turbine inlet (After considering the steam for SJAE)	About 27.49 TPH
Deaerator pressure and temperature	1.21 bar a and 105ºC
First extraction steam pressure	3 bar (a) or to suit the Deaerator pressure
First extraction steam quantity	2.36 TPH
Condenser operating pressure	0.10 bar
Condenser Cooling water inlet temperature	32 ºC
Condenser cooling water outlet temperature	40 ºC
Power Generation required	6 MW

At Generator terminal normal operating condition	
Power factor (lagging)	0.8
Generation Voltage (kV)	11 kV+5%
System frequency	50 Hz –5%,+3%
Ambient temperature for electrical equipment design	45 Deg.C
Parallel operation with grid	Required

Cooling water system

The cooling water system will cater to the cooling water requirements of Condenser, Generator Air cooler, TG Lube Oil cooler, Compressor etc. The cooling water system will be designed for circulating cooling water flow of 2100 m^3/hr, including 10% margin.

The cooling water system will consist of the following major items of equipment.

i. Three (3) electrically driven horizontal centrifugal cooling water pumps, each of 920 m^3/hr capacity (two working and one standby) with associated drive motors for TG condenser cooling.

ii. Two (2) electrically driven horizontal centrifugal auxiliary cooling water pumps each of 220 m^3/hr capacity (one working and one standby) with associated drive motors.

iii. Induced draft cooling tower will be designed for a total circulating water flow of 2100 m3/hr. The tower will be of RCC construction with two cells (both working). The cooling range will be 8 Deg C based on a WBT of 28 Deg C and approach of 4 Deg. The Cooling water inlet temperature will be 40 Deg C. There will be two cells with capacity of 1050 cum/hr (both working)

iv. The induced draft cooling tower will be complete with basin, associated supporting structures, foundation, casing with internals such as fills, drift eliminators, hot water distribution system, instrumentation, fans, recovery cone, isolating valves. The basin will be partitioned suitably to facilitate isolation and maintenance and will be complete with draining facilities, cold-water outlet channel, with screens and stop logs. Suitable handlings system for handling fans, associated motors, and screens/ stop logs will be provided.

v. Cold water from the cooling tower basin will be pumped by the cooling water pumps to the TG condenser and other auxiliary consumers in the power plant. The hot water return from the consumers will return to the cooling towers for cooling and re-circulation.

vi. About 94.59 m3/hr of make up water will be added in the cooling tower basin to compensate the evaporation, drift and blow down losses.

vii. The cooling water system will include all associated electricals and instrumentation.

D. ASH HANDLING SYSTEM

Ash generated during the operation in the power plant will be suitably collected and disposed. A detailed ash disposal plan will be worked out for disposal of ash. The bottom ash will be collected at the bottom of the boiler furnace and will be removed manually. The fly ash handling will be by means of dense phase handling system. The fly ash will be collected from various hoppers of the boiler including Economiser hopper and ESP hoppers and conveyed to an ash silo. Ash quantities will be as below:

Total ash generated	:	1.604	TPH
Bottom ash	:	1.04	TPH
Fly ash	:	0.62	TPH

2.8 SANITARY LANDFILL

For the development of sanitary landfill, RCC retaining wall of 8m height is proposed to be constructed around the site to avoid surface water impounding. The space enclosed within the retaining wall shall be filled with inert waste and processing rejects (after 2m fill with soil) and above it 10m high landfill will be created at the slope of 1:5; About 15.12 ha area has been earmarked for the development of sanitary landfill.

Based on this concept, an assessment has been carried out for the volume of landfill and the expected life of landfill is estimated to be 20 years.

2.8.1 Specifications Of Landfill Development, Operation And Management

Development of landfill site should be subjected to rigorous planning. Key elements in developing a scientific landfill for Guwahati comprise of the following,

- Reorganising and enhancing the present waste collection and transportation practices
- Detailed plans outlining the site development activities and
- Detailed designs of all the engineering works

- The overall control on the development and operation of each landfill site will be the requirement to adopt a cellular approach to land filling. The landfill development activities will comprise

- Site Clearance
- Sub-division of site into major operational phases
- Progressive excavation for landfill earthworks
- Ordered development of operational phases in working land filling cells
- Advance preparation of the lining system on the landfill base
- Sequential infilling of land filling cells and operational phases and
- Early and timely capping of land filled cells

2.8.2 Leachate Collection System:

The primary function of leachate collection system is to collect and to convey the leachate out of the landfill unit and to control the depth of the leachate above the liner. As per USEPA Manual the leachate collection system should be designed to maintain a leachate depth or head of 30 cm or less above the liner. The design leachate head is very important as flow of leachate through imperfections in the liner system increases with an increase in leachate head above the liner. Maintaining a low leachate level above the liner helps to improve the performance of the composite liner system. The main components of leachate collection system are leachate collection tank, feeder mains and header main.

2.8.3 Liner System Design:

The liner system for landfill site at Guwahati is designed based on MoEF recommendations. As per MoEF "Construction of a non-permeable lining system at the base and wall of waste disposal site area. For landfill receiving residues of waste processing facilities or mixed waste or waste having contamination of hazardous material (such as aerosol, bleaches, polishes, batteries, waste oils, paint products and pesticides) minimum liner specification shall be a composite barrier having 1.5mm High Density Polyethylene (HDPE) geomembrane or equivalent overlying 90cm of soil (clay/amended soil)

Therefore for the landfill site composite liner of following specifications has been recommended complying Municipal Solid Waste (Management and Handling) Rules 2000.

A 90cm thick compacted clay or amended soil (amended with bentonite) of permeability not greater than 1 x 10"7 cm/sec

A HDPE geomembrane liner of thickness 1.5mm

A drainage layer of 300 mm thick granular material of permeability not greater than 10" cm/sec

2.8.4 Landfill Gas Management System:

Landfill gas is a bi-product of biodegradation process that takes place in landfills. Since landfill site at Guwahati is supported by compost plant, gas generation is anticipated to be very less. The principal components of landfill gas are Methane (CH_4) and Carbon dioxide (CO2). For landfill site at Guwahati a gas venting system with flaring arrangement is proposed. A gas-venting layer of 20 cm thick granular soil should be provided on the top of solid waste and the gas collected in this layer shall be collected and vented through gas vent pipes (38 no.) of 150 mm diameter perforated HDPE pipes. With the help of blower, gas through the pipes shall be collected and taken to flaring unit. The collection system is a network of 150 mm HDPE perforated pipes connected to flaring unit. The flaring unit consists of collection chamber, blower, ignition mechanism, control valves and sensors.

2.8.5 Final Cover System:

The final cover consists of the following components,

- Vegetative layer of 450 mm thick with good vegetation supporting soil
- Drainage layer of 150 mm thick granular material
- Barrier layer of 600 mm thick clay/amended soil
- Gas venting layer of 200mm thick granular material

2.9 UTILITIES

2.9.1 Water

The plant water requirements includes plant cooling water make up requirements, potable & service water requirements. The quantity of plant water requirement is about 2000 m3/day including the requirement for power plant & RDF Plant. This water will be taken from either surface water or the groundwater sources. Alternatively, the option of air cooled condenser is also being examined to minimize the requirement for water. The plant potable requirement of about 20 m3/day will be met from either surface or groundwater sources. The effluent from the integrated plant will be treated as perthe required standards before letting out in to a Nallah.

2.9.2 Power

The total RDF generated will be 180 tones per day from MSW, which will be fired in the power plant boiler along with 57 TPD of biomass to generate 6 MV power. The steam turbo generator will be generating Power at 11kV. The rating of the generator is 7.5 MVA. The generated power will be connected to one 11kV Switchgear through suitably sized generator breaker. The 11kV Switchgear will have two feeders connecting to the Garchug 11 kV grid substation, which distributes Power to the other areas.

During start up of the plant, the power will be drawn from the 11 kV feeder in 11 kV switchgear of the plant, which is connected to the 11 kV Grid. The plant will be started and brought up to synchronizing speed and voltage. Generator will be synchronized with the plant 11 kV switchgear and the generator breaker will will be closed. After synchronizing of the power generated, the excess power over and above the power consumption of Integrated Municipal waste complex will be exported. There will be an energy meter in the 11 kV feeders, which will measure the power exported as well as imported.

Power Import to the plant during the shutdown of the power plant will also be through the same 11 kV feeders. The auxiliaries for the RDF / Power Plant will be fed from the 11kV Switchgear.

2.10 PROJECT BENEFITS

Apart from growing urban infrastructure leading to indiscrete disposal of solid waste, lack of proper solid waste management system, Guwahati city has a characteristic low-lying topography and mountains on all sides, which has created a worse situation for solid waste accumulation and management. The situation is further worsened by the floods every year. There is no proper system for collection, transportation, disposal, and treatment processes for solid waste. Therefore it is imperative that a scientific and an integrated approach should be adopted to tackle the solid waste problem.

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

- Reduction, reuse and recycle of the waste
- Source Segregation & collection of waste (Systematic Door to Door collection has been proposed in the project)
- Transportation of waste in covered /closed vehicles to the site
- Processing of waste through composting, RDF and electricity generation
- Conversion of waste into a useful and marketable product (Manure)
- Only inerts/processing rejects to be landfilled which is about 20% of total waste quantity transported to the site. . This would save upon the future requirements of area for land filling.
- Public and private participatory mechanism to ensure a long-term sustainability of the project.
- Commercially viable project and long term sustainability
- Systematic approach
- Clean, hygienic and better infrastructure of the city

- Improved and mechanized services for the community
- Increase in employment opportunities in collection and transportation, door-to-door collection and in processing and disposal facility.
- Good market for compost in North East Region especially in the tea gardens
- Organized and a scientific land fill site with 20 years of life
- Regulatory compliant system
- Reduce financial burden and operational hassles on the municipal corporation

CHAPTER 3
PROJECT SITE DETAILS

3.1 PROJECT SITE ALTERNATIVES CONSIDERED

Earlier MSW was being disposed off at Sachhal site. This site is at around 10 km away from the city centre. Although the area allotted by the government for this site was quite big, around 30 acres and only 3 acres had been developed for dumping. However, it has been abandoned because of its unsuitable location and leading to inconvenience to the public. Nearly two years back, public protest was organised against the odour, mosquitoes, cattle and other menaces arising out of the garbage at this site. However, after the limited remediation by spraying of the de-odouriser there has been a fair amount of control in the odour. In response to a court order this site has finally been abandoned.

There were two other options of land chosen by GMC for the integrated solid waste management facilities. These were in Panikheti and Garchug. Preliminary site surveys were done by team of experts to assess the site suitability. However, both the sites were found to be unsuitable for the integrated solid waste management facilities.

3.1.1 Environmental Concerns of the Proposed Landfill Site at Panikheti

This site was about 25 km away from the city centre and in Chanderpur area and suggested by GMC as another alternative site.The size of the site was around 4 acres.

This site was not considered because of the following:

- Very small area of the site
- Risk of flooding due to low lying flat area along the flood plain to Brahamaputra river
- Requirement for overall development of the area in terms of approach roads and associated infrastructure

3.1.2 Environmental Concerns of the Proposed Landfill Site at Garchug

This land fill site was about 12 km away from the city centre and near Garchug village. The site is near the main city and has access by the NH 37. The size of the site is very small which would be unsuitable for future requirements. Few of the perceived impacts of this site are:

- The Garchug land is very small in size (about 3-4 ha) and spending money to make the site suitable, which will last only for a few years, is not economical.
- Risk of surface water contamination. There is a water body in one of the plots near the site

- As the site is on the foothills there is an increased risk water flooding of the during the monsoon due to the runoff from the adjacent hills which are lining one side of the site
- Health and other related risks like odour, cattle, insects etc to the nearby settlement. This settlement is revenue village and is about 200-300 meters away from the site
- Rehabilitation and Resettlement problems due to presence of a habited village at less than a half-kilometer

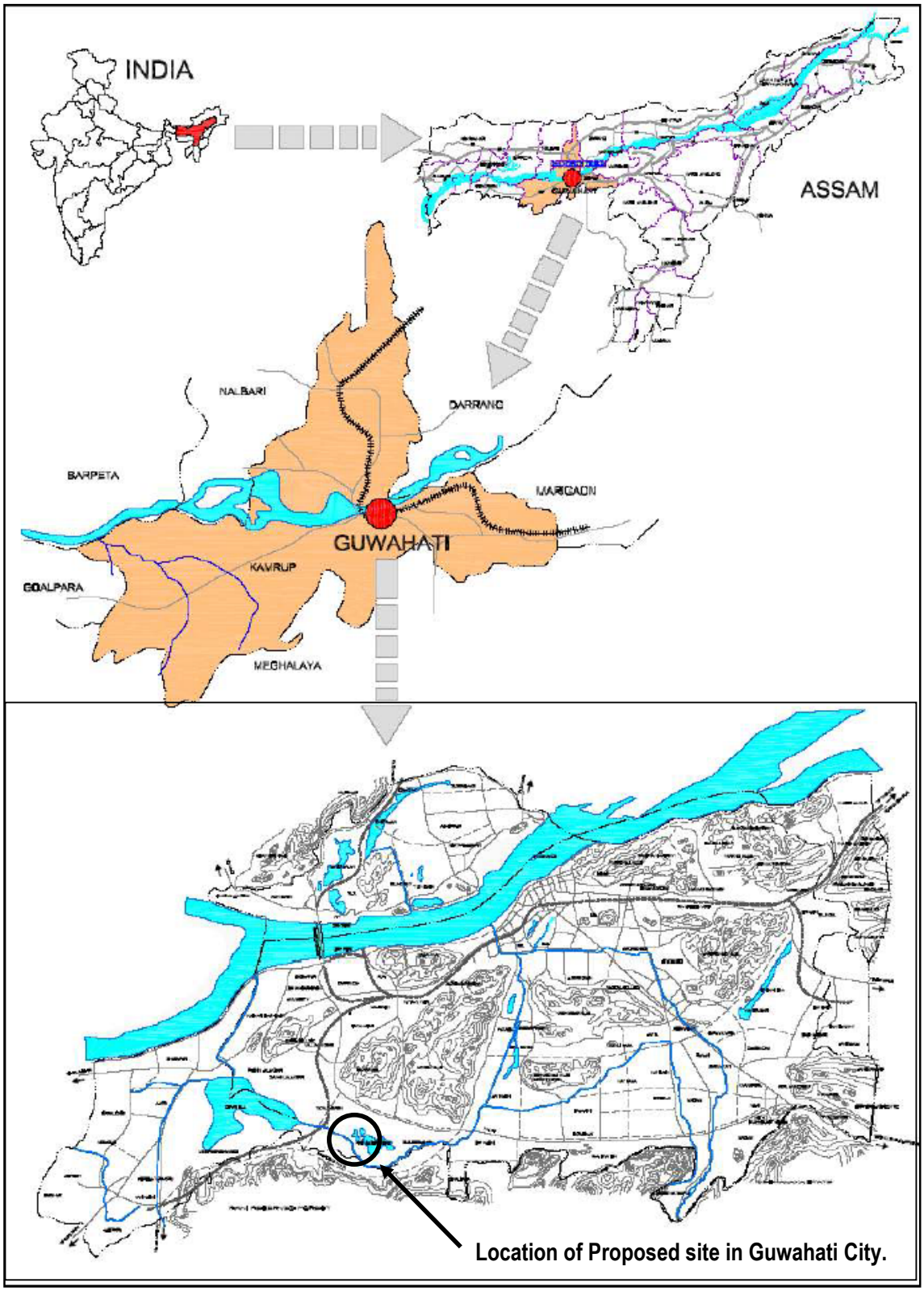
Both the above sites were not finally considered for the above stated reasons.

Finally a third site at Paschim Boragaon, Garchug was proposed by GMC. This new site is a big piece of land (24.12ha), but in the floodplains of Brahamputra. After considerable deliberations, the present site in Boragaon has been earmarked by the Government for the MSW disposal. Though this site is also not particularly suitable for MSW disposal, GMC indicated in several meetings to Ministry of Urban Development that no other suitable site is available for this purpose. The land needs to be protected from the flood waters by having suitable measures and GMC committed to adhere to the adequate measures to be adopted for a safe and environmentally sustainable disposal of MSW. Detail of this land is described in the following section.

3.2 DESCRIPTION OF THE PROPOSED PROJECT SITE

The proposed project is proposed to be developed at Paschim Boragaon, Garchug which is located (See Fig 3.1) along the national highway 37 bypass (NH-37) towards the north-east of Guwahati and 12 km away from the city center. There is a paved access road of about 1.km mainly constructed for the Institute of Advanced Studies in Science & Technology (IASST) connecting to the NH-37 up to the disposal route to the site. The disposal route (kaccha and unpaved) of about 1 km *is* connected to the paved access road up to the proposed site. The site is located close to a small stream, Mora nalha, which is streaming from Garchug village and thereafter joining the Dipar beel at about 1.5 km from the proposed site. The integrated waste management facility comprising of compost plant, RDF plant, Power plant and landfill is planned in about 180 bighas (i.e. 24.12/ha) of land. The latitude and longitude of the site is lat. 26°6.872’ and Long. 91°40.896’ with the elevation of 154 feet (46.9m) above mean sea level (MSL). The land has been acquired by the GMC for the said purpose. The site is inundated and likely to be flooded during monsoons. This land has also been acquired by the GMC for the said purpose. Currently no activities are seen on the land.

Fig 3.1: Location map of Proposed Project site at Paschim Boragaon, Garchug



The Paschim Boragaon village is demarcated into 13 wards having a total population of about 16,609. The population is mainly concentrated along the NH-37 and very sparsely populated towards the proposed site. The demography of the ward is very heterogeneous. About 31% persons are working and out of the remaining 69% non-working persons only 0.3 to 1.4% are involved in agricultural related activities.

The potential site has the largest available area and the population density in the villages situated around the proposed site area is observed to be very low. The land use pattern within 2 km of the site area is mixed and also consists of zones which are mostly small scale industrial belts along with sparse residential tracts forming villages such as Maghuwapara, Pamahi, etc. Hence, several other related activities like agriculture and fishing are observed in the area. By virtue of the hills, several stone crushing units are observed in the area, while several industries are also located towards the northeastern side of the site along the NH-37.

The proposed site is surrounded by Meghalaya hills on the south and the Phatasil hills on the east side. Variable topography is observed in the area. The aquifer in the area is composed of brownish soil mixed with loose sand (i.e. inter bedded cohesive soils). The water ponding level at the site during monsoon remains 30 to 40cm below the paved access road level. The average depth to groundwater is about 7 to 15m. Groundwater flow is generally west towards the Dipar beel.

3.3 LAND USE PROFILE

3.3.1 Landuse and Utilization Pattern

The landuse pattern in the city is mixed. The establishment of industrial development such as Guwahati refinery and other industries also contributed to the rapid development of the city. The city houses a number of educational and professional institutes like university, agricultural university, veterinary campus, forest school, textile institute, television station, a large airport at Borjhar along with a Regional Meteorological Center, etc. and a large number of small and medium industries. These are the causes for population growth as well as floating population from adjoining area and neighboring places. All these activities have significant influence over land use changes.

The landuse pattern of the city and adjoining areas (Figure 3.2) show the mixed land uses mainly covering the marshy, grass lands, vegetations, agricultural and water bodies. Apart from the built up area, the city mainly covers with low-density vegetation followed by marsh.

The landuse categories and the area under each category within the municipal limits are tabulated in **Table 3.1.** Some stone quarries and crushing units are also observed close to these villages polluting the environment in terms of noise and dust.

FIGURE 3.2: THE LANDUSE PATTERN OF THE CITY AND ADJOINING AREAS

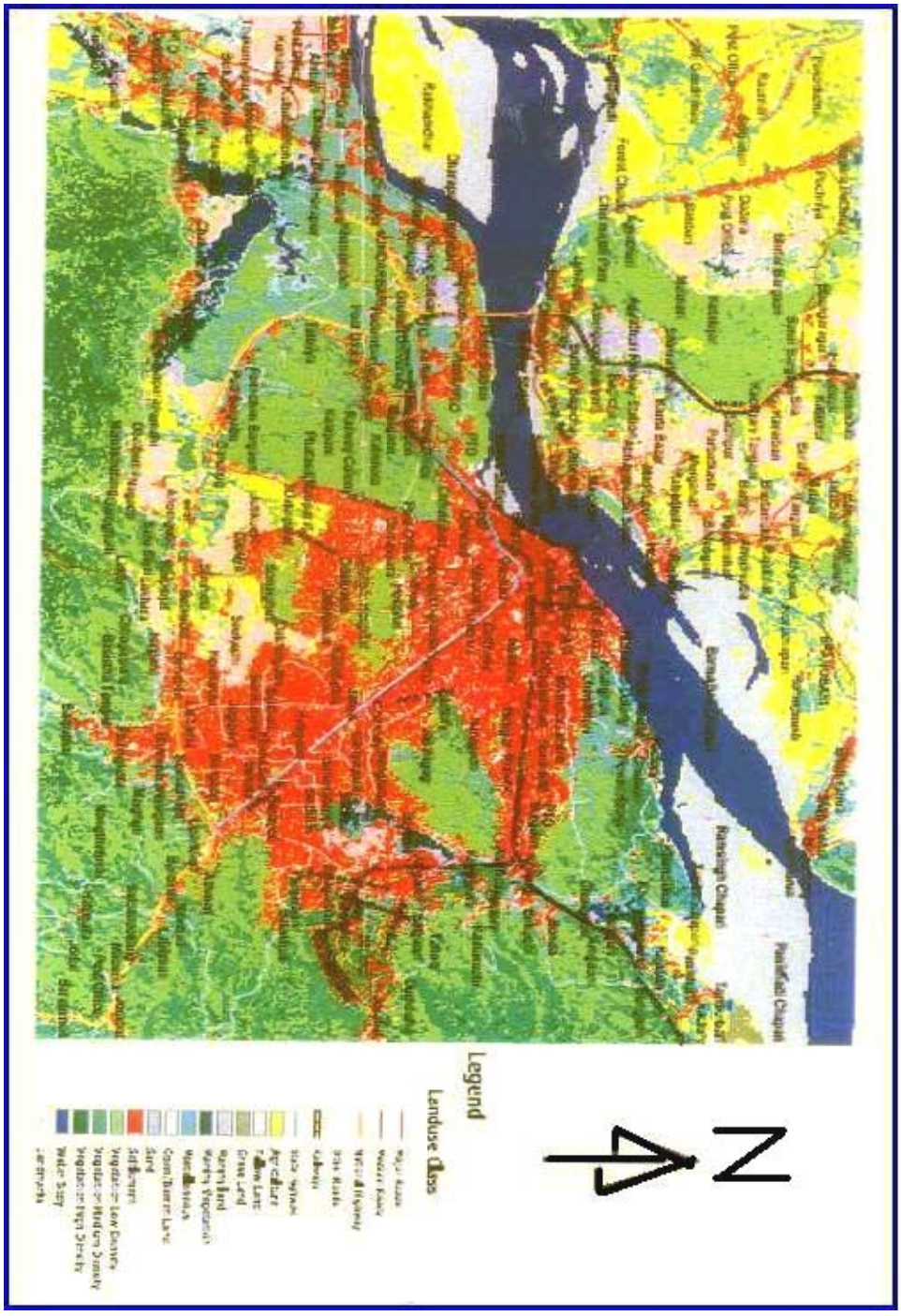


TABLE 3.1: LANDUSE CATEGORIES WITH THE AREA COVERED

S. No	Land-use Categories	Area in Km^2	Percentage of Total Area
1	Built-up area	79.92	**37**
2	Low density vegetation	64.8	30
3	Marshy vegetation	23.76	11
4	Medium density vegetation	8.64	4
5	Open land	8.64	4
6	Barren land	8.6	4
7	Agricultural land	8.6	4
8	High density vegetation	4.32	**2**
9	Marshy land	4.32	**2**
10	Unclassified miscellaneous land	2.48	1.15
11	Water bodies including river bed	1.84	0.85
Total area in sq km		**216**	**100**

3.4 SITE SUITABILITY ANALYSIS

In India, recently, solid waste management systems are assuming larger dimensions especially in keeping the guidelines issued by the committee appointed by the Hon'ble Supreme Court on the subject of Municipal Solid Wastes (Management and Handling) Rules 2000. Many of the municipalities are taking appropriate actions to improve collection and transportation of solid waste (MSW) from the generation areas, and opting for suitable technology for processing and disposal of MSW. In India, normal practice of open dumping is obviously causing public nuisance, pollution of air, water and land environment along with a constant source of hazard to the adjoining habitation. An extensive study has been carried out to delineate the health hazards of open dumping. Based on this review, a site selection criterion has been developed considering environmental conditions, hydro geological characteristics, accessibility etc.

Availability of suitable land for construction of landfill is a major problem in Guwahati. Most of the land in Guwahati is low lying and prone to flooding. Because of flood inundation, all the high level lands already have high-density settlements. With lots of difficulties, GMC could obtain just 24.12 ha of land. However, for the site development in phase 1 of this land to develop Integrated MSW processing & disposal facility (50 TPD compost plant, 500 TPD RDF Plant, 6 MW Power Plant & sanitary landfill), developer will be provided the grant amount for this component as approved under JNNURM Scheme and any amount beyond the approval limit has to be arranged by the developer by his own resources. After processing of waste the quantity of waste to be disposed in landfill will be reduced significantly (only 20-30% of total waste will be needed to be disposed off).

3.4.1 Proposed Project Site Features

The proposed site for Integrated MSW Processing & disposal facility development is located at Boragaon. The Garchug village is approximately 3 km away from the proposed site. Initially GMC had provided two isolated pieces of land. One was 9.38 Ha piece of land and the other was 2.8 Ha land at a distance of 200-300 m from each other. After the presentation of the project to the Chief Minister, additional land area has been allocated for the integrated facility. Total area for the development of integrated facility for the management of MSW of Guwahati is now 24.12 Ha (180 Bigha). The features of the site are presented in Table 3.2. Schematic Map Presenting Integrated Project Facility Site and Location Aspects have been presented in Fig 3.1.

Table 3.2: Features of Proposed Site

S. No	Features	Details
1	Latitude & Longitude	Lat. 26°06'872, Long. 91°40'896
2	Land use	It is on Brahmaputra flood plain. The land is generally lies idle, but occasionally used for minor cultivation and for fishing
3	Major crops in the study area	Reported some occasionally paddy cultivation around the site but often gets washed away in floods. However, there is no indication that the site is being cultivated.
4	Nearest Highway	National Highway-37 is 1 km away
5	Access Road detail, if any	The road is metalled and paved upto IASST, while about 0.5 km road leading to the site is
6	Nearest Railway Station	Guwahati —15 km
7	Nearest Airport	Guwahati air port -10 km
8	Nearest Town/City	Maligaon village towards North about 6 km from

S. No	Features	Details
9	Major Settlements	On the other side of NH-37 about 1.5 km and in Gorchug about 2.5 to 3 km from the proposed site; settlements in Paschim
10	Minor settlements	Harapur (Harapara / Hirapara, ~5km), Chakard (~3km), Devchatal (-1.5 to 1.75 km), Maghawpara (~1 to 1.25 km), Teteliya
11	Water bodies and dams, canals	Mora nalha which, originate from the Garchuk, passing right through the site and joining the dipar beel (within 200 to 300 m
12	Hills and Mountains (within or around the area)	Meghalaya Pahad behind the Maghuwapara about 1.5 to 2 km from the site; behind that Rani reserve forest starts while on the other
13	Reserve forests	Rani reserved forest about 1.5 km from the site
14	Ecologically sensitive zones (within 10 km)	Deepar beel about 1.5 km from the site
15	Monuments (within 10 km)	Not observed any
16	Sensitive Receptors	Shiv temple within 1 km from the site.
17	Socio-economic	Activities have been observed. Occasional paddy farming has also been reported in some patches. No lands at and in the vicinity of site is used for residential purposes except the proposed lands of LIC and tea industry in between the compost and landfill. Moreover, hardly any identify the site as of scenic importance.
18	Major important industries with in 10 kms	There are tea warehouses, small-scale textile (weaving) mill, salt factory and stone crushing factory near the site.

3.5 SITE EVALUATION METHODOLOGY

Since GMC does not have any other better land available within its limits for the proposed Integrated MSW Processing Complex, the present site is considered as a potential site for preliminary assessment.

For preliminary site assessment the following two methods would be used:

- Locational criteria recommended by Central Public Health and Environmental Engineering Organization, (CPHEEO) Manual on Municipal Solid Waste Management
- Site Sensitivity Analysis based on Central Pollution Control Board (CPCB) guidelines.

3.5 SITE EVALUATION BASED ON LOCATIONAL CRITERIA

The site was evaluated with respect to locational criteria specified in the Manual on Municipal Solid Waste Management, shown in Table 3.2 below.

Table 3.2 Assessment Based on Locational Criteria as Per CPHEEO Manual

S. No	Criteria	CPHEEO Manual Requirements	Description of the Site	Status of the Site
1	Lake/Pond	200 m away from the Lake/Pond	Depar beel 1.5 km away	Complies
2	River	100 m away from the rivers	Small stream (Mora Nallah) passes close to the site boundary.	**Does not comply**
3.	Flood plain	No land fill within a 100 year flood plain	Within flood plains	**Does not comply**
4	Highway	Away from 200 m NHAI/State	NH 37, 1 km away	Complies
5	Public parks	300 m away from public parks	No parks within 0.3 km	Complies
6	Wet lands	No landfill within wet lands.	Not a wetland	Complies
7	Habitation	500 m away from the notified habitation area	No habitations observed within 500 m from the site	Complies
8	Ground water table	Ground water table >2m.	At the ground level	**Does not comply**

S. No	Criteria	CPHEEO Manual Requirements	Description of the Site	Status of the Site
9	Critical habitat area	No landfill within the Critical habitat area. It is defined as the area in which 1 or more endangered species live.	No critical habitat	Complies
10	Air ports	No landfill within 20 km	Guwahati airport - 10km	**Do not comply; Application for Clearance from Air port authority**
11	Water supply schemes/ wells.	Minimum 500 m away	There are no schemes/wells in the area.	Complies
12	Coastal regulatory zone	Should not be sited	Far away from sea.	Not applicable
13	Unstable zone	No landfill	Not located in unstable zone – prone to landslide, fault etc	Complies
14	Buffer zone	As prescribed by regulatory	The entire area and their surroundings are vacant land. Can be declared by GMC or State UD department.	Can be met easily.

From the above table, it can be seen from the above that out of 14 criteria, the site does not comply for 4 of them.

3.6 SITE EVALUATION BASED ON CPCB SITE SENSITIVITY ANALYSIS

CPCB has developed the site sensitivity analysis with the following attributes:

1. Receptor related
2. Pathway Related
3. Waste characteristics related
4. Waste management practice related

A set of 34 attributes has been considered for the analysis. The analysis of the proposed site with respect to CPCB site sensitivity index is mentioned below in Table 3.3 below:

3.6.1 Site Evaluation - Estimation of Score for Individual Attributes

Based on the attributes related to the site, the corresponding site sensitivity index is found out and presented in Table 3.3. The value of the site sensitivity index multiplied by corresponding weightage results in score for each of the attributes as given below:

Table 3.3: Site Evaluation based on CPCB sensitivity Analysis

S.No.	Attribute	Attribute Measurement	Sensitivity	Weightage	Score
Accessibility Related					
1.	Type of road	National Highway	**0.2**	**25**	5.00
2.	Distance from collection area	1km	**0.1**	**35**	3.50
Total				**60**	**8.50**
Receptor Related					
3.	Population within 500 m	250-1000	0.5	50	25.00
4.	Distance to nearest drinking water source	1000-2500 m (Deepar Beel)	0.65	55	35.75
5.	Use of site by nearby residents	Moderate (agriculture), fishing (not commercial)	0.6	25	15.00
6.	Distance to nearest building	IASST (<500 m)	0.9	15	13.50
7.	Land use/Zoning	Agricultural (Only 3-4 months in a year)	0.25	35	8.75
8.	Decrease in property value with respect to distance	> 5000 m	0.1	15	1.50
9.	Public utility facility within 2 kms	Small-scale industries (tea ware house, salt factory etc.)	0.2	25	5.00
10.	Public acceptability	Not Known		30	
Total				**250**	**104.50**

S.No.	Attribute	Attribute Measurement	Sensitivity	Weightage	Score
Environmental Related					
11.	Critical environment	Wetland & Floodplains	0.75	45	33.75
12.	Distance to nearest surface water	1500-8000 m	0.50	55	27.50
13.	Depth to ground water	~ 0 m	1	65	65.0
14.	Contamination	No contamination	1.0	35	35.00
15.	Water quality	Potable	0.75	40	30.00
16.	Air quality	Not Known (But perception is confirming the standards)	0.95	35	33.25
17.	Soil quality	Not contaminated	1	30	30.0
Total					**254.50**
Socio Economic Related Economic Related					
18.	Health	No Problem	0.15	40	6.00
19.	Job opportunities	Low	0.70	20	14.00
20.	Odour	No odor	0.10	30	3.00
21.	Vision	Site is Fully Seen	0.90	20	18.00
Total				**110**	**41.00**
Waste Management Related Practice					
22.	Waste quantity/day	< 250 tonnes	0.15	45	6.75
23.	Life of site	20 years	0.25	40	10.0
Total				**85**	**16.75**
Climatology Related					
24.	Precipitation effectiveness index	Not Known		25	

S.No.	Attribute	Attribute Measurement	Sensitivity	Weightage	Score
25.	Climatic features contributing to Air pollution	No Problem	0.1	15	1.5
Total				**40**	**1.50**
Geological Related					
26.	Soil permeability	Mainly clay	0.4	35	14.0
27.	Depth to bedrock	10-20 m	0.3	20	6.0
28.	Susceptibility to erosion and runoff	Susceptible - Moderate	0.75	15	11.25
29.	Physical characteristics of rock	Not Known		15	
30.	Depth of soil layer	> 5 m	0.1	30	3.0
31.	Slope pattern	<1%	0.1	15	1.5
32.	Seismicity	Zone V	1	20	20.0
Total				**150**	**46.00**
Grand Total				**1000**	**482.50**

The following are the interpretation of the total score of the site

Less than 300	Less sensitive to the impacts (Preferable)
300 to 750	Moderate
More than 750	Highly sensitive to the Impacts (undesirable)

From the above exercise as carried out above, the proposed site scored a total score of 482.50. This score when compared to ranking of the site, indicates that the hazard potential of the site is Moderate.

The moderate hazard potential of the site has been mainly due to the problem associated with anticipated flooding of the site during monsoon due to floods. To improve this it is proposed to engineer the site development with suitable means so that no flooding or water inundation occurs at the site.

3.7 SITE DEVELOPMENT

The following have been proposed after analyzing different options for site development, as detailed in the DPR for the project:

Part 1 of 7.05 Ha for development of MSW processing area consisting off compost plant, RDF plant and Power Plant can be developed by raising the level of ground by filling upto 8m.

Part 2 of 11.67 Ha for the development of sanitary landfill (MSW disposal) by construction of retaining wall around this area.

A. Levelling

The required leveling for the entire MSW processing area will be carried out by the civil contractor in order that the finished ground level (FGL) and Finished Floor Level (FFL) are uniform through out the plant area.

B. Roads

All roads in the plant area will be well-designed bitumen roads. All main roads will be 4m wide with 1 m wide berm on either side. The crown of the road will be minimum 200mm above FGL. The final finished road will have a camber of 1in 60. Camber on top of water bound macadam surface will be 1 in 40.The existing ground level is NGL+0.00LVL and the formation level is FGL +1.00.

C. Drainage

Surface drainage will be designed based on the maximum rainfall intensity prevalent in the area over the last 50 years. Building will be provided with plinth protection all around, sloped towards side drains. The side drains will be connected to the main drains on either side of the roads.

For pipe drains, concrete pipe class NP2 confirming to IS: 458 will be used. However for road crossing, class NP3 pipe will be used. If sufficient clearance cannot be provided between the top of pipe and road top, the pipe will be encased in PCC / RCC. For the process drain, catch pits will be provided at the source location and they will be interconnected by buried RCC / CI pipelines and connected to waste water treatment plant.

The MSW storage areas will be provided with a slope to drain the water collected to a sump from where it will be pumped to effluent treatment plant.

D. Boundary Wall

The boundary wall for the MSW-Energy complex will be provided to a height of 2.5 m from the finished ground level (FGL) with angle iron bars and barbed wire for an additional height of 1 m.

3.8 ENVIRONMENTAL CONCERNS

Selection of suitable site for the disposal of solid waste has always been a difficult task for GMC, owing to its great environmental problems. The environmental concerns are significant for the proposed site as it is located in a flood-prone area. In addition, this site has heterogeneous characteristics i.e., marshy, shrubs, agricultural and fishing activities. Main issues that need to be addressed very carefully in the present project are as follows:

- Since, the proposed site is topographically lower and has higher aquifer level, the integrated waste management facility should be suitably designed. Proper mitigative steps have to be taken to avoid the possibilities of the surface water, soil and ground water contamination. Also, there are about 50 to 60 houses located within the 10 km radius of the site. The residents use tube-wells and dug-wells for drinking purposes. The groundwater is already reported to have a high concentration of **iron.**
- The Dipar beel's ecosystem that extends over a large area may have mild effect of landfill and composting operations during the construction phase. *Dipar Beel* is included in the Ramsar list of wetlands of international importance as Ramsar site no. 1207 on 19 August, 2002 having about *4000ha* of area. As per this convention, the Dipar beel is a permanent freshwater lake in a former channel of the Brahmaputra river, and of great biological importance and also essential as the only major storm water storage basin for the city of Guwahati. The beel is a staging site on migratory flyways and has some of the largest concentration of aquatic birds in Assam. The potential threats identified for the beel are over-fishing, hunting of water birds, pollution from pesticides and fertilizers and infestation by water hyacinth.

CHAPTER 4

LEGAL AND ADMINISTRATIVE FRAME WORK

4.0 INTRODUCTION

The 1972 United Nation Conference on Human Development at Stockholm influenced the need for a well-developed legal mechanism to conserve resources, protect the environment and ensure the health and well being of the people in India. Over the years, the Government of India has framed several policies and promulgated number of Acts, Rules and Notifications aimed at management and protection of the environment. As a result, our country now has a fairly comprehensive set of environmental legislation aimed at ensuring that the development process meets the overall objective of promoting sustainability in the long run.

Moreover, the Indian Constitution has also incorporated specific articles to address environmental concerns through the 42nd Constitutional Amendment of 1976. As stated in the Constitution of India, it is the duty of the state (Article 48 A) to *'protect and improve the environment and to safeguard the forests and wildlife of the country'*. It imposes a duty on every citizen (Article 51 A) 'to protect and improve the natural environment including forests, lakes, rivers and wildlife'. Reference to the environment has also been made in the Directive Principles of State Policy as well as the Fundamental Rights.

4.1 ENVIRONMENTAL POLICIES

Several environment policy statements have been formulated in the last few decades as a part of the Governments' approach to integrate environmental and developmental aspects of planning. The policies reflect a gradual shift in emphasis from pollution abatement and control to proactive and voluntary approaches for pollution prevention in keeping with global paradigm shifts and trends in environment management.

Following are some of the key policies that have been laid down by the Central Government:

- National Forest Policy, 1988;
- National Conservation Strategy and Policy Statement on Environment and Development, 1992;
- Policy Statement on Abatement of Pollution, 1992.

Despite these policy documents, a need for a comprehensive policy statement had been evident for some time in order to infuse a common approach to the various sectoral and cross-sectoral, approaches to environmental management. As a result, a National Environment Policy (NEP, 2006) has been drawn up as a response to our national commitment to a clean environment, mandated in the Constitution in Articles 48 A and 51 A (g), strengthened by judicial interpretation of Article 21.

4.2 LEGAL PROVISIONS FOR ENVIRONMENT

The principal environmental regulatory agency in India is the Ministry of Environment and Forests (MoEF), New Delhi. MoEF formulates environmental policies and accords environmental clearance for the projects.

It is important to note that the Central Government framed 'umbrella legislation', called the Environment (Protection) Act, 1986 to broadly encompass and regulate an array of environmental issues. The overall purpose of EPA is to establish an overall coherent policy and provide a basis for the coordinated work of various government agencies with operational responsibility for the environment and natural resources. This legislation also invests authorities with regulatory powers to address specific issues affecting the environment. The Act does not allow any person to establish an industry, operation or process that discharge or emit any environmental pollutant in excess of standards prescribed under specific rules and notifications.

The Acts, Rules and Notifications applicable to environmental aspects of the construction and operational phases of proposed project is summarized in **Table 4.1** and briefly described in the following sections.

TABLE 4.1: SUMMARY OF ENVIRONMENTAL LEGISLATION APPLICABLE FOR PROPOSED PROJECT

Legislation	Areas / Activities Covered
Environment (Protection) Act, 1991 (as amended) with Rules.	Overall Environment Protection Compliance to environmental (Air, Water, Noise) Standards issued under EPR
Air (Prevention and Control of Pollution) Act, 1987 (as amended) with Rules.	Protection of Air Quality Consent to Establish (NOC) for establishing and Consent to Operate (CTE) for activities causing air pollution from DG sets from SPCB Compliance to National Ambient Air Quality Standard
Water (Prevention and Control of Pollution) Act, 1974 with Rules.	Protection of Water Quality Discharge of sewage from proposed project Obtaining Consent to Establish (NOC) for establishing and Consent to Operate (CTE) for activities causing water pollution from SPCB
Water Cess Act, 2003 (as amended)	Paying Water Cess to Local Body for sourcing of domestic water

Legislation	Areas / Activities Covered
Noise Pollution (Regulation and Control) Rules, 2006 (as amended)	Compliance with Ambient Noise Standards in accordance to land use of the area
The Municipal Solid Waste (Management and Handling) Rules, 2000	Establish consistent regulations governing collection, segregation, transportation, and disposal of all types of municipal solid wastes
The Public Liability Insurance Act, 1992 (as amended)	An Act to provide public liability- insurance for the purpose of providing immediate relief to the persons affected by accident while handling any hazardous substance and for matters connected therewith or incidental thereto
Manufacture, Storage and Import of Hazardous Chemicals Rules, 2000 (as amended)	Notifying regulatory authority (in this case, the State Factories Inspectorate) of storage of hazardous substances like Waste Oil, etc Follow guidance on such storage, maintain updated MSDS, submit annual Safety Report to authority Prepare Onsite Emergency Plan
State Groundwater Regulation	Conform to restriction for drawing of groundwater Arrange for recharge through Rainwater Harvesting Schemes (as applicable)
Siting Guidance	Follow Siting Guidance as far as practicable Avoid sites which are environmentally sensitive
National Policy on Resettlement and Rehabilitation	Resettlement and Rehabilitation issues of project affected people
Ancient Monuments and Archaeological Sites and Remains Act, 1958	No development activity (including building, mining, excavating, blasting) is permitted within radii of 100m (protected area), and 300m (controlled area) without prior permission of the Archaeological Survey of India (ASI) or State Department of Archaeology.

The MoEF has the overall responsibility to set policy and standards for the protection of environment along with Central Pollution Control Board (CPCB). This includes air,

stack emissions, noise, wastewater and hazardous waste standards. The relevant standards, which are of significance to the proposed project, are given below:

4.3 SITING OF PROJECTS

The siting of developmental projects in India is managed by Siting Guidelines for activities and projects delineated by the MoEF and the CPCB. The overall purpose of the guideline is to aid proponents in judiciously selecting project sites, keeping in mind various environmental sensitivities. However, the guidelines for siting are not legally enforceable except for areas, which are ecologically fragile (as notified by certain specific notifications) or are located in the Coastal Regulation Zone as demarcated by the Coastal Regulation Zone Notification, 1991 and subsequent amendments. Additionally, State Governments sometimes formulate State wide siting guidelines for development planning.

4.4 ENVIRONMENTAL CLEARANCE

The requirement involved in the setting up of selected development projects (projects with potential to cause significant environmental impacts) in India is through the Environmental Clearance (EC) Process on the basis of an Environmental Impact Assessment study/filling up of necessary forms. The EC process is mandated by the EIA notification dated September 14, 2006.

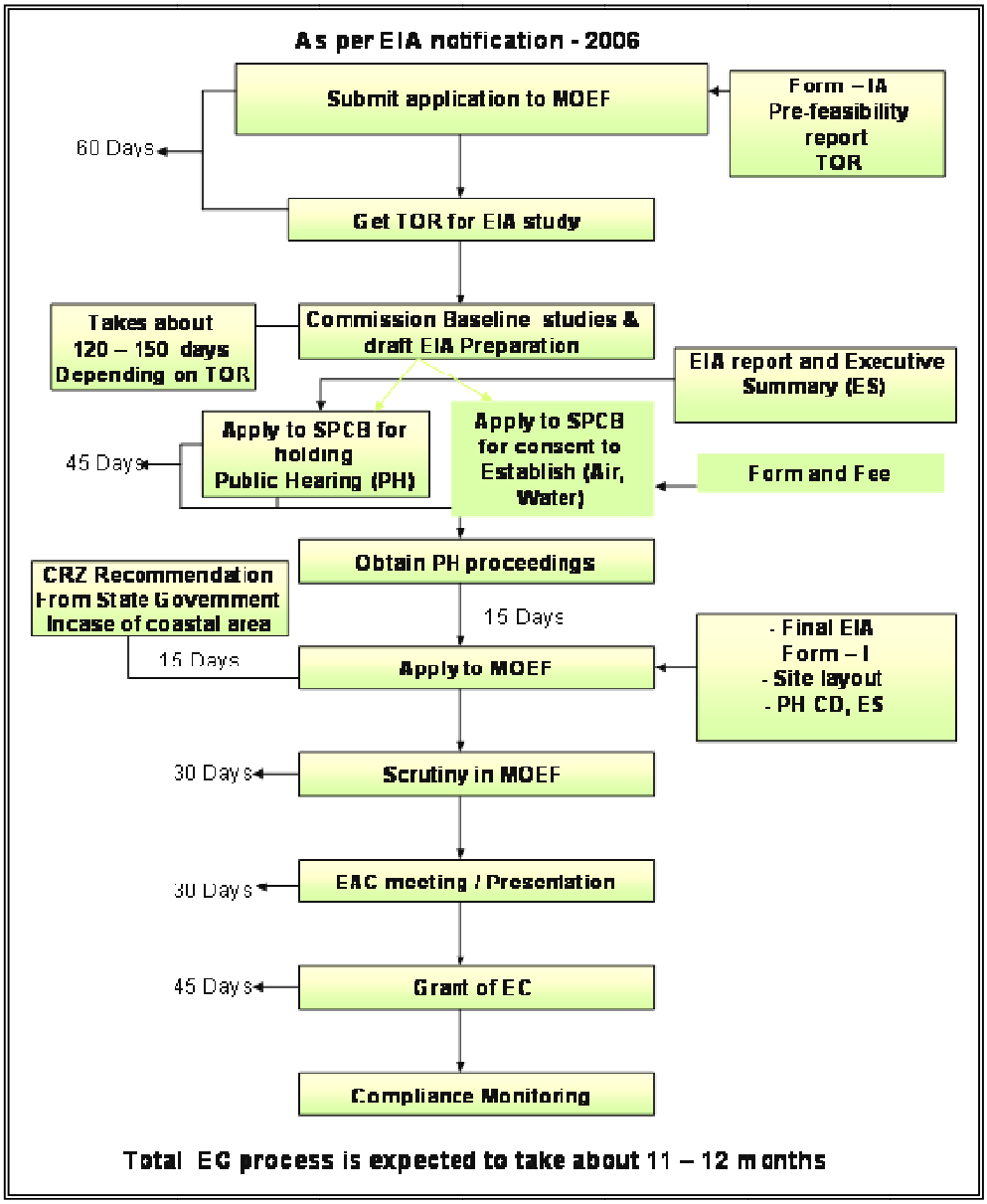
The project have been categorized under Item 7(i) as per MoEF Notification dated September 14, 2006

This proposed project is a Designated Project under Schedule and will fall under category A of the Environmental Impact Assessment (EIA) Notification due to the General conditions (interstate boundary) and requires Environmental Clearance from the Ministry of Environment and Forests (MoEF).

4.4.1 PROCEDURE FOR SEEKING PRIOR ENVIRONMENTAL CLEARANCE (EC) FROM MOEF

Typical EC procedure, as applied as per EIA Notification, 2006, consists of the actions given in **Figure 4.1**.

FIGURE 4.1: ENVIRONMENTAL CLEARANCE (EC) PROCESS



4.5 USAGE OF WATER & WATER POLLUTION

The use of water resources and the discharge of polluted water (sewerage) are primarily regulated by the Water Cess Act, 1977 and the Water (Prevention and Control of Pollution) Act, 1974.

The Water (Prevention and Control of Pollution), Cess Act, 1977 including Rules 1978 and 1991 provides for levy and collection of Cess on water consumed by the local authorities and by persons carrying on certain industries with a view to generate resources for prevention and control of water pollution. It also covers specifications on affixing of meters, furnishing of returns, assessment of Cess, interest payable for delay in payment of Cess and penalties for non-payment of Cess within the specified time.

The proposed project will fall under the Act only if they source water from water supply schemes of urban municipalities and corporations and these bodies levy such cess as some form of water tax to the proposed project.

The Water (Prevention and Control of Pollution), Act, 1974 including Rules, 1975 (as amended up to 1988) provides for the prevention and control of water pollution and maintaining or restoring good water quality for any establishment. The Act assigns functions and powers to the CPCB and SPCBs for prevention and control of water pollution and all related matters.

The liquid wastewater discharge limit from the proposed project as per CPCB norms are given in **Appendix I.**

Of late, with rapid depletion of groundwater resources in several areas of the country, efforts have been initiated to regulate the use of groundwater resources. The focus of such acts and rules (many of which are still in draft form) is to provide for mechanisms that would lead to replenishment of groundwater reserves through techniques like ground water recharging.

4.6 AIR QUALITY

The Air (Prevention and Control of Pollution) Act, 1981 including Rules 1982 and 1983 was enacted to prevent, control and reduce air and noise pollution. According to Section 21 of the Act, no person shall establish or operate any activity, which can cause air pollution without obtaining Consent to Establish (CTE) as per the Air Act.

The Act also lays down National ambient air quality standards for common pollutants like Suspended Particulate Matter (SPM), Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_x), Carbon monoxide (CO) and Lead (Pb) with the intent of managing air quality for different category of areas (residential, industrial and sensitive). The Environment Protection Rules (EPR) also specifies source emission standards determined on the basis of the impact of pollutants on human health, vegetation and property for activities, which can pollute the air. The National Ambient Air quality standards are presented in **Appendix II.**

It may be noted that normally the CTE for the Air and Water Act is provided in the form of a No Objection Certificate (NOC) to the project proponent when the project falls under the 1-8 categories of activities covered by the EIA notification. Grant of NOC is independent of EC process.

4.7 NOISE QUALITY

With the objective of regulating ambient noise level in the environment, the Central Government has notified the Noise Pollution (Regulation and Control) Rules, dated February 14, 2000 under the EPA.

The EPR also lays down equipment specific noise emission standards for DG Sets, Air conditioners and Construction Equipment, which would be in use for the proposed

project. Specific standards for control of noise from DG sets and measures to be taken for reduction of noise by using acoustic enclosures, acoustic treatment of rooms or exhaust muffler have also been specified through the Environment (Protection) Second Amendment Rules, 2002 notified through notification GSR 371 (E) on 17th May, 2002.

4.8 THE MUNICIPAL SOLID WASTE (MANAGEMENT AND HANDLING) RULES, 2000

The Municipal Solid Waste (Management and Handling) Rules, 2000 (MSW Rules) establish consistent regulations governing collection, segregation, transportation, and disposal of all types of municipal solid wastes throughout India. The MSW Rules apply equally to every municipal authority regardless of its size.

4.8.1 TREATMENT AND DISPOSAL OF MUNICIPAL SOLID WASTE

The MSW Rules seek to minimize the burden on landfills for the disposal of municipal waste by adopting appropriate waste segregation and treatment technologies. Municipalities have the responsibility to implement appropriate strategies and systems to minimize disposal volumes based on the following criteria:

- Processing of biodegradable wastes by using composting, vermi-composting, anaerobic digestion or any other appropriate biological processing for stabilization of waste. The objective is to minimize disposal volumes and generate a valuable end product. It must be ensured that compost or any other end product shall comply with standards specified in MSW Rules.
- Mixed waste should be sorted to remove recoverable materials prior to disposal.
- Incineration, with or without energy recovery, including pelletization can be used for processing wastes in specific cases.
- Alternative, state-of-the-art technologies may also be applied provided that the Municipal Authority or Private Operator obtains authorization from the Central Pollution Control Board.

  The MSW Rules restrict landfill disposal to non-biodegradable, inert, and other wastes that are unsuitable for either recycling or biological processing. Residues of waste processing facilities, as well as pre-processing rejects, should be land filled. Land filling of mixed waste should only be permitted in situations where the waste stream is unsuitable for alternative processing or when additional time is required to establish appropriate waste diversion and treatment programs and technologies.

4.9 INSTITUTIONAL FRAMEWORK

Whereas the legislative branch of the government (Parliament) is responsible for the enactment of environmental law and the judiciary for its enforcement in the case of transgression, it is the function of the executive branch (ministries, regional and local

authorities) to determine policies and administer environmental law in actual practice. Also, since an environmental dimension has now become a part of all economic activities, an effective mechanism of coordination and control is the responsibility of the central environmental agency so that environmental policies can be translated into action.

The Government of India took a major step in 1972 when it constituted the National Committee on Environmental Planning and Coordination (NCEPC). Later in 1980, the Government of India established a new Department of Environment on the recommendation of a committee constituted by the Indian Parliament. The Central and State Pollution Control Boards were set up and entrusted with the task of air and water pollution control in 1974.

4.9.1 Ministry of Environment and Forests (MoEF)

In view of the growing importance of environmental affairs, the Government of India set up a Department of Environment in November 1980 under the portfolio of the Prime Minister. The Department, later renamed as the Ministry of Environment and Forests (MoEF) plays a pivotal role in environmental management for sustained development and for all environmental matters in the country. The major responsibilities of MoEF include:

- Environmental resource conservation and protection, including environmental impact assessment of developmental projects;
- Co-ordination with the other ministries and agencies, voluntary organisations and professional bodies on environmental action plans;
- Policy-planning;
- Promotion of research and development, manpower planning and training and creation of environmental awareness;
- Liaison and coordination with international agencies involved in environmental matters.

Developmental project proponents are also required to submit Environmental Impact Statements/Assessments to establish that preventive measures are planned by installing adequate pollution control and monitoring equipment, and that effluent discharged into the environment will not exceed permissible levels. The MoEF appraises these statements/assessments and approves the project from the environmental angle. The respective State Pollution Control Board is to give a No Objection Certificate (NOC).

4.9.2 Central and State Pollution Control Boards

The Central Pollution Control Board is directly responsible for pollution control throughout the national territory. In addition to the control of air, noise and water pollution it is also responsible for ensuring effective control on disposal of hazardous wastes and storage and handling of hazardous chemicals and substances.

Additionally, with the enactment of air and water pollution laws, states have set-up their own Pollution Control Boards (SPCBs) to monitor industrial emissions and effluents

and to approve the operation of new industries after careful scrutiny. The functions of the SPCBs include:

- The planning of comprehensive state programs for the prevention and control of air and water pollution and to ensure the implementation thereof;
- Inspection of control equipment, industrial plants, etc.;
- Establishing norms in consultation with the Central Board and having regard to national air quality standards, gaseous emission standards from industrial plants, automobiles, etc. Different emission standards may be laid down for different industrial plants, having regard to the quantity and composition of emissions into the atmosphere from such plants and the general pollution levels in the area;
- Advising the State Government on siting of new polluting industry.

CHAPTER 5

EXISTING ENVIRONMENTAL STATUS

5.0 INTRODUCTION

This chapter describes the existing environmental settings in the study area and is based upon the secondary information collected from the published sources, reconnaissance survey, primary socio-economic survey and environmental monitoring of air, noise, soil, ground water and surface water in the study area. The baseline data was generated on meteorology, air quality, noise levels, ground and surface water quality, land environment including soil quality, land use pattern, biological environment and the socio-economic status during the period of February and March 2006. However, the meteorological data for the previous year (i.e. 2005) has also been collected to know the prevailing seasonal conditions. The stations chosen for the study included Paschim Boragaon, Garchuk, Pamahi and Maghuwapara village. The measurement campaign includes the ambient air monitoring, noise level measurements, traffic counting, soil sampling, and water and groundwater sampling. While the meteorology and climate related data were obtained from the regional meteorological center of Guwahati

The major purpose of describing the environmental settings of the study area is:

- To assess the existing environmental quality, as well as study the environmental impacts due to the proposed project.
- To identify environmentally significant factors or geographical areas that could preclude any future development.

Additional purposes of the baseline studies is to provide sufficient information so that decision makers unfamiliar with the general location can develop an understanding of

- The project need
- Environmental characteristics of the study area

The objective of the present study is to assess environmental impacts due to proposed Integrated Municipal Waste Management Project at Guwahati, comprising of the following:

1. **Primary collection of MSW:** Door-to-Door collection of MSW is to be implemented.
2. **Transportation of MSW:** After collection MSW will be transported in the closed/covered vehicles to the processing and disposal site at Boragaon.
3. **Processing and Disposal of MSW:** MSW is to be processed for energy recovery before final disposal into landfill site. Only inerts or processing rejects to be land filled which is to be in range of 20-30% of total waste transported to the site. Processing and disposal site is to be developed at Boragaon. Processing complex would comprise of the following:

i. **RDF Plant to handle 500TPD MSW**: Mixed MSW would be converted into Refuse Derived Fuel (RDF) in the RDF Plant.

ii. **Compost Plant to handle 50 TPD of Organic waste:** Organic components of MSW segregated during RDF Process will be treated in the compost plant to produce manure.

iii. **Power Plant**: Power Plant boiler will be fed with the 180 Tonne per day of RDF having CV in range of 2500-2800 Kcal/kg and 57 TPD of biomass, up to the limit laid as per MNRE Policy/ guidelines to use supplementary fuel for such plants as fuel and will generate 6 MW of electricity. waste collection, transportation of MSW to the waste processing & disposal site where MSW is to be processed before final disposal to the landfill site. MSW processing complex & disposal facility would be located at Boragaon in Guwahati and would comprise of compost plant of 200 TPD designed capacity, RDF Plant to process 500 TPD of Mixed waste to produce 180 TPD of RDF and power plant to generate 6 MW of electricity by utilizing RDF & 57 TPD of biomass as a fuel.

The current environmental quality status around the identified project site represents the baseline status for the proposed project. The methodology adopted for conducting baseline studies is described in following sections.

5.1 METHODOLOGY OF CONDUCTING BASELINE STUDY

The guiding factors for the present baseline study are the requirements laid down by the Central Pollution Control Board (CPCB), and guidelines as per the Environmental Impact Assessment notification and TOR assigned by MoEF vide letter No.-10-74/2007-IA-III dated 6th September, 2007

For the purpose of the EIA study, the impact zone for the proposed implementation shall confine within a radius of 10 km from the center of the project site. For this study data for all the seasons in a year has been collected.

The studies were conducted by considering the following:

- Various environmental attributes were divided into primary and secondary studies. Primary attributes such as micro-meteorology, air environment, water, soil, noise, traffic, flora and fauna and socio-economic aspects were assessed by conducting field studies and on-site monitoring and review of the past studies conducted; and
- Secondary attributes such as land use studies, geology, physiological characteristics, have been assessed by literature review of studies conducted in the past and by various government publications.

The baseline studies started with reconnaissance survey and site visits in the study area for fixing the monitoring locations for collection of the primary data. Various

Government, Semi-Government departments were approached for getting information for the secondary data generation.

5.2 PARAMETER FOR STUDY

The various parameters surveyed and studied for the baseline study are discussed in the following sections components:

- Air Environment
- Noise Environment
- Water Environment
- Land Environment
- Ecological Environment
- Socio-Economic Environment

5.2.1 METEOROLOGY & CLIMATE

The meteorological data were obtained from the regional meteorological center (RMC), which is located at Airport, Borjhar. The meteorological parameters include, wind speed, wind directions and other information, viz. humidity, rainfall, temperature. The study area is low lying and surrounded by hills and is subjected to a wet weather. The area experiences a lot of rainfall every year. The pre-monsoon months, March-April, have winds from North East. During monsoons, the predominant wind corridors are North East, North, and also South. The post monsoon period, from October-November is a period mixed with calm conditions and winds mainly from North. The winter months, November to February, experience frequent calm conditions. The maximum number of calm periods observed is in the month of December and January. The annual average temperature observed of maximum mean daily is 29.5 °C and that of minimum mean daily temperature is 19.7 °C. August is the hottest and January is the coldest month of the year. The annual average mean relative humidity is 82% in the morning and 70% in the evening. The climatic condition in the area is thus humid and tropical. The average rainfall during May to September is about 81% of the total contribution. The highest rainfall occurs in the month of July followed by June. The average annual rainfall in the city of Guwahati is 166cm.

During the study period, the inversion levels (up to 150 to 200m) were observed to be very low, and the prevailing wind direction is observed to be from North-East and East. Based on the data collected the wind rose diagrams are presented for all the seasons of the year 2005 and for the month of February 2006 **(See Figure 5.1 & 5.2).** The wind speed recorded mostly remained within *3kmph.*

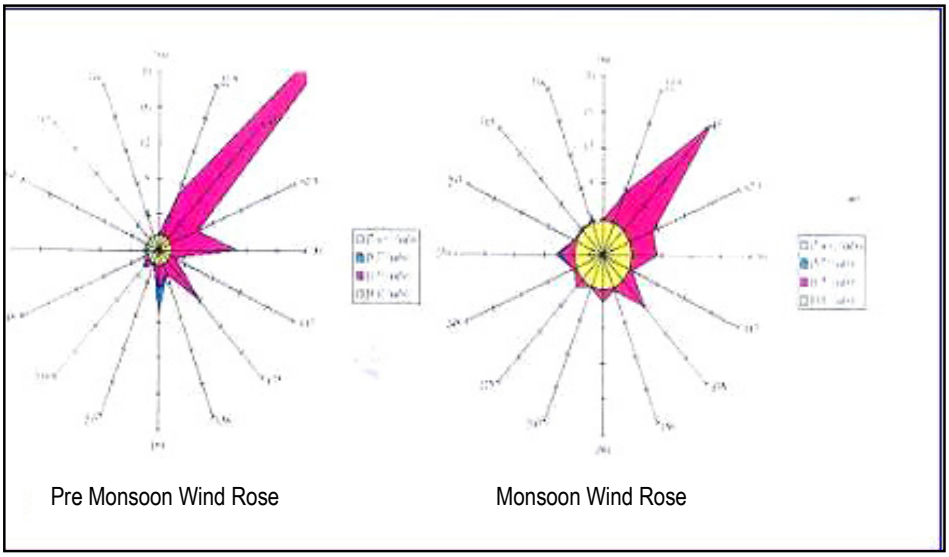


Fig 5.1: Wind Rose Diagram

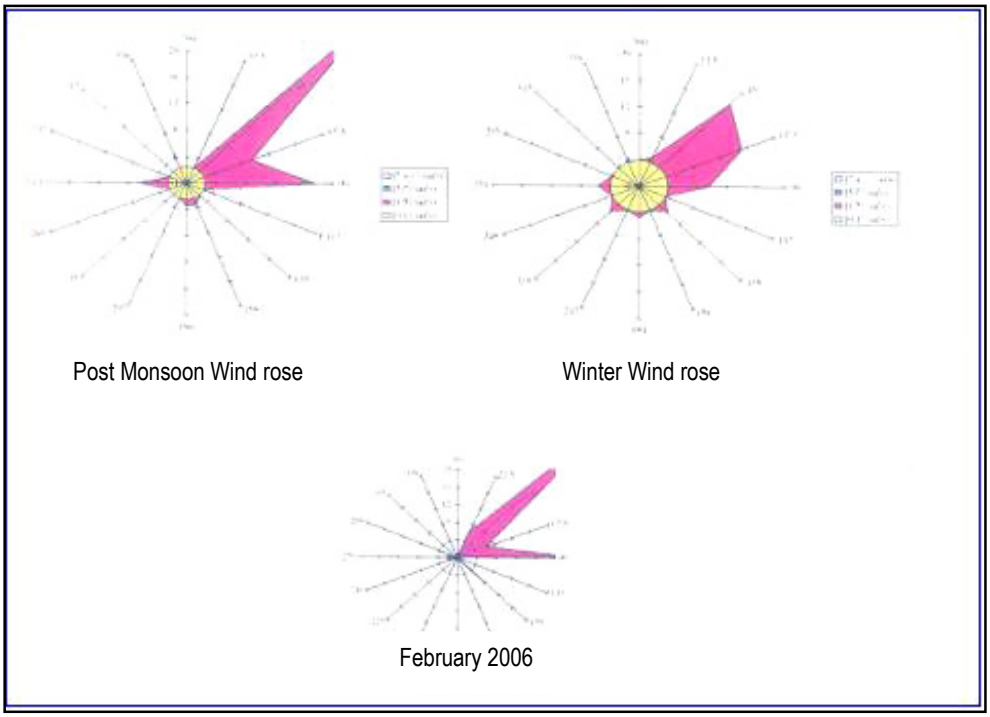


Fig 5.2: Wind Rose Diagram

5.2.2 AIR ENVIRONMENT

Air pollution can cause significant effects on the environment, and subsequently on humans, animals, vegetation and materials. It primarily affects the respiratory (e.g. by

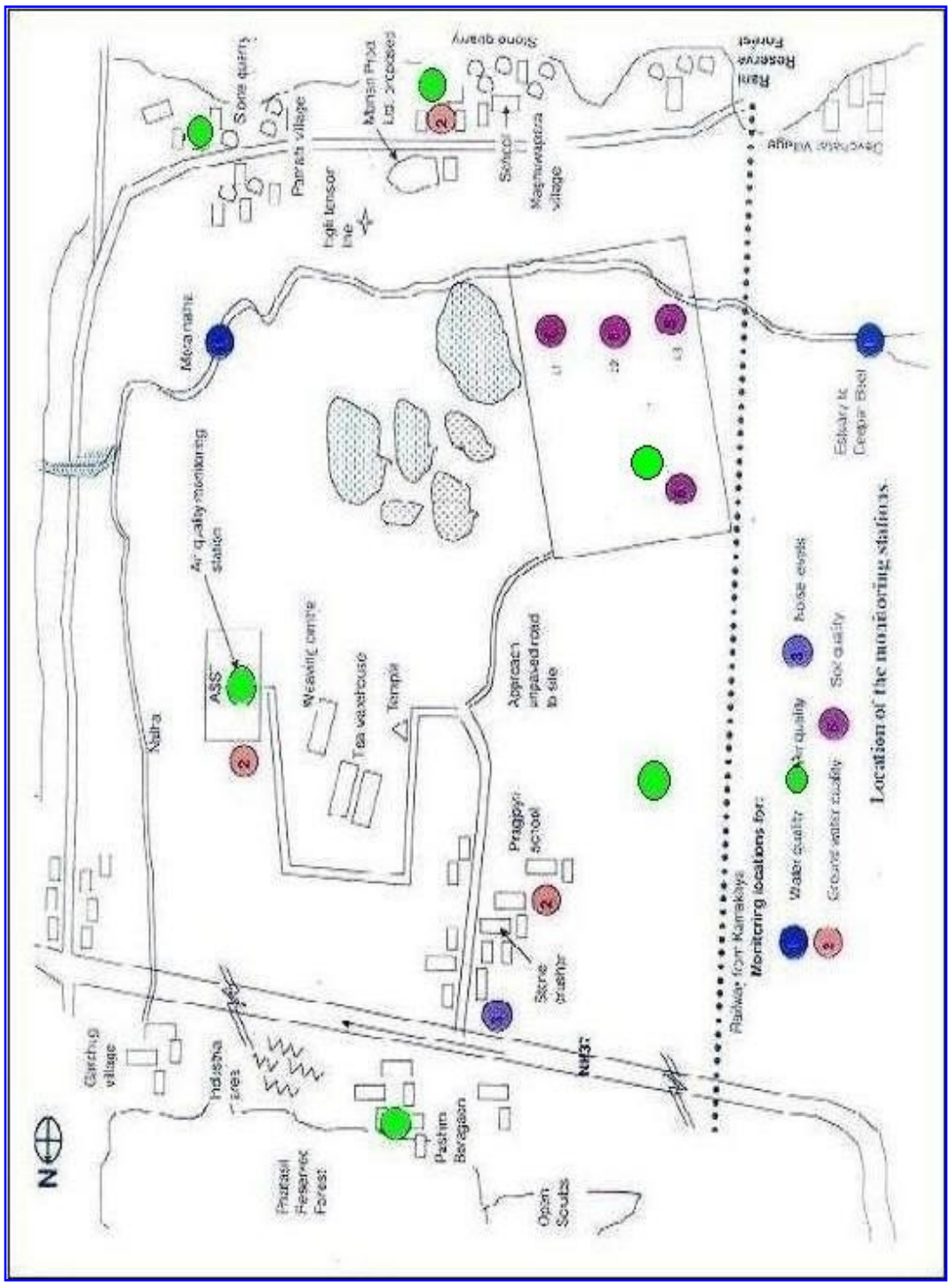
fine dust), circulatory (e.g. by carbon monoxide) and olfactory (e.g. by odors) systems in humans. In most of the cases, air pollution aggravates pre-existing diseases or degrades health status, making people more susceptible to other infections or the development of chronic respiratory and cardiovascular diseases. Environmental impacts from air pollution can include acidic deposition and reduction in visibility.

Following the reconnaissance survey of the study area and taking into account the predominant environmental factors such as winds, topography and details of existing industrial activities in the region,

Ambient air quality was monitored at six stations (see fig. 5.3.(B). 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. In upwind direction The first monitoring station was, on the terrace of IASST building about 500m from the proposed landfill site and the second was, in the Paschim Boragaon Industrial area on the other side of NH-37 about 2.5km from the proposed site towards North-East. Three stations was setup in down wind direction at Maghuwapara Village, Pamahi village and at junction of paved and unpaved road near to the proposed 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 February to March 2007 at all the stations. The frequency of sampling was two consecutive days a week for a month.

Fig 5.3 (A): Location of Monitoring Station



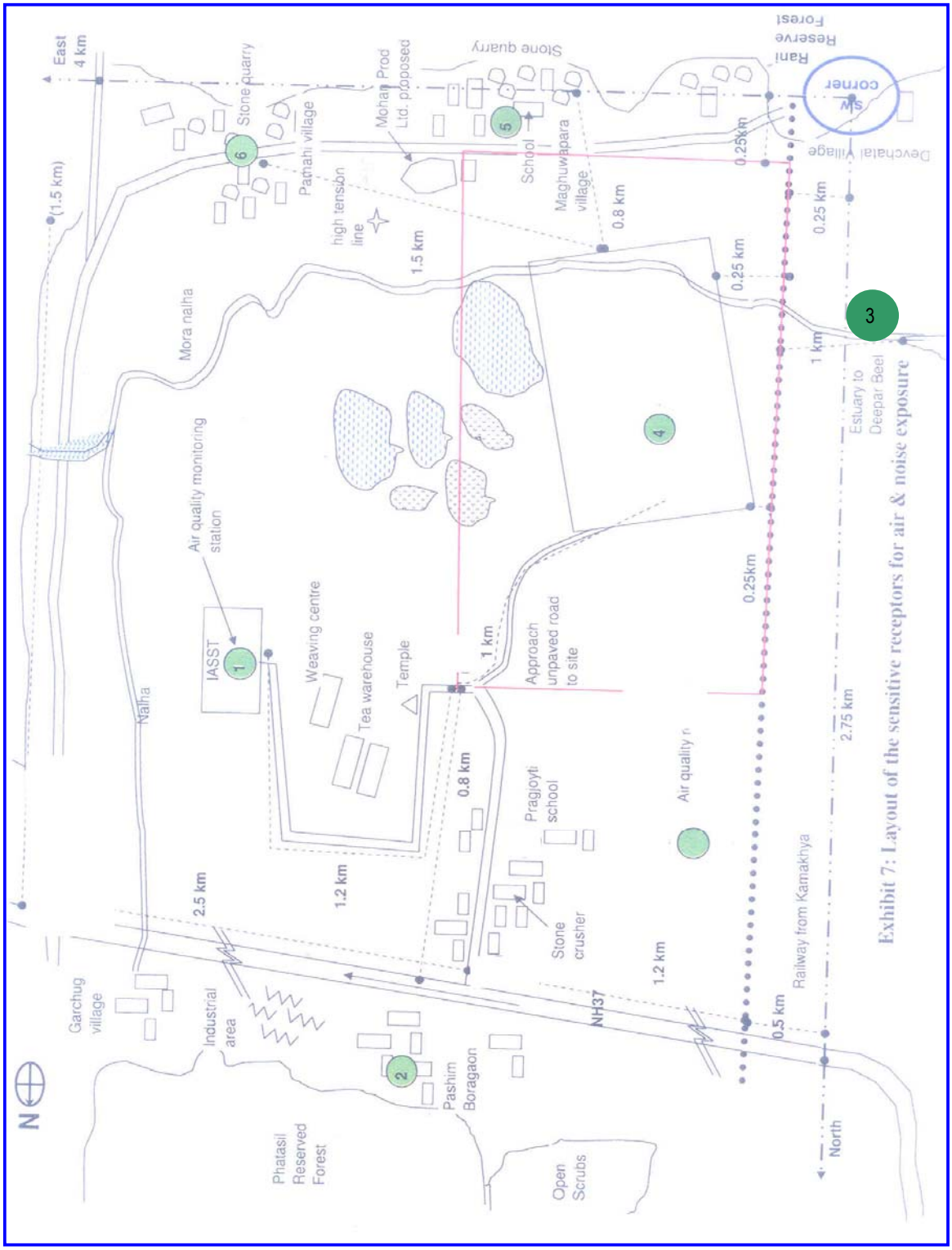


Fig 5.3(B): Location of Air Quality Monitoring Stations

The pollutant concentration data was analyzed to evaluate the air quality in the study region. The pollutant concentration levels of NOx, SO2, and RPM were measured at all the stations **(See Figure 5.4 to 5.9**). The pollutant concentrations were compared with the National Ambient Air Quality Standards (NAAQS) as notified by CPCB.

It was observed that pollutant concentration levels of NOx and SO2 at the stations in upwind directions i.e at IASST were very low while it was comparatively high at the industrial location. However, at all the sites, the pollutant concentrations comply with the NAAQS of India. However SPM exceed the limits at both upward and downward location .The concentration at Paschim Boragaon industrial area is found to be in the range of 125-510 ug/m3.

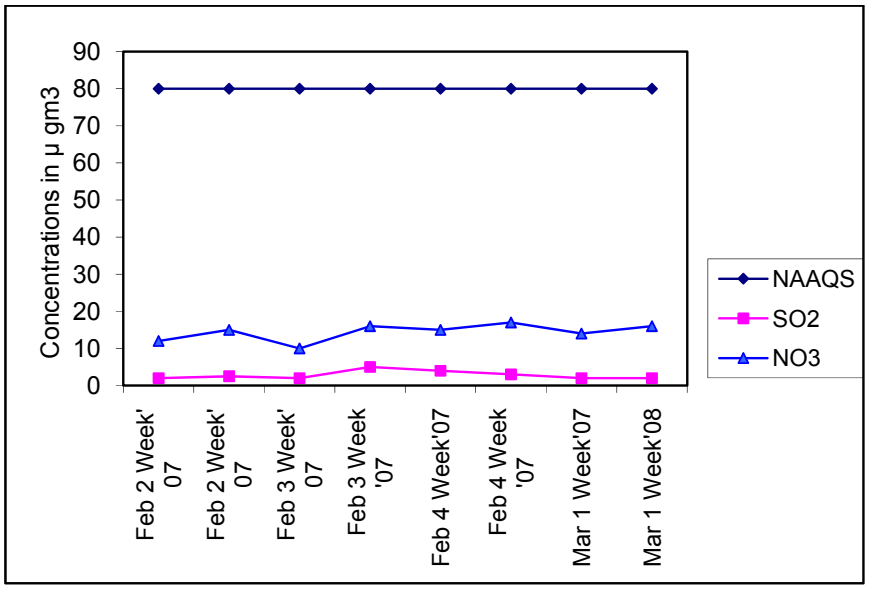
However in three locations at downwind direction the RPM & SPM was found to be in the range of 60-120ug/m^3 and 90-340 ug/m^3

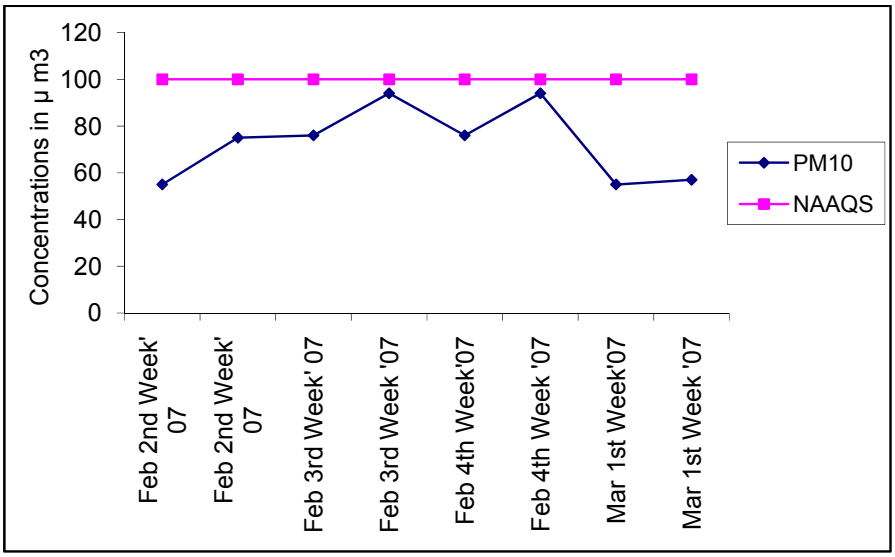
The higher values are attributed to the re-suspended dust from the unpaved disposal (kaccha) roads in the area used by trucks for carrying soils and also stone quarries and crushing units located in the close vicinity. The road construction and land reclaiming activities in and around the area also leads to the high concentration of SPM and PM. The major contribution at all the stations in both upwind and downwind direction is the airborne and resuspended dust. The main source of gaseous pollutants is the industries located near Paschim Boragaon while that of higher SPM observed at areas may be the construction of roads and various other activities in the region, which render dust and particulate matter suspended in atmosphere. The higher gaseous pollutant concentrations at both the stations are observed to be influenced by the predominant wind direction, from N-E and N. The daily monthly average values of air pollutant at all sites are also shown in Table 5.1.

Table 5.1: Ambient air quality monitoring data at sites

Sr. No.	Pollutant µg/m^3	IASST Building	PB Industrial area	Maghuwapara Village	Pamahi village	At junction of paved and unpaved road near to the proposed site	Project Site
1	SO_2	3	4	3	4	4	4
2	NOx	14	21	20	20	22	18
3	RPM	73	107	90	82	85	74
4	SPM	203	336	214	205	206	198

Fig 5.4: Ambient Air Quality at IAAST Building





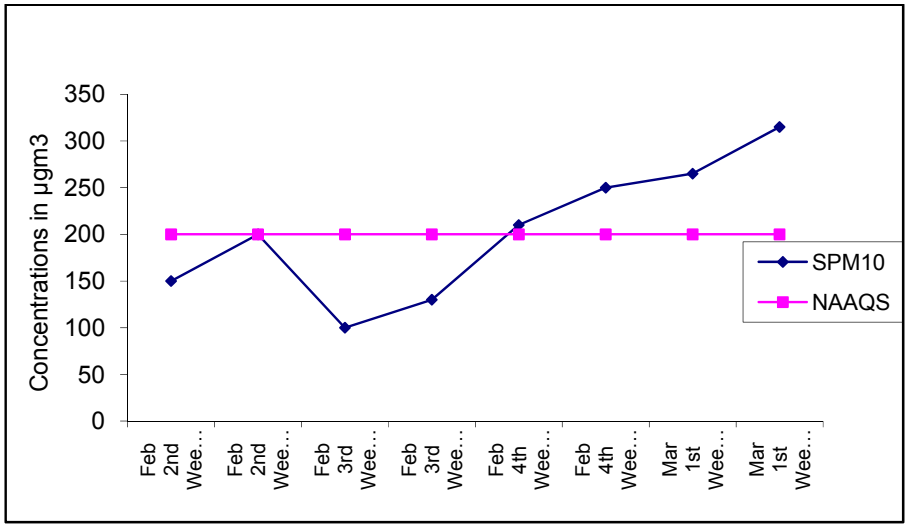
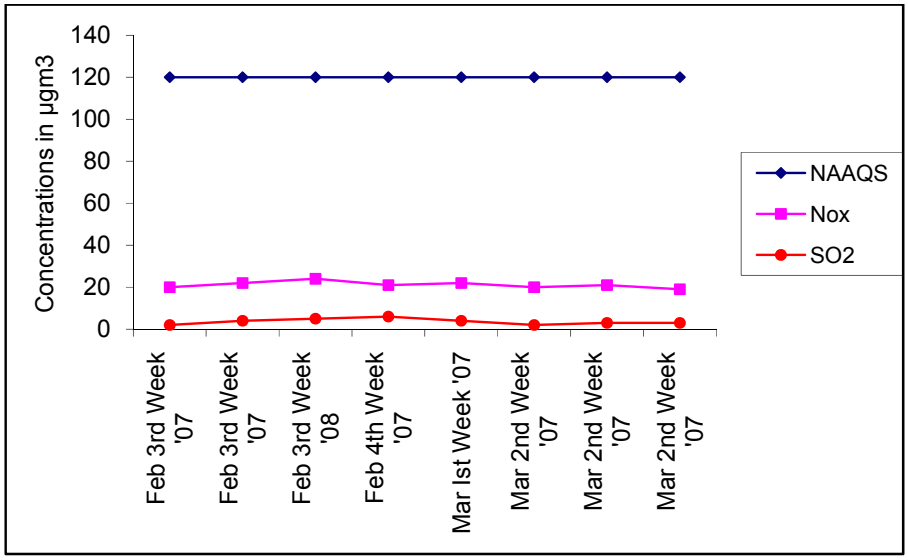
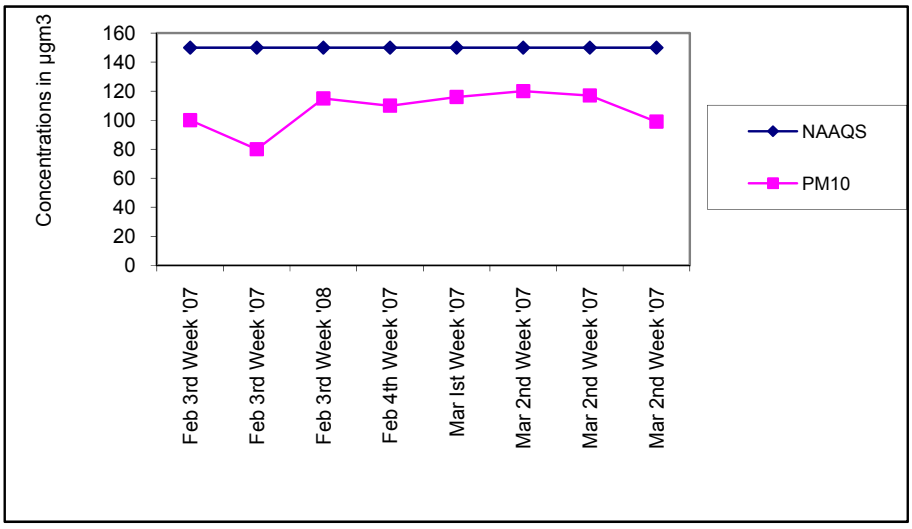


FIG 5.5: AMBIENT AIR QUALITY AT PB INDUSTRIAL AREA





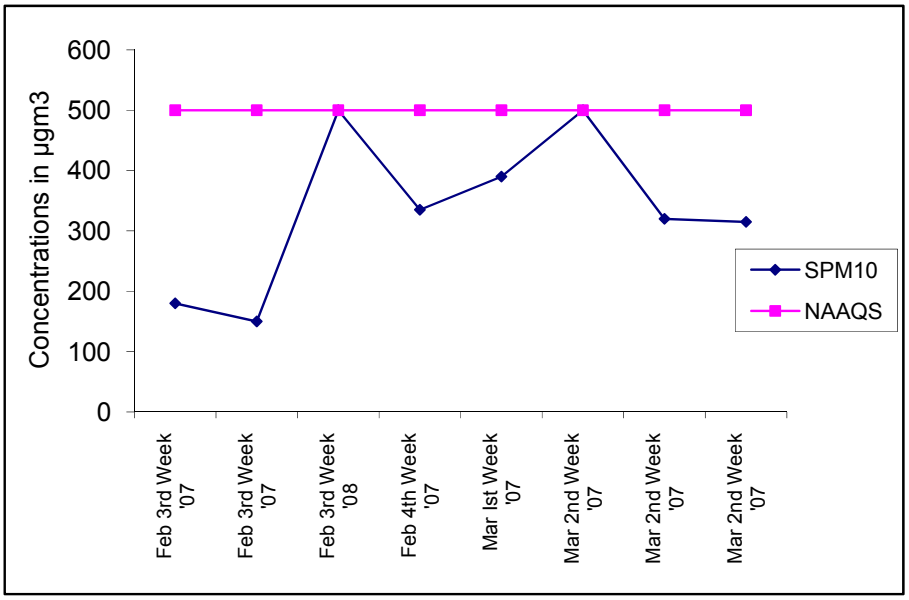
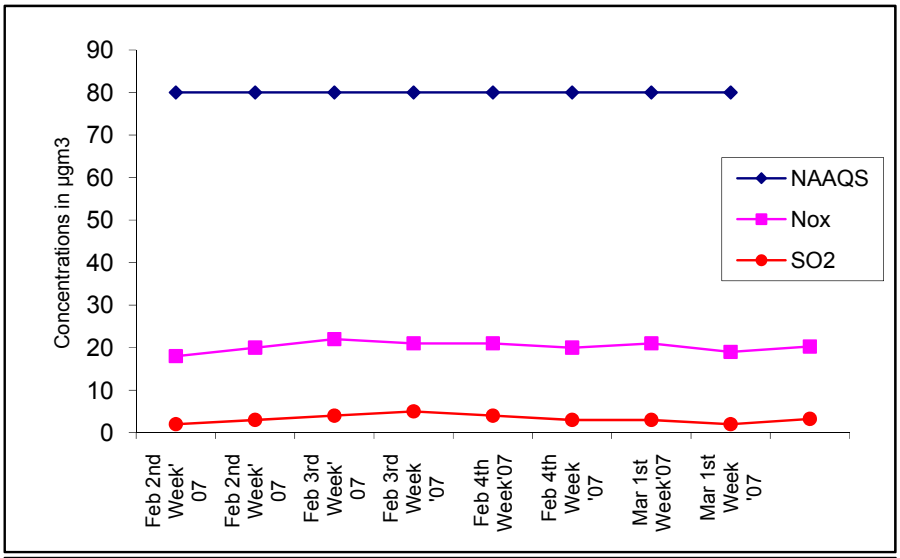
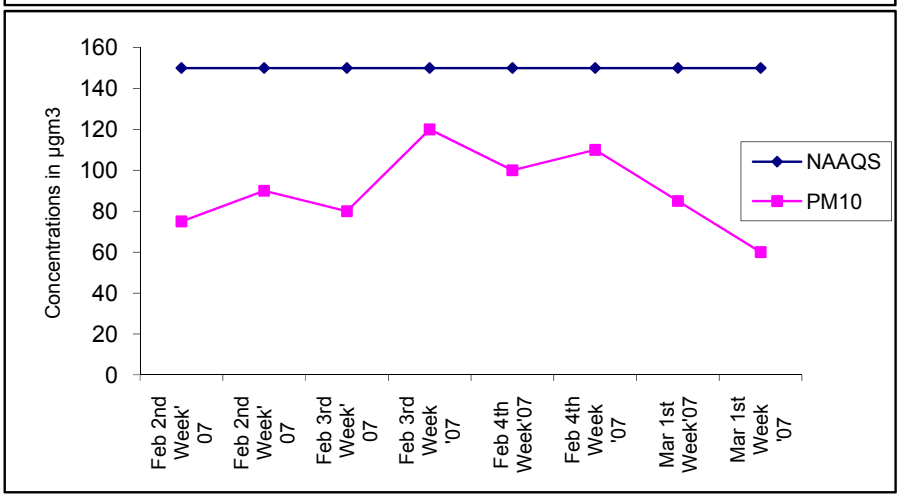


Fig 5.6: Ambient Air Quality at Maghuwapara Village





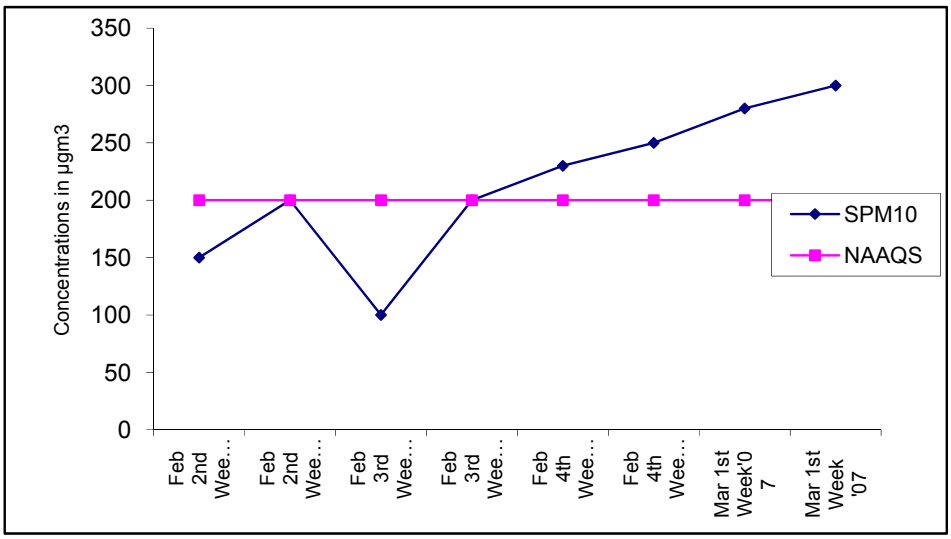


Fig 5.7: Ambient Air Quality at Pamahi Village

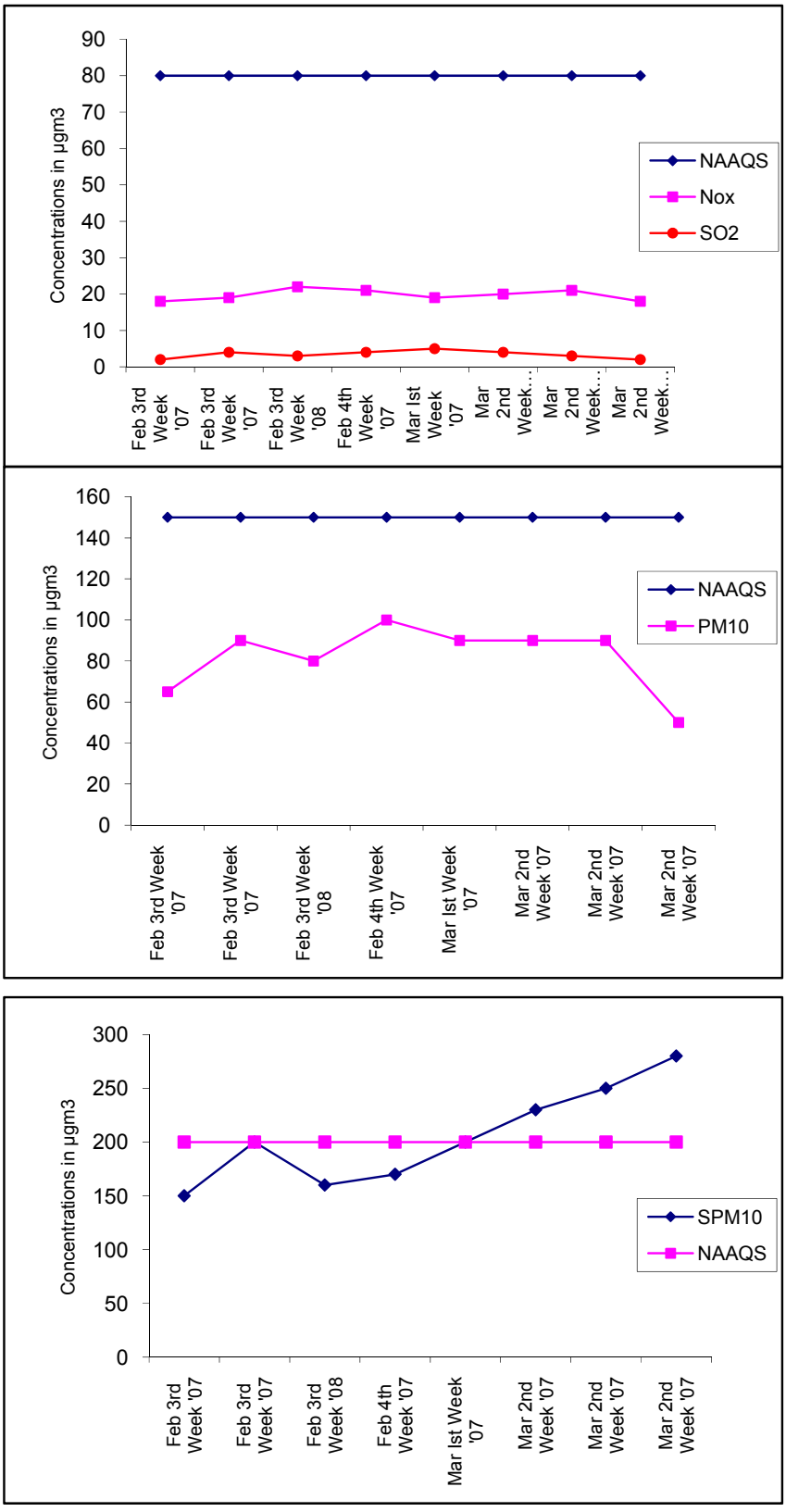


Fig 5.8: Ambient Air Quality at junction of Paved and unpaved road near to the proposed site.

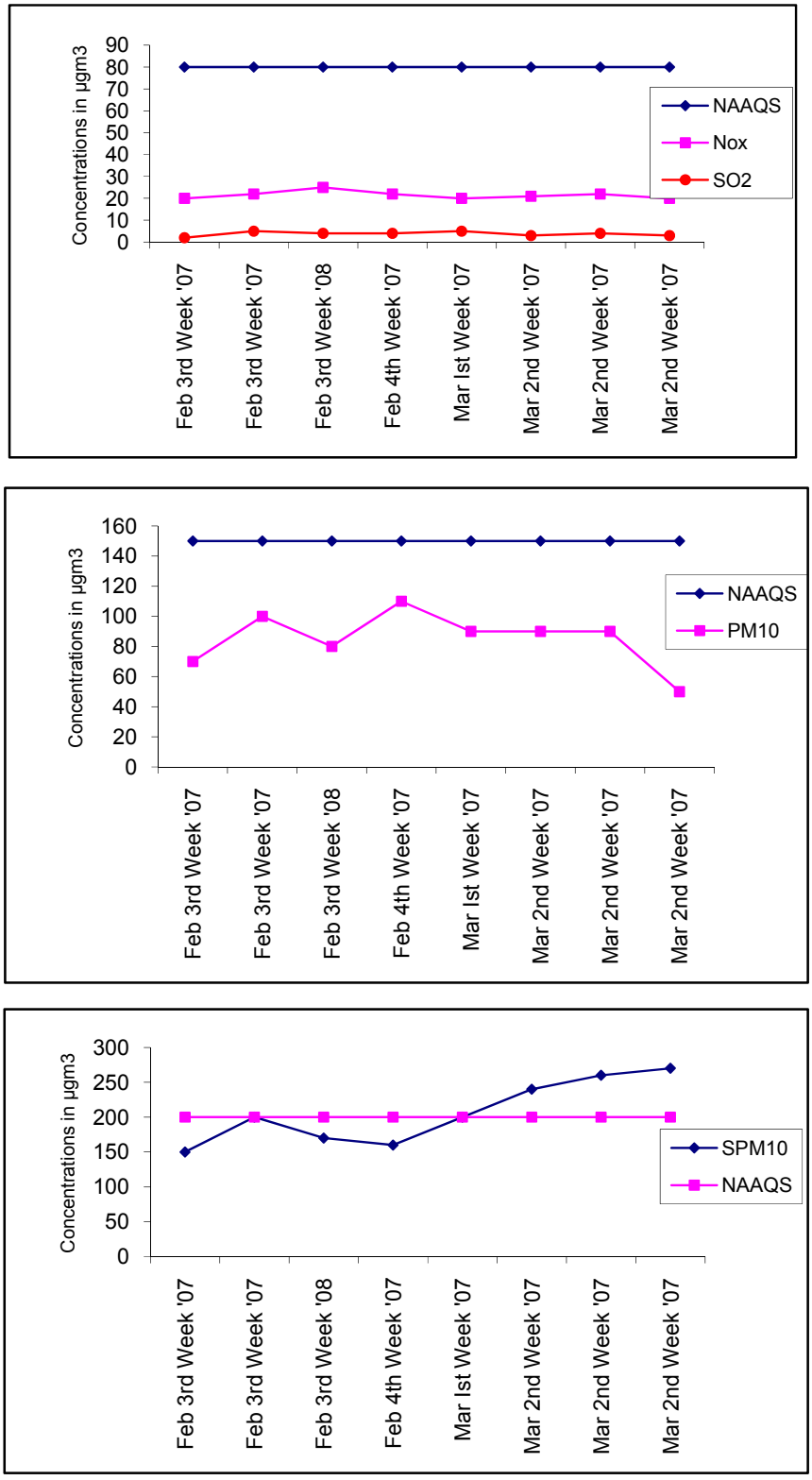
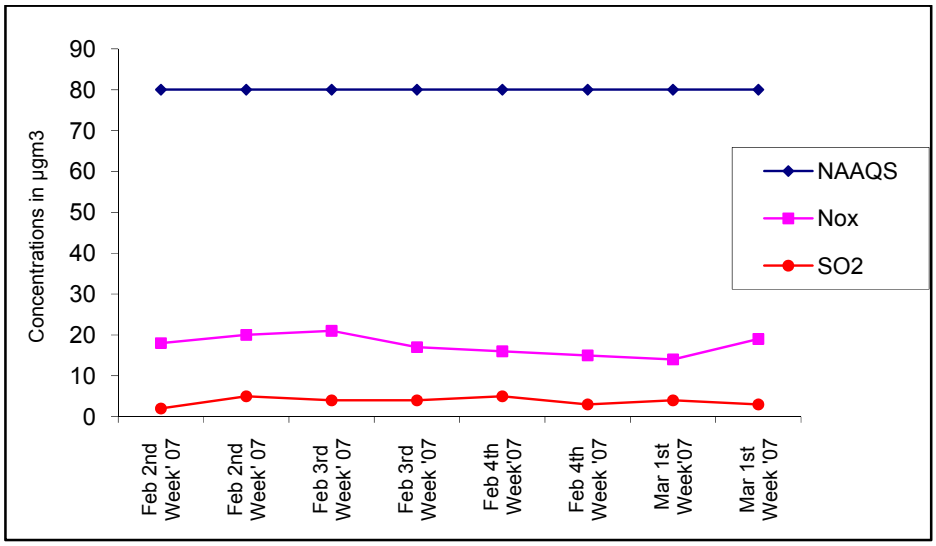
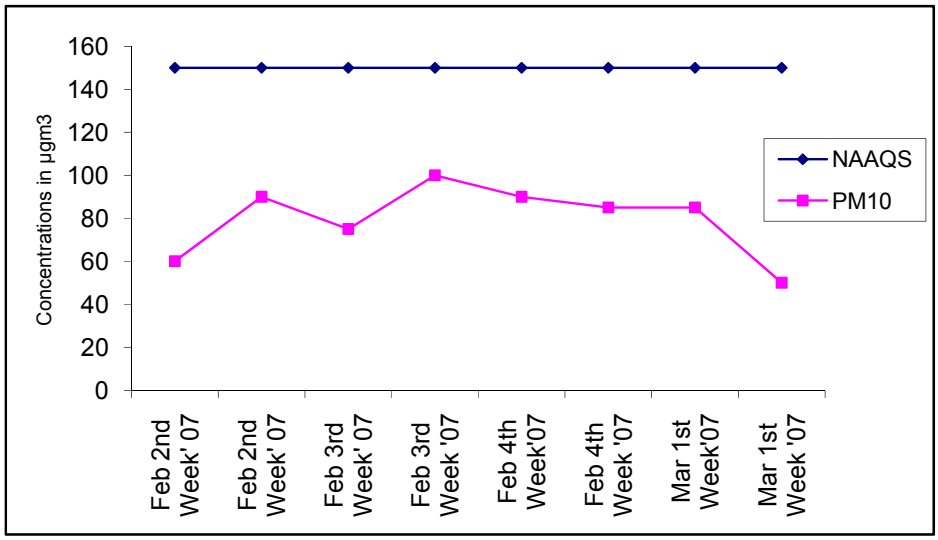
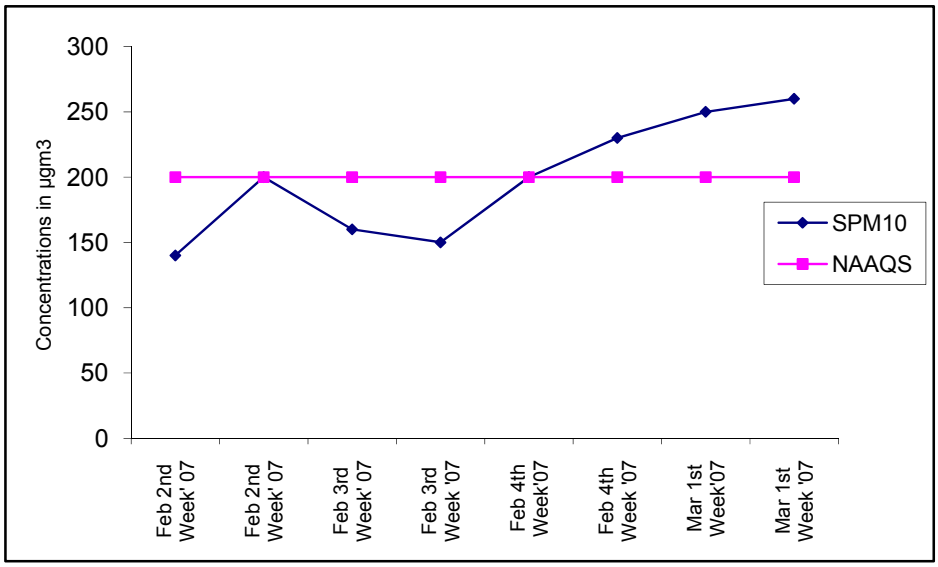


Fig 5.9: Ambient Air Quality at Project Site


Concentrations in µgm3
90
80
70
60
50
40
30
20
10
0
NAAQS
Nox
SO2
Feb 2nd Week' 07
Feb 2nd Week' 07
Feb 3rd Week' 07
Feb 3rd Week '07
Feb 4th Week'07
Feb 4th Week '07
Mar 1st Week'07
Mar 1st Week '07


Concentrations in µgm3
160
140
120
100
80
60
40
20
0
NAAQS
PM10
Feb 2nd Week' 07
Feb 2nd Week' 07
Feb 3rd Week' 07
Feb 3rd Week '07
Feb 4th Week'07
Feb 4th Week '07
Mar 1st Week'07
Mar 1st Week '07


Concentrations in µgm3
300
250
200
150
100
50
0
SPM10
NAAQS
Feb 2nd Week' 07
Feb 2nd Week' 07
Feb 3rd Week' 07
Feb 3rd Week '07
Feb 4th Week'07
Feb 4th Week '07
Mar 1st Week'07
Mar 1st Week '07

5.2.3 ENVIRONMENTAL NOISE

Noise is considered to be one of the dimensions of pollution, which also leads to the gradual degradation of the environment and also poses health and communication hazards. The impact of noise pollution on migratory birds is already exemplified in various studies. The resultant noise pollution often discourages the visit of the migratory birds. For measuring ambient noise levels a sound level meter was used at the site. Noise monitoring locations are shown in **Fig 5.3.(A)**

The noise levels are recorded at an interval of 10 minutes during peak hours of 09:00-13:00 in the morning and 16:00-19:00 hours in the evening on both weekday and weekend day **(See Figures 5.10& 5.11).**

The day & evening time noise levels recorded at the junction of NH-37 and the access road were well within the commercial and residential area limits of CPCB. The persistent noise levels are observed due to continuous traffic on NH-37 and from the stone crushing unit and other activities in the residential area. The equivalent noise levels measured during day time and evening time are given in the **Table 5.2.** The noise levels are well within the noise standards.

$$L_{eq} = 10 \log\left[\sum_{i=1}^{n} fi 10^{Li/10}\right] dB(A) \qquad (1)$$

Fig 5.10: Day Time noise levels at NH37 and access road junction

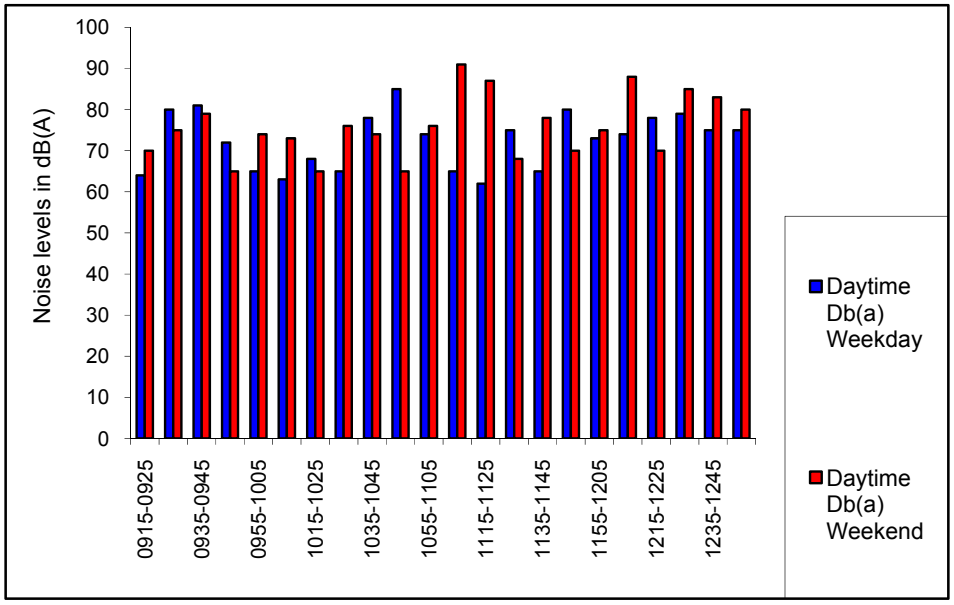


Fig 5.11: Night Time (Evening Hours) noise levels at NH37 and access road junction

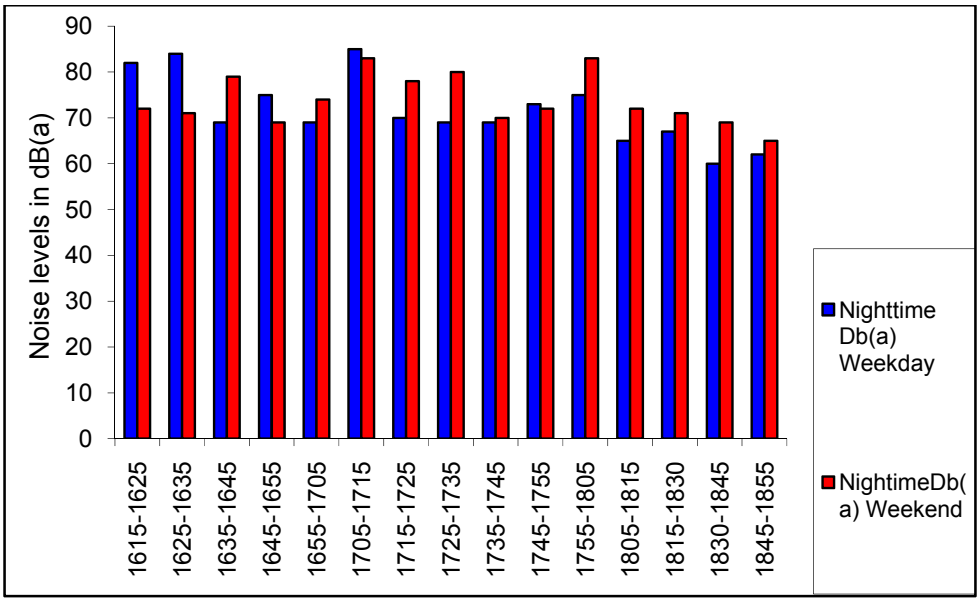


Table 5.2: The measured equivalent noise levels in dB (A)

Sr.	Time in hours	Daytime dB (A) Weekday	Daytime dB (A) Weekend	Remarks
Daytime				
1	0900-1000	84.48	82.84	Noise levels are high (i.e. Exceeding Noise Stds. of 75dB(A)
2	1000-1100	84.02	95.85	
3	1100-1200	87.19	92.32	
4	1200-1245	86.22	89.92	
Evening time (treated same for night time)				
5	1600-1700	87.29	82.24	Noise levels are high (i.e. Exceeding Noise Stds. of 70dB(A)
6	1700-1800	86.09	88.77	
7	1800-1855	70.72	77.08	

The nighttime noise levels are being considered the same as recorded in the late evening hours. It is also observed that despite little change in the traffic there is a significant change in noise levels. Moreover, no specific trend or correlation is observed between the traffic and the noise. The reason for the sudden high levels of noise is mainly the honking and goods carrying trucks. However, at night the noise level is expected to be reduced further.

5.2.4 TRAFFIC AND TRANSPORT

The baseline traffic count studies are required for assessing the future traffic flow due to proposed activity i.e. landfill and compost facility. The traffic survey is therefore carried out at the NH-37 and the access road junction. However, traffic counting was done for all vehicles passing both ways on NH-37 and passing towards the either side of NH-37.

It was carried out during morning and evening including peak hours of the working day and the non-working (weekend) day, at 0900 to 1300 hrs and 1600 to 1900 hrs **(See Figure 5.12 a, b & 5.13 a, b).** The traffic counting includes 3 major compositions, viz. 2-wheelers, scooters, mopeds, and motorcycles; light vehicles comprising petrol and diesel driven car, taxi, van, auto; and heavy vehicles comprising mainly diesel driven, buses and trucks.

The major composition of light vehicles and 2 wheelers is observed during day time and heavy vehicles i.e. trucks are observed during night time. The traffic volume is mainly composed of commercial and private vehicles, and seen throughout the day. The kerbside air quality is deteriorated due to the dust pollution, re-suspended and generated when big vehicles such as buses and trucks carrying stones from the quarries use the access road and the NH-37.

Fig 5.12 a: Traffic during morning peak hours of weekdays at NH37 junction near Paschim Boragaon

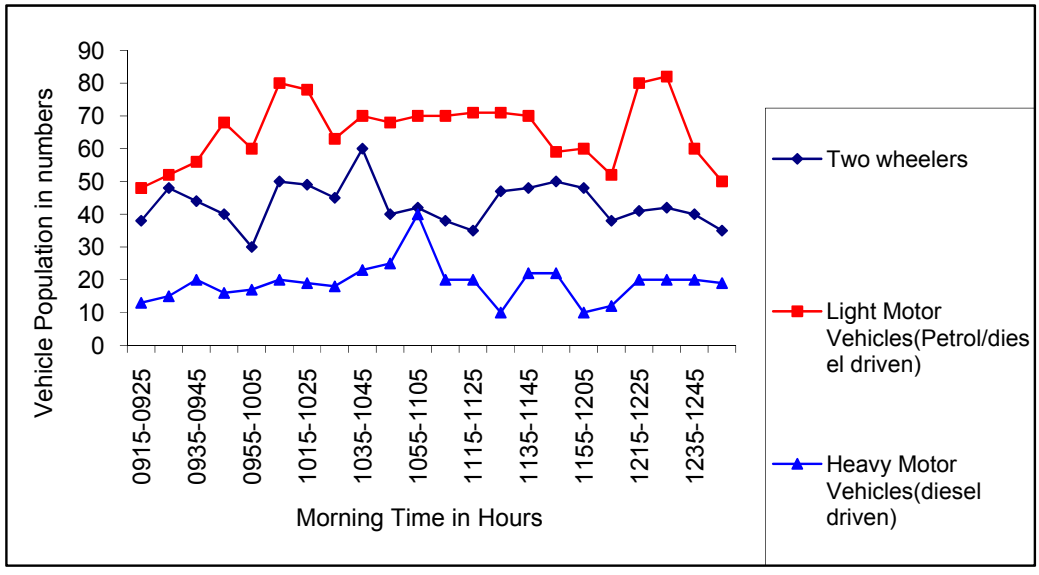


Fig 5.12 b: Traffic during evening peak hours of weekdays at NH37 junction near Paschim Boragaon

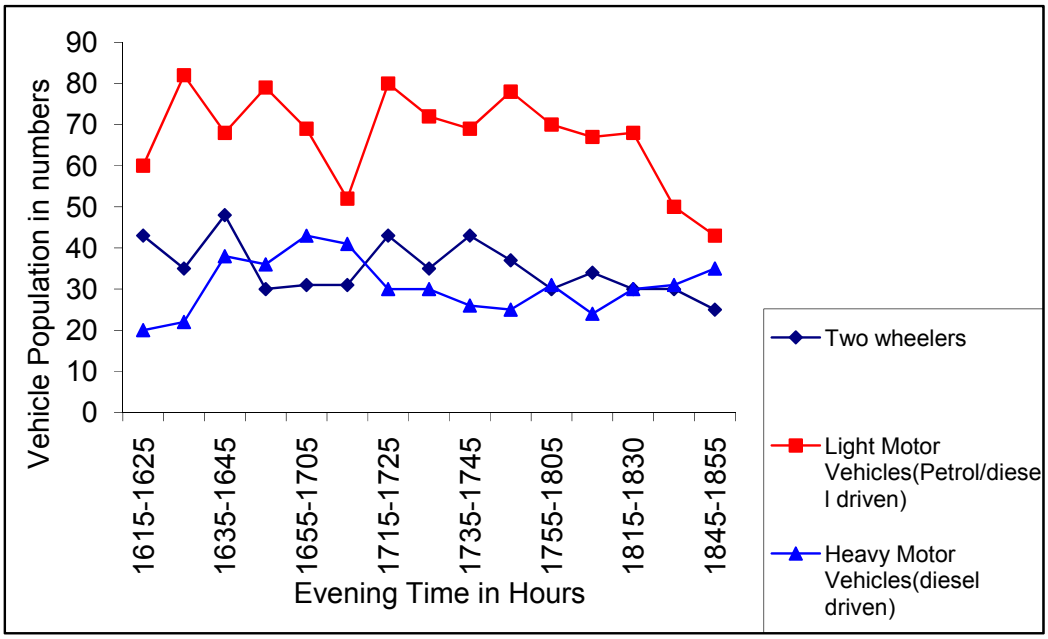


Fig 5.13 a: Traffic during morning peak hours of weekends at NH37 junction near Paschim Boragaon

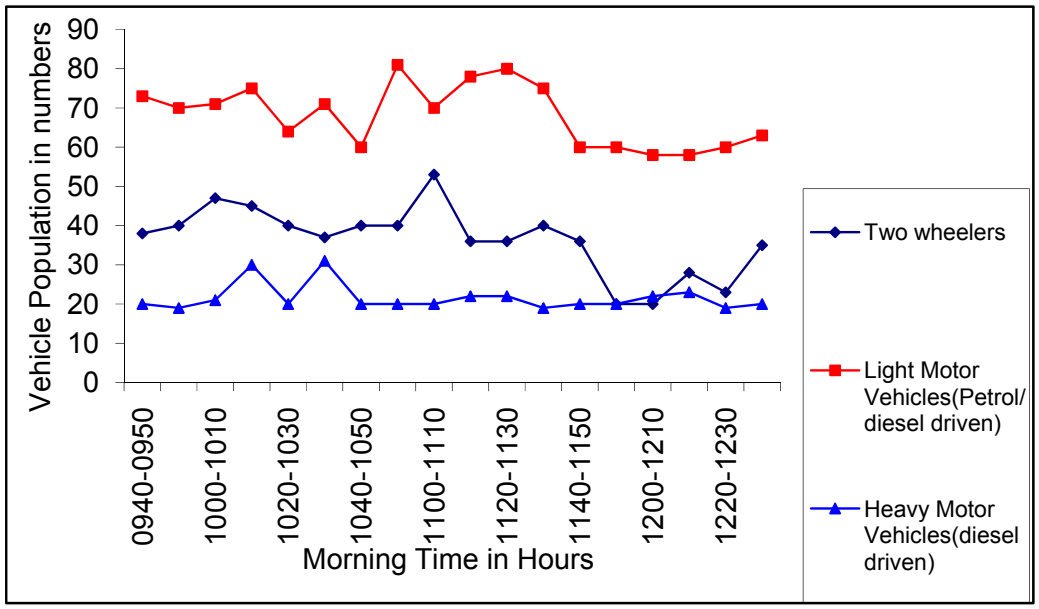
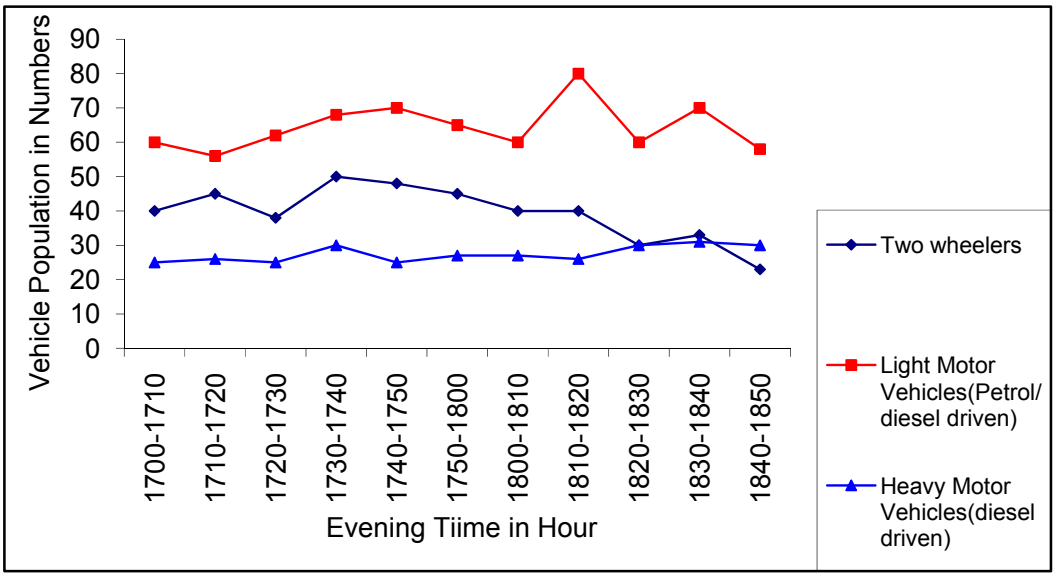


Fig 5.13 b: Traffic during evening peak hours of weekends at NH37 junction near Paschim Boragaon



5.2.5 WATER RESOURCES ENVIRONMENT

Water quality characteristics of the environments arise from multitude of physical, chemical and biological interactions. The water bodies are continuously subjected to dynamic state of changes with respect to their geochemical characteristics. The dynamic balance in aquatic ecosystem is often upset by human activities, resulting in the pollution of water which is obvious by bad taste of drinking water, offensive odour, unchecked growth of aquatic weeds, and decrease in number of fish, oil and grease floating on water bodies. These disturb the normal uses of water for public water supply, industry and agriculture etc.

5.2.5.1 Surface Water

The assessment of water quality in the study area was done by comparing with the standards prescribed in the IS: 2296. After studying the drainage pattern of the study area, 2 samples of surface waters were collected, one is, from Mora nalha at the Garchug (passing adjacent to the proposed site) and the second is, from the water body near the landfill site. These two locations were identified by the people in the region, considering the proximity of the study site and depending upon their utility. The sampling points are shown in the **Fig 5.3(A)**

The analytical results of surface water samples show that the Calcium and Magnesium content indicates water to be soft and suitable for drinking as well as for construction activities. The dissolved oxygen value for all the samples ranging from 4.9 to 5 indicates the sustainability of aquatic life. Thus almost all physico-chemical parameters are well within the prescribed limits as per IS: 10500:1991 standards. Calcium and magnesium represents the hardness is low in the surface water.

Table 5.3: Surface water quality of Mora Nalha and Water body close to the landfill site

S. No.	Parameters	Mora Nalha	Water Near Landfill site	Unit
1	pH	7.1	6.97	
2	EC	0.219	0.235	*millimhos/cm*
4	Acidity	13.5	14	*mg/l* as CaC03
5	Alkalinity	107	69	*mg/l* as $CaC0_3$
6	Nitrate	0.85	1.3	*mg/l*
7	Calcium	6.9	6.31	*mg/l*
8	Magnesium	3.3	2.93	*mg/l*
9	Chloride	14	11	*mg/l*
10	Sulfate	7.0	6.84	*mg/l*
11	DO	4.92	5	*mg/l*
12	Sodium	26.7	19.37	*mg/l*
13	Total Suspended Solids	181	200	*mg/l*
14	Dissolved solids	48	54	*mg/l*
15	Iron	0.69	0.9	*mg/l*
16	Potassium	3.9	4.8	*mg/l*
17	Lead	BDL	BDL	*mg/l*
18	Cadmium	BDL	BDL	*mg/l*
19	Copper	0.01	0.03	mg/l
20	Chromium	0.04	0.06	mg/l
21	Zinc	0.26	0.31	mg/l
22	Nickel	BDL	BDL	mg/l

5.2.5.2 Groundwater

Three ground water samples were collected. One is, from IASST towards east of the site, Second is, from a residence in Paschim Boragaon towards the north of the site, and the third is, from the Maghuwapara village towards the south of the site, for testing the various physical and chemical properties (See **Table 5.4).**

The water quality with respect to almost all was observed to be of good and acceptable quality except for the concentration of iron which was found to be very

high. Sulfate was found to be higher at one of the sites in groundwater compared to surface water. There was no significant difference in total hardness in the different locations and also in the fluoride concentration. Similarly, no significant differences were observed in the levels of inorganic pollutants with the location

Table 5.4: Ground water quality of IASST, Paschim Boragaon and Maghuwapara

Sr. No.	Parameters	IASST building	Paschim Boragaon residence	Maghuwapara village	Unit
1	PH	7.09	7.15	6.9	
2	EC	0.25	0.27	0.23	mmhos/c
3	Nitrate	0.31	0.26	0.30	mg/l
4	Total Hardness	93	92	96	mg/l as
5	Chloride	6.5	3.5	5.9	mg/l
6	Sulphate	4.74	11.26	7.1	mg/l
7	Fluoride	0.574	0.615	0.38	mg/l
8	TSS	200	64	180	mg/l
9	Dissolved solids	146	162	152	mg/l
10	Iron	0.9	0.69	0.7	mg/l
11	Potassium	4.2	3.8	3.3	mg/l
12	Magnesium	7.9	8.3	9.1	mg/l
13	Calcium	23.7	22.3	28	mg/l
14	Lead	BDL	BDL	BDL	mg/l
15	Cadmium	BDL	BDL	BDL	mg/l
16	Copper	0.025	0.015	0.045	mg/l
17	Chromium	BDL	BDL	BDL	mg/l
18	Zinc	0.29	0.21	0.32	mg/l
19	Nickel	BDL	BDL	BDL	mg/l

5.2.6 SOIL & LAND ENVIRONMENT

The variations in soil characteristics are mainly dependent on lithology, topography, latitude, climate and vegetation cover. Soil is as important as water. Most of the properties related to soil morphology are inherited from the parent rock types and their mineralogical assemblage. Lithology of the area shows gneisses and phyllite. Hence the soil is clayey and sandy. To assess the baseline soil quality in the study region, four soil samples were collected and analyzed at three locations (LI at 1.0-1.5m, L2 at 3.0/n, & L3 at 1.0-3.5/w depth) from the landfill site and one location (at 1.0-4.5m depth) from the compost site. The surface layer (top layer) is most important in a wetland in water-soil exchange process. The soil samples are analyzed using EDS, electronic dispersion spectroscopy, in terms of weight percentage and also in terms of atomic percentage. The soil sampling locations are shown in **Fig 5.3,** and the quality of the soil samples collected is summarized in **Table 5.5.**

The surface soil at the proposed site is silty brown, mixed with fine grained sand. The soil being mostly loose sandy for a significant depth has more water contaminant filtering capacity. The share of oxygen and silica content in the soil is more compared to others, however, other macronutrients, nitrogen, phosphorus and potassium have been found in very insignificant amount. The depth of rock in the area is over about 100. The soil is observed to be having high cation exchange capacity and low soluble ions. The soil is slightly acidic with low nitrogen and phosphate. The properties of these cations on the colloid surface are constantly changing as ions are added from dissolving minerals or by addition of lime and fertilizers. However, losses by leaching also change the cation proportions. It is observed that the magnesium content is very low compared to the potassium indicating the cations are faster. The heavy metals are generally absorbed to the cations. Cation exchange helps initially to retain them and cleanses the percolating water.

Table 5.5: Soil quality (on % weight & % atomic basis) at proposed Project site

Sr. No.	Parameters	Landfill sites (% wt basis)			Compost (% wt basis)	Landfill sites (% atomic basis)			Compost(%) atomic basis
		LI	L2	L3		LI	L2	L3	
1	Oxygen	53.1	33.8	47.9	54.8	61.6	49.4	59.2	70.0
2	Silicon	21.6	26.8	22.3	21.9	14.5	22.9	15.9	16.0
3	Aluminium	11.4	14.5	14.6	12.5	8.5	12.9	10.5	9.5
4	Iron	3.2	14.3	3.3	8.6	1.1	6.8	1.2	3.2
5	Carbon	8.4	1.3	7.2	BDL	13.2	2.2	11.0	BDL
6	Potassium	1.2	3.6	2.0	1.4	0.6	2.6	1.1	0.7

7	Magnesium	BDL	BDL	BDL	0.7	BDL	BDL	BDL	0.6
8	Copper	BDL	2.1	2.3	BDL	BDL	0.8	0.9	BDL
9	Titanium	1.1	1.6	0.4	BDL	0.5	0.9	0.2	BDL
10	Arsenic	BDL	2.0	BDL	BDL	BDL	1.6	BDL	BDL

5.2.7 ECOLOGICAL ENVIRONMENT

5.2.7.1 Flora and Fauna

The study region supports on its base a range of shrubs & grasslands, characteristics of different altitude. The site being inundated, i.e. a wetland, sparsely ruderal and medium density vegetations are observed. The site is of importance due to the large water body, Dipar beel nearby the site (about 2.5 km). The beel is having faunal and floral diversity and hence of great environmental concern. It attracts a large number of migratory birds (species) especially in winters. The information on the fauna and flora in the region is collected from the Assam Science and Technology and Environment Council (ASTEC) and other relevant sources.

Dipar Beel is included in the Ramsar list of wetlands of international importance as Ramsar site no. 1207 on 19 August, 2002 having about 4000/za of area. As per this convention, the Dipar beel is a permanent freshwater lake in a former channel of the Brahmaputra river, and of great biological importance and also essential as the only major storm water storage basin for the city of Guwahati. The beel is a staging site on migratory flyways and has some of the largest concentration of aquatic birds in Assam. The potential threats identified for the beel are over-fishing, hunting of water birds, pollution from pesticides and fertilizers and infestation by water hyacinth.

5.2.8 SOCIO-ECONOMIC STATUS

In total, 25 numbers of houses were surveyed in total for knowing the socioeconomic status of the residents living in and around the study region, 10 from Paschim Boragaon, 5 from Garchuk, and 5 each from the Pamahi and the Maghuwapara villages. These villages are demarcated into the ward 10 and 13. The result of the social survey is expressed under various sociological indicators as below:

5.2.8.1 Population & Educational Profile

The population distribution is correlated with the physiographic division. The study area is scarcely populated and because of wetland and forested (hills) steep slopes, there are no proper roads and other amenities of life. Around the site, few numbers of small villages like Devchatal, Pamahi, Maghuwapara, Garchug and Pashim Boragaon are situated. Of them, Garchug is the largest village and other villages are the part of Garchug. Each of these villages has about 200 to 700 residents. The village Maghuwapara, which is very close to

the Meghalaya hills having population of about 200 is the closest village to the site towards south. The literacy level in this ward is less than 50%. There is a government primary school at Maghuwapara village and the other is the 'Pragjyoti School' recently opened in Paschim Boragaon.

5.2.8.2 Occupation

The survey revealed that about 30% in both the wards are working persons. Of them, 40% are salaried and employed in offices, schools, etc., whereas 60% are involved in commercial business. The balance population of males is engaged in petty business like running roadside hotels, repair shops, telephone booths and other mercantile business activities. Females are mainly engaged in household chores.

5.2.8.3 Agriculture

Only 0.3 to 0.5% of the non-working persons are occupied in agricultural activities. Agriculture, though an established tradition and main stay of the people, is not a major occupation in the study region. It was also found by the survey that agriculture as an occupation is fading away due to the lucrative jobs in factories and industries. It is found that some agricultural activities like, growing rice crops, are carried out near the site by cultivators who are said to be not from the Paschim Boragaon.

However, this is a temporary activity and during monsoon, rice crops are generally destroyed. Moreover, several Garchug and Paschim Boragaon residents are not aware of any paddy farming activity in the area. Fishing activity is also observed in the water body near the site, but 60% from Paschim Boragaon and Garchug are not aware of the same. The Pamahi and Maghuwapara village residents are aware of the fishing activity in the water bodies near the proposed sites but it is found that fishing is not done for business purposes.

5.2.8.4 Livestock

Livestock is always the major asset of rural population. People own milk-yielding livestock like goats and cows. These are seen grazing on the proposed sites and the slopes of the Meghalaya hills. Besides these, they also own poultry birds.

5.2.8.5 Material Assets

Majority of people have their own permanent houses and all are aware of the variable land prices, which is very high for land close to the highways (about 35 to 40 lacs/bigha) and low inside the villages and near hills (about 1 to 2 lacs/bigha). At the proposed sites, land price is very low. It has been observed that people in villages own various modes of entertainment like TV, radio sets, tape recorders. However, for transportation they have to depend upon the private trekkers. For cooking and other purposes many people of Maghuwapara and Pamahi village use forest wood.

5.2.8.6 Electricity

It is observed that electricity is available for all uses including domestic and commercial purposes in most of villages situated along NH-37. But in Maghuwapara, it is available only for few people. Pamahi village also partially electrified. However, power supply in the Paschim Boragaon is adequate.

5.2.8.7 Drinking Water

It observed that in almost all villages, tubewells and dugwells are used for drinking water purposes. These tubewells are private-made in their own lands. All the residents of Paschim Boragaon and Garchuk agreed that the water contains high concentration of iron.

5.2.8.8 Health & Medical Facilities

There is no primary health center in any of the villages. Therefore for treatments people have to rush to nearest towns like Maligaon and Guwahati city center.

5.2.8.9 Postal and Telephone Facilities

Post and telegraph facility in the project area is varied. BSNL has installed communication towers in the area.

5.2.8.10 Communication Facilities

The villages situated along NH37, like Paschim Boragaon, and Garchug have bus stops located along the highway near to the villages. However, for other villages, i.e. Pamahi, Devchatal and Maghuwapara an unpaved kaccha road approaching from Garchug is connected to NH-37 but no bus service is available

5.2.8.11 Cultural Facility

Almost all agreed that festivals like Bihu and others are performed at the common place in Namgarh near NH-37, and the temple near the proposed site and also in front of the school in Maghuwapara village for nearby residents.

5.2.8.12 Common Perception

About 50 to 80% feel that reclaiming the lands for construction activities are creating dust nuisance in the area. Almost all people feel that trucks carrying stones are causing dust and noise nuisance to them. And 60 to 100% agreed that various health problems are caused due to the 'carbon' emission from the nearby industries and from the stone quarries/crushing unit of Paschim Boragaon.

It is also found that 100% residents of all the villages feel there are no special problems during monsoon. The area is flooded due to the water streaming out from the nearby hills. But this recedes quickly towards the proposed sites. The roads also remain well above the flood level during monsoon. About 60% residents sensed that development in the area is taking place gradually, while only 40% are aware of the proposed future activities in the region.

Persons fishing in the water bodies near the site are very few in number, moreover it is not their means of livelihood. The demographics as detailed - population in the ward no. 13 is 16,609. The distribution and projections of demography are at the normal rate in the area. Numbers of households are about 3558. The population trend is increasing, but the condition of in-and-out migration could not be known. The number of unemployed persons is about 11465. The size of private housing stock is bigger and the size of proposed housing areas is vastly expanding. About 50 to 80% felt that the available infrastructure is just

adequate for the residents, i.e. power supply, drinking water, roads and schools. However, medication facility is not satisfactory.

5.3 LANDSCAPE AND VISUAL AMENITY

According to the 40% residents of major villages the proposed site has a scenic importance. The area being the wetland is blessed with an attractive landscape but due to the development sprawling around, the pattern is under a rapid change. At present, medium vegetation with small water bodies and paddy fields with a backdrop of the forest makes the area pleasant. The visual amenity in the area has decreased due to the sporadic developments.

The lack of tree cover, increasing diversity & prominance of topography is observed. Visual sensitivity is less as number of viewers are less in the area due to their non proximity to the source. Landscape character at present are acceptable, as topography, landuse, vegetation and water bodies are present.

CHAPTER 6

POTENTIAL ENVIRONMENTAL IMPACTS & ASSESSMENT BEFORE MITIGATION

6.0 INTRODUCTION

This chapter focuses on identification of pollution sources due to the proposed project activity. The pollutants generated during operation phase will be assessed and quantified to estimate the level of impact and thus formulate environment management measures to mitigate theses impacts.

Chapter 4 provided the information on the baseline environmental conditions at the project site for various parameters. 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.

6.1 IMPACT IDENTIFICATION

MSW Management project for Guwahati would comprise of all the components of waste management i.e collection, transportation, processing and disposal. During collection and transportation of waste there is no significant air pollution has been anticipated. More over as door-to-door collection system would be followed and waste to be transported in the closed vehicles it would reduce the impact on air quality as presently waste is being transported in open trucks. Hence these two activities in proposed project would be beneficial for the project. However potential impacts arising due to construction and operational activities of proposed project Processing facility have been identified in **Table 6.1**.

TABLE 6.1: IDENTIFICATION OF IMPACTS DURING CONSTRUCTION AND OPERATION PHASE

SN	Components	Aspect	Potential Impact
CONSTRUCTION PHASE			
1.	Ambient Air Quality	Dust emissions from site preparation, excavation, material handling and other construction activities at site.	Minor negative impact inside plant premises. No negative impact outside plant site. Short term
2.	Noise	Noise generation from construction activities, construction equipment and vehicular movement	Minor negative impact near noise generation sources inside premises. No significant impact on ambient noise levels at sensitive receptors. Short term

SN	Components	Aspect	Potential Impact
3.	Water quality	Surface runoff from project site Oil/fuel and waste spills. Improper debris disposal	No significant negative impact. However, hazardous chemicals should be handled properly Short term
4	Landuse and Aesthetics	Land development	Positive impact. Currently most of the land is in flood prone area and is used for dumping of waste. Development of integrated plant will increase the aesthetics of the area.
5	Topography and Geology	Site development	Positive impact as site filling to rais the site level and boundary wall to be built-up
6.	Soils	Construction activity leading to topsoil removal and erosion.	No impact as plant site is currently being used for dumping of waste. Soil of the area is already degraded.
7.	Ecology Flora and Fauna	Habitat disturbance during construction activity	No impact as the area is devoid of any vegetation.
8.	Socio-economy	Increased job opportunity for locals	Overall positive impact
9.	Traffic Pattern	Haul Truck/construction vehicle movement	Minor negative impact
OPERATIONAL PHASE			
1.	Ambient Air Quality	Particulate emissions from compost plant, RDF plant, Boiler, material handling.	Minor negative impact
2.	Noise	Noise from plant operation and vehicular movement	Minor negative impact
3.	Water Quality	Oil/fuel and waste spills. Wastewater from plant processes	No significant adverse impact as storm water and other wastewater generated from the plant site will be treated and then disposed.

SN	Components	Aspect	Potential Impact
		Discharge of waste water and contaminated storm water from site	
4.	Water usage	Ground water will be used	No negative impact as ground water is readily available at the site at 7-15 m of depth
5	Soils	Storage of solid wastes Fuel and material spills	No negative impact
6.	Ecology- Flora and Fauna	Land use change	No negative impact
7.	Traffic Pattern	Slight increase in traffic on NH-37	No negative impact due to proposed plant as increase in traffic is insignificant in comparison to the vehicles currently plying on the NH-37 as waste is being transported and disposed at this site only, presently.

6.2 IMPACT EVALUATION

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 socio-economic 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. The following major valued environmental components are considered related to the proposed project for assessing the potential environmental impacts during various project phases:

i. Air quality
ii. Environmental noise
iii. Traffic and transport
iv. Surface water quality
v. Ground water quality
vi. Soil and geology quality
vii. Flora and fauna
viii. Socio cultural, and
ix. Socio-economic

From compost plant it has been assumed that there will not be significant environmental impacts as there will not be any air emissions apart from slight increase in SPM matter, which will be there during operation phase due to its operation. However from RDF plant and Power plant there will be air emissions has been considered for impact evaluation. Hence compost plant and land filling has been clubbed as one of the components and RDF & Power plant operations as other components.

6.3 IMPACTS ON AIR ENVIRONMENT

Prediction of air 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. The impact on the air environment for the proposed project has been carried out using U.S. EPA approved model and is discussed in subsequent sections. The results obtained from the predictions have been 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.

6.3.1 AIR EMISSIONS

Air emissions have no boundaries and can migrate from one place to another place depending upon the wind direction and speed. The sources of air emission can be grouped into three categories of point, area and line sources:

- A pollutant source that can be treated in a dispersion model as though pollutants were emitted from a single point that is fixed in space. Example: the mouth of a smoke stack.

- An array of pollutant sources, so widely dispersed and uniform in strength that they can be treated in a dispersion model as an aggregate pollutant release from a defined area at a uniform rate. Such sources may include vehicles and other small engines, small businesses and household activities, or biogenic sources, such as a forest, that release hydrocarbons.
- An array of pollutant sources along a defined path that can be treated in dispersion models as an aggregate uniform release of pollutants along a line. Example: the sum of emissions from individual cars traveling down a highway can be treated as a line source.

6.3.2 PREDICTED AIR EMISSIONS FROM THE SITE

The following section details the potential emissions from the construction/operational activities due to proposed project.

A) Construction Phase

During the construction phase, SPM is expected to be the main pollutant associated with on-site roads (paved and unpaved), stockpiles and material handling. The activities those are responsible for the adverse air quality and fugitive dust are site clearing and preparation, grading of the site- dredging and filling and from the use of unpaved routes. During these activities, construction equipments and earth moving machinery would be used vigorously and would generate huge amount of fugitive dust in the area, trucks carrying construction materials and soil would also add into other pollutants, viz. carbon monoxide (CO), oxides of nitrogen (NOx) and inhalable particles besides fugitive dust. The scale of impact would be temporary but very adverse, as lots of dust would be produced, which could cause loss of visibility.

Impacts on the air quality during the pre-construction phase of the project will be due to the movement of few vehicles for site-visits of the officials. Therefore the impact will be minimal and temporary too.

Impacts on air quality during the construction phase of the project will be considerable as the amount of work involved in construction of the waste management facility is significant. There will be movement of heavy construction vehicles, which emit pollutant loads into the atmosphere. However, the impacts will last only during the construction and will therefore be temporary.

The project area is dulating hilly area and flood prone so during site development back filling is required, so extensive formation work is 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. The entire site will not be simultaneously under heavy construction, with different sections of the site generating SPM in a progressive manner. Thus, it is conservatively assumed that the SPM emission would not be significantly high to warrant any impact prediction. Provision of adequate air pollution control measures, like dust suppression

by water sprinkling and planting of green belt may further help to significantly reduce the impact.

Due to ground level temperature inversion at site during winter months, meteorological conditions after the sunset tend to become stable. The overall meteorological parameters thus constitute adverse conditions for dispersion of ground based air pollution emissions. Under adverse meteorological conditions, it may be possible that the Particulate matter (PM) standards may be violated only if the construction work is carried out round the clock. Implementation of mitigation measures as given in the EMP will mitigate or minimise these temporary impacts

B) OPERATIONAL PHASE

1. POWER PLANT

During the operational phase, the major source of pollution will be boiler stack for which modeling exercise has been performed. The proposed project will not result in significant increase in traffic and vehicular activity on the NH-37 for transportation of waste to the project site.

The vehicular traffic generated due to the proposed project is negligible as compared to the existing traffic on NH- 37 road, hence the contribution due to proposed project is negligible. Modeling therefore has not been done for the tailpipe emissions (i.e. CO, NO_x and SPM) for vehicles traveling along this road.

AIR QUALITY IMPACT PREDICTION

Stack height of the power facility is 68m. With topography and the rate of emissions remaining constant, the extent of these impacts, at any given time will depend upon the prevailing meteorological conditions. The impacts will have strong temporal dependence as these factors vary with time.

To evaluate such components in the present situation, modeling has been done and is discussed in the following section.

AIR QUALITY MODELING

Estimation of emissions load is an essential step in order to know the impacts on air quality. In the current study, the major sources of air pollution include:-

POWER PLANT EMISSIONS FROM THE STACK

During the operation of the proposed power generation facility, there will be stack emissions as follows:

‘

Gas Flow	=	50000 m^3/hr	= 13.89m^3/s
Velocity	=	25m/s	
Area	=	0.56 m^2	
Diameter	=	0.84m	
SPM Conc.	=	50mg/m^3	
SPM emissions	=	Gas Flow x SPM Conc. =13.89 x 50/1000 = 0.694 g/s	

The stack inventory and pollutant emission limits are provided in **Table 6.2**.

TABLE 6.2: STACK INVENTORY & POLLUTANT EMISSION RATES

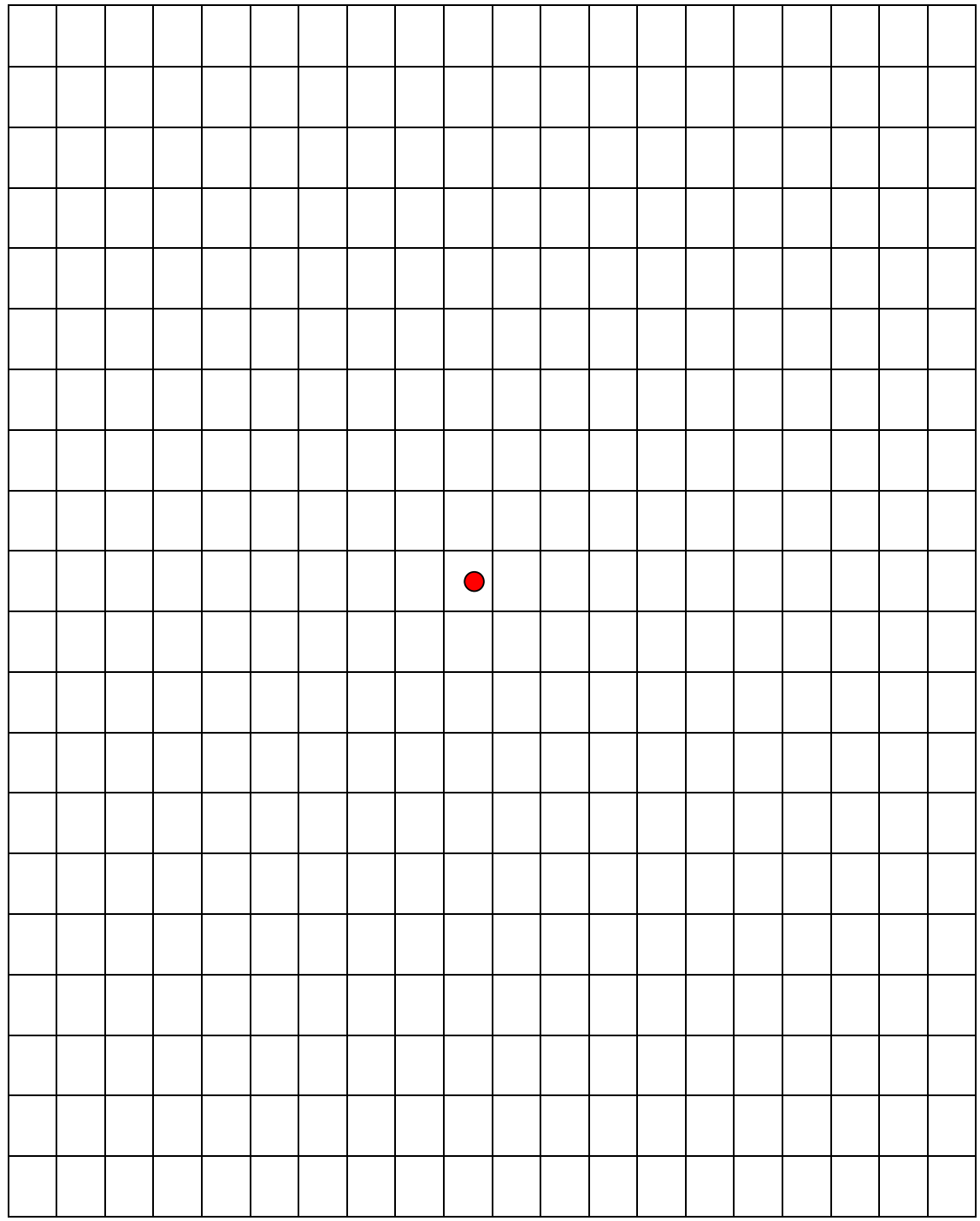
Source	Description	Source Data					Emission Data	
		Stack Gas Flow Rate (Nm^3/s)	Stack Gas Velocity (m/s)	Area (m2)	Stack Diameter (m)	Stack Height above ground (m)	Pollutants	Emission Limit
PS	Boiler Stack	13.89	25	0.56	0.84	68	SPM	50 mg/Nm^3
							SO_2	100 mg/Nm^3
							NO_x	200 mg/Nm^3

Grids

20x20 km² area around the project is selected to predict air quality impacts due to project activities. Figure 6.1 shows the total study domain, which is divided into grids of 1 x 1 km².

Scenario Building

Three scenarios were evolved for air quality modeling to see the seasonal effect on the air quality due to project operations.



: Power Plant

FIGURE 6.1: GRID ASSUMED FOR MODELING

Scenario Building

Three scenarios were evolved for air quality modeling to see the seasonal effect on the air quality due to project operations.

Table 6.3: Scenarios considered

Season	(Plant Operation)
Summer (May)	√
Post- Monsoon (September)	√
Winter (December)	√

In present study, ISCST3, which is a steady-state Gaussian plume model, is used to assess pollutant concentrations around the power plant. Air quality concentrations are modelled at evenly distributed locations around the project region. The model is used to predict the ambient concentrations for different scenarios (as defined above).

Meteorological and topographical input

Meteorological data is one the most important input to the ISCST3 model. Metrological data has been collected from IMD for all the months. Meteorological data collected from IMD includes wind speed, wind direction, temperature, etc. The data is represented in **Figures 6.2, 6.3 and 6.4**

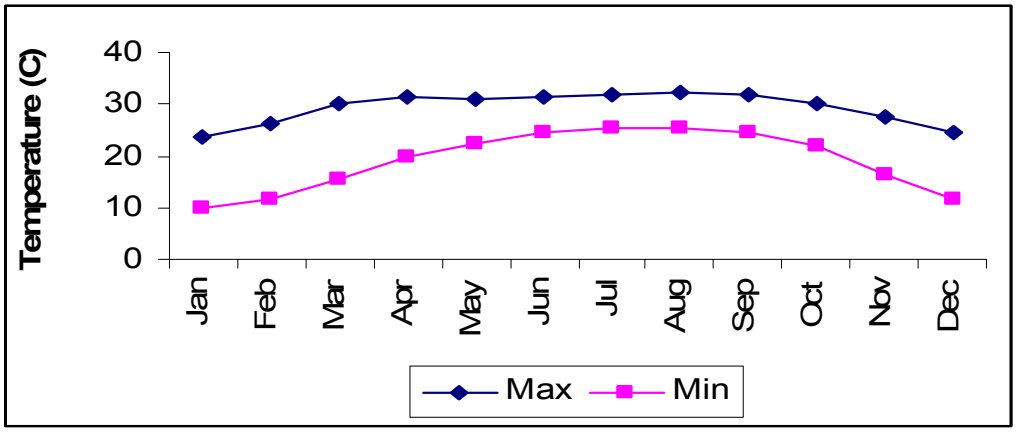


Figure 6.2: Temperature profile during the year at Guwahati IMD station

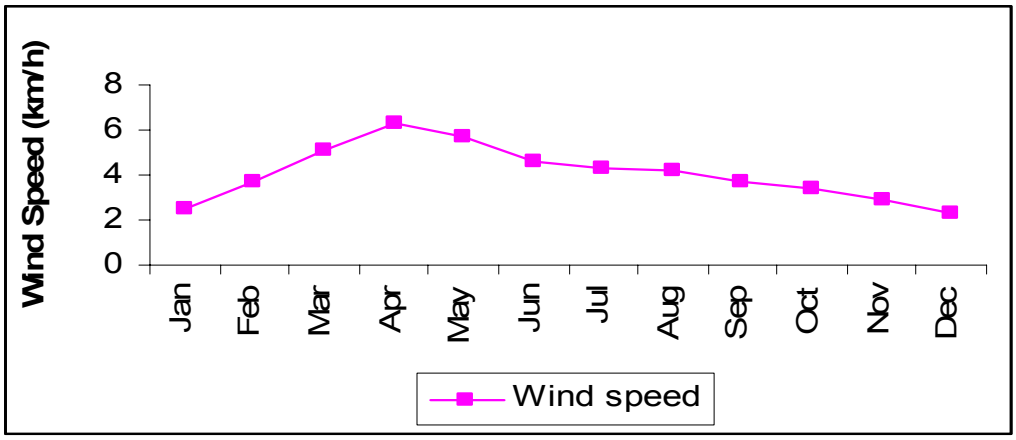


Figure 6.3 : Wind speeds during the year at Guwahati IMD station

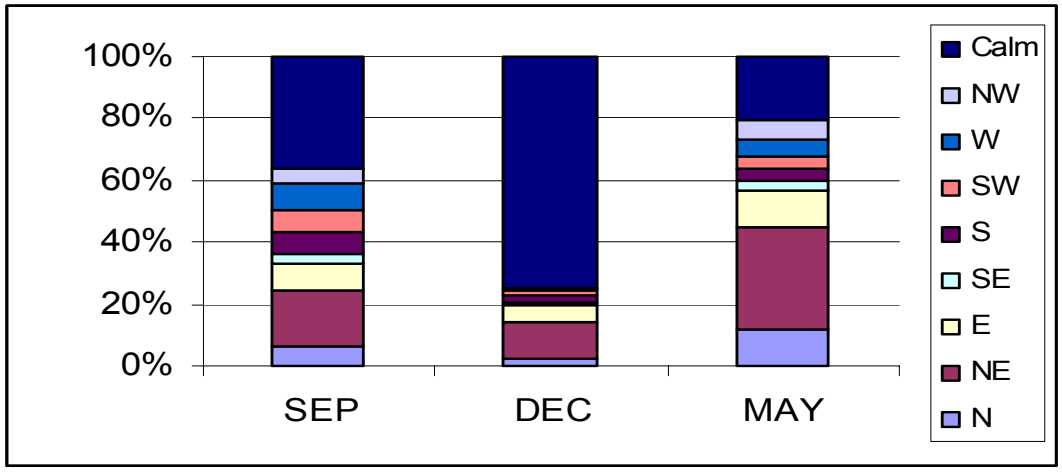


Figure 6. 4: Wind directions during the year at Guwahati IMD station & high percentage of calm conditions in the winter season.

Terrain

Terrain data for the current study domain has been retrieved from the topo-sheet of the region and used to get elevation data for each of the 1x1 km² grid. Grid-wise elevation data served as an input to the ISCST3 model.

Modelling results

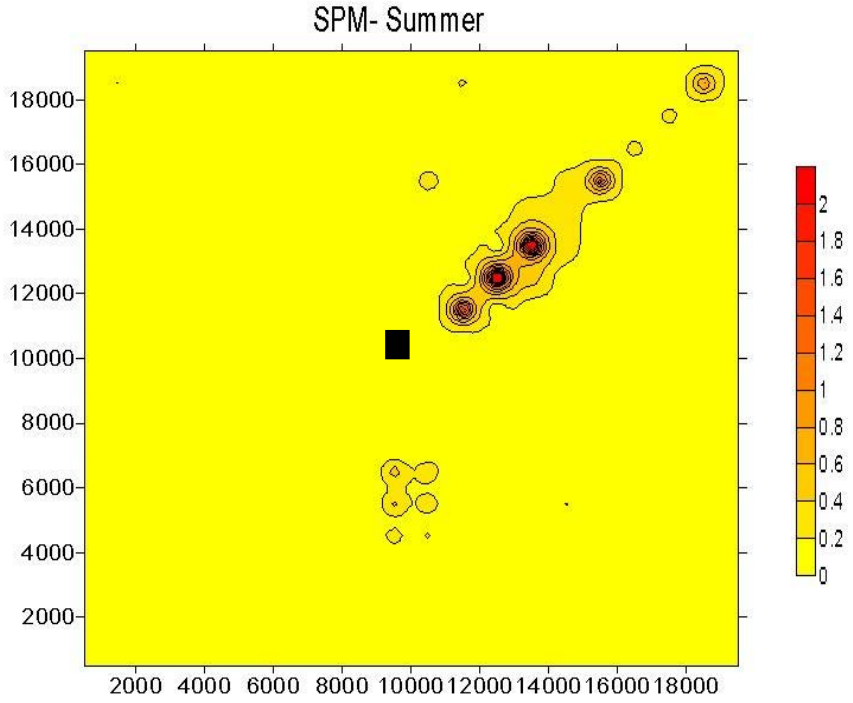
Based on the emission inventory developed in the current study and the onsite meteorological data, ISCST3 model is run and ambient SPM, and SO2 concentrations are predicted under different scenarios.

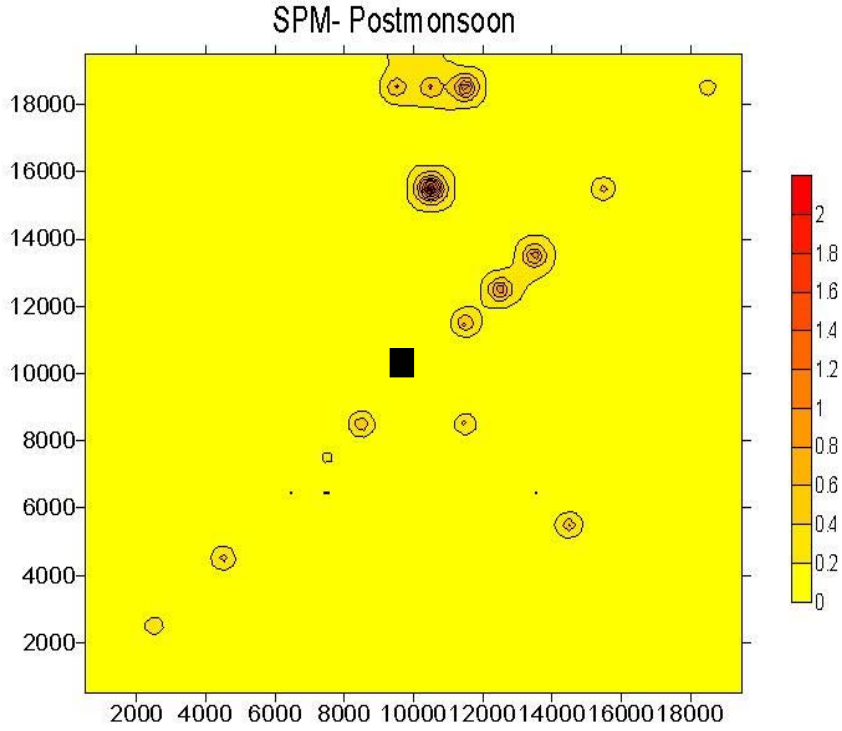
Results of air quality modelling suggest that proposed plant would be having minimal impacts of 2-3 µg/m³ on the prevailing air quality of the region. The predicted SPM and SO2 levels attributed to the plant operations for different seasons are presented in Table 6.4.

Table 6.4: Air quality modelling results (Max GLC due to stack emissions)

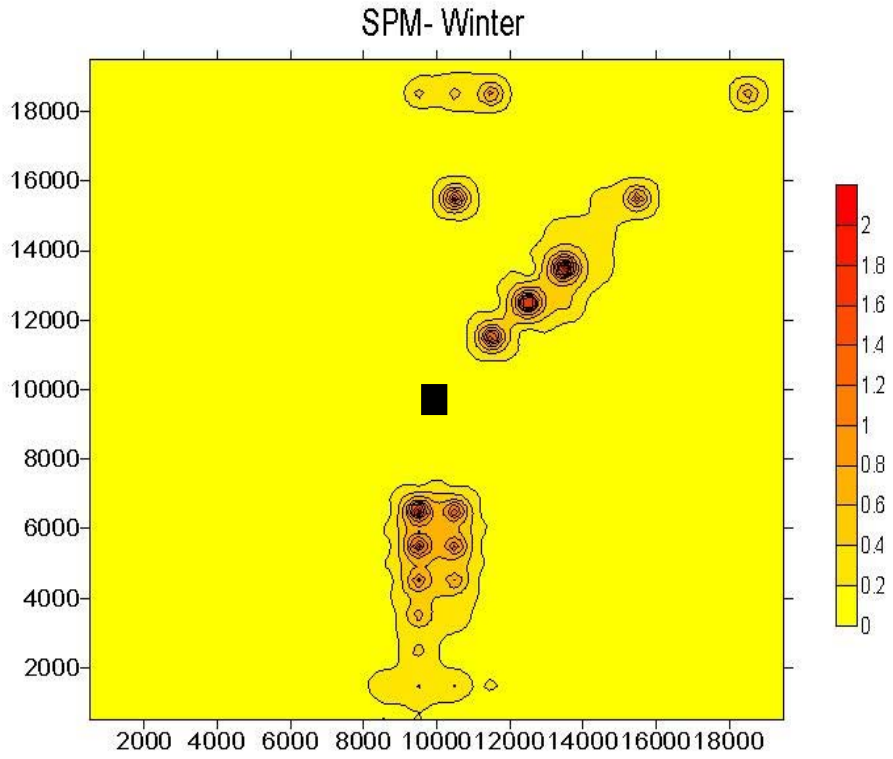
Season	Max. SPM (µg/m³)	Location (x,y)	Max. SO2 (µg/m³)	Location (x,y)
Winter (Dec)	2.37	13500,13500	1.56	12500, 12500
Summer (May)	2.92	12500,12500	2.52	12500,12500
Post-Monsoon (Sep)	2.06	1 0500,15500	0.83	12500,12500

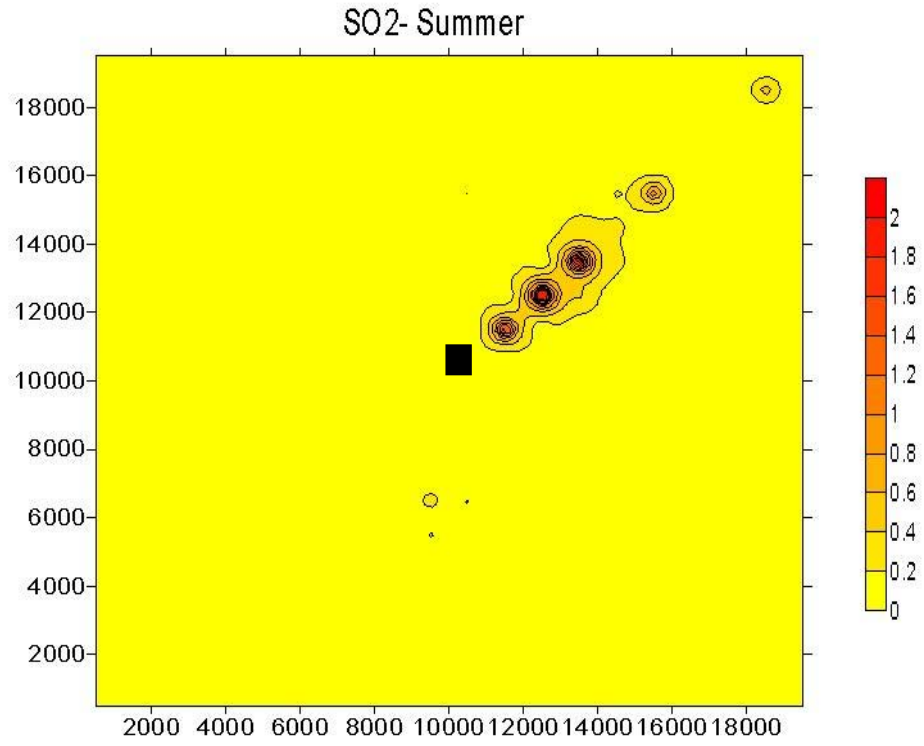
This is to be noted that values are not so substantial which could force the air quality of the region to violate the air quality standards. Also, this to be noted that effects of washout of the pollutants due to rainfall has not been taken into account to arrive at conservative worst case estimates. Spatial distribution of the air quality concentrations is presented in Figure 6.5(a-f).


SPM- Summer
18000
16000
14000
12000
10000
8000
6000
4000
2000
2000 4000 6000 8000 10000 12000 14000 16000 18000
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0


SPM- Postmonsoon
18000
16000
14000
12000
10000
8000
6000
4000
2000
2000 4000 6000 8000 10000 12000 14000 16000 18000
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0

■ : Power Plant


SPM- Winter
18000
16000
14000
12000
10000
8000
6000
4000
2000
2000 4000 6000 8000 10000 12000 14000 16000 18000
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0


SO2- Summer
18000
16000
14000
12000
10000
8000
6000
4000
2000
2000 4000 6000 8000 10000 12000 14000 16000 18000
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0

■ : Power Plant

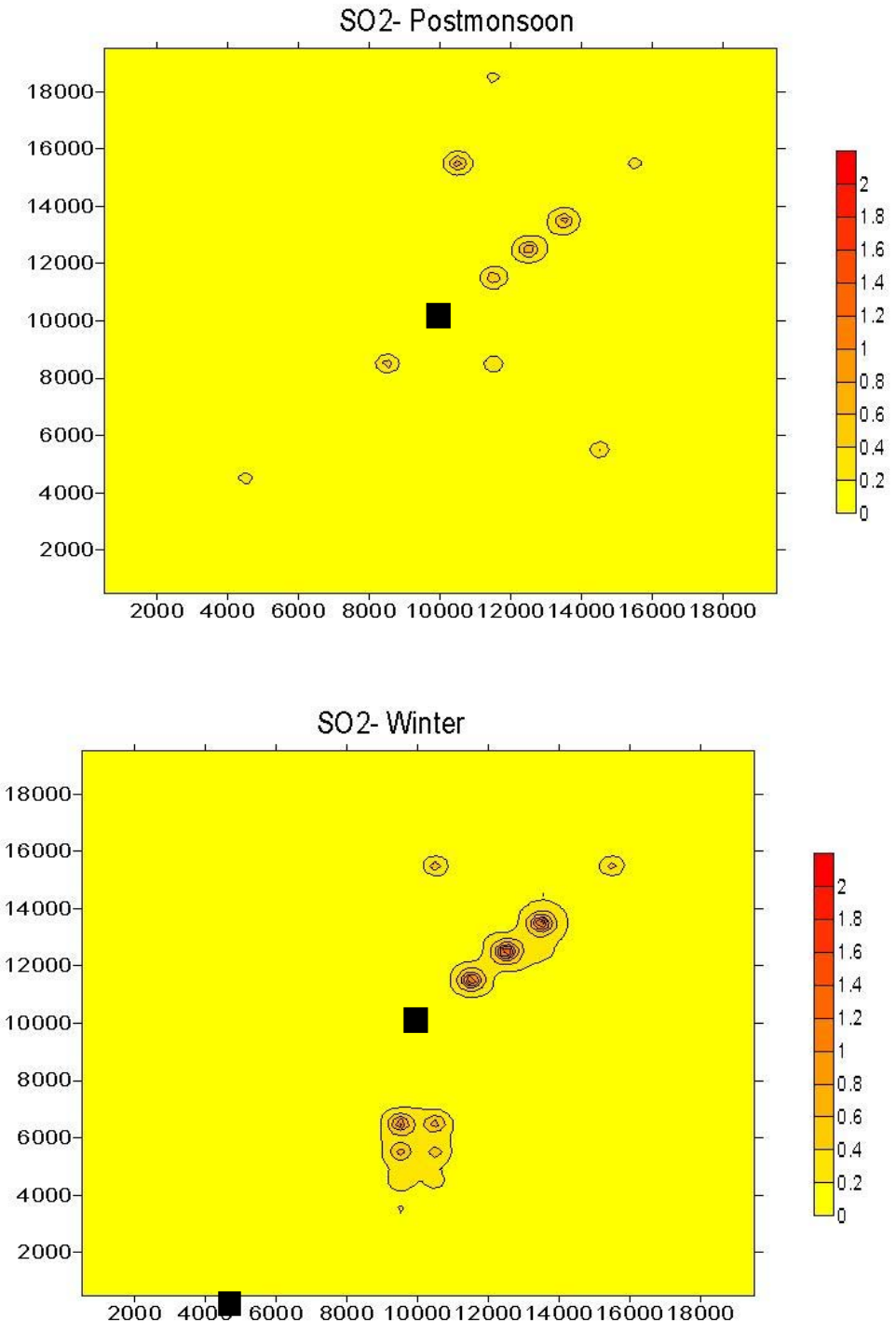


Figure 6.5(a-f): Spatial distribution of expected SPM and SO2 concentrations (µg/m³) during 3 seasons at project location.

2. COMPOST PLANT/ RDF PLANT/ DISPOSAL SITE

The activities those are responsible for the adverse air quality, fugitive dust and the odour nuisance are the trucking operations carrying waste to the disposal and the compost & RDF facility site, use of the unpaved disposal road, and odour nuisance may be caused due to compost & RDF Plant operations. These activities would generate significant amount of fugitive dust in the area, trucks carrying waste would add into CO, NOx and PMio besides fugitive dust. The scale of impact of trucks emissions on the air quality would be permanent but very minimal; however, fugitive dust produced while trucking on unpaved disposal route would cause more visibility and other problems.

It is observed that the gaseous pollutants found to be marginal while fugitive dust remained very high, and therefore may need permanent solution for bringing the dust levels and Green belt has been proposed for development around the facilities.

6.4 NOISE ENVIRONMENT

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.

A) CONSTRUCTION PHASE

The activities those are responsible for the adverse noise levels are equipments used for site clearing and preparation, grading of the site- dredging and filling and the trucks carrying soil and other materials to the sites. During these activities, construction equipments and earth moving machinery would be used vigorously and would generate unbearable noise in the area, trucks carrying construction materials and soil would further add into the noise. The scale of impact would, however, be temporary but may cause disturbance to the local residents.

The noise is anyway the existing problem for the residents because of the heavy traffic on NH-37. The noise generated in the site area would be comparatively very low and therefore to investigate the noise levels caused due to the NH-37 traffic, the noise level modeling is carried out to predict the extent of the noise nuisance at the NH-37 junction of Paschim Boragaon.

Noise levels are predicted for the three compositions of traffic, two wheelers (scooter, motorcycles, etc), light motor vehicles (car, van, taxi, and auto) and heavy motor vehicles (bus and trucks) during the daytime as well as the nighttime. The night time traffic is assumed to be about 5 to 7 percents of the daytime light vehicles for the light motor vehicles and 110 percent of the daytime heavy vehicles for the heavy vehicles. It is observed that during night time, heavy vehicles increase drastically while two wheelers and light vehicles are seen almost thin. Moreover, the additional trucks that would be generated due to the project are accounted in predicting the noise levels.

The predictions are done for the weekday (Monday/ Friday, assuming same traffic) and also for the weekend (Saturday). The other details like fleet speed, distance of the observer from the lane center, etc. are recorded at the site by observations. The energy curves are used for calculating some important parameters required to run the model (Rau and Wooten, 1980).

The results of the modeling study for the daytime and night time noise levels are tabulated in Annex 4. It is observed that the effect of the increased trucks due to the project is negligible while the noise levels are high due to the existing traffic, however, are within the acceptable noise standards for the industrial area. On the other hand, it is noticed that noise levels shoots up to high levels mainly due to honking of heavy trucks, causing more noise in the night time. The noise is therefore mainly due to the high number of heavy trucks and honking, as also seen from the observations.

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 **Table 6.5** below:

TABLE 6.5: NOISE LEVELS GENERATED FROM CONSTRUCTION EQUIPMENT

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

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)
Cranes - mobile	81	105
Dump Truck	83	107
Generator	Not considered	75 (as prescribed by CPCB)
Hammering	86	110
Jackhammer	88	112
Pile Driver	100	124
Radial Arm Saw	80	104

Source: www.gvrd.bc.ca/education/pdf04/ColumbiaWorkshop1-ConstructionNoise.pdf

Since the construction phase is expected to be minor in nature, hence the possibility of all the equipments working together is ruled out. Hence, the noise generated is not anticipated to be high.

B) OPERATIONAL PHASE

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

- Noise from blowers, shredders of RDF plant
- Noise from turbo generator, compressor and other rotating equipments of the power plant
- Noise due to vehicular movement inside the plant premises and on the NH-37

All the noise producing equipments such as blowers, shredders, turbo generator, and compressors 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 is not very high.

6.5 TRAFFIC AND TRANSPORT

A) CONSTRUCTION PHASE

Transport of waste provides a direct and visible component of the facility thus brings impacts much closer to the people. The waste management facility generating a traffic demand during the construction phase would have a temporary impact but nevertheless will be significant. Import of the raw materials, plant equipment from the local area or from the distant locations, removal of soil would generate quite irregular traffic.

B) OPERATION PHASE

The substantial number of vehicle movements from the local area and over greater distances, will usually take place over at least 5 to 6 working days a week for delivering the waste to the facility. As a result, the pedestrians and traffic movement would be adversely affected. The traffic carrying waste may lead to the congestion at the junction of NH-37 and the access road at the Paschim Boragaon. The traffic generating in terms of number and size can be irregular. Moreover, the proximity of sensitive land uses may affect due to the continuous traffic movement. There may be an intrusive effect of increased traffic, particularly, heavy trucks in the amenity areas. Dust, noise and air pollution as described earlier due to increased vehicle movements would worsen. The transport of waste is often perceived to be undertaken in a less professional manner, may have impact on the people. Deliveries of additional materials and equipments, e.g. clays and soil during waste covering and during maintenance would lead to significant number and size of vehicles. In addition, the turning movements at site entrance, increased traffic at key road junctions, increased traffic results in speed change of vehicles may lead to other pollution problems. The vibration effect of vehicle movement often leads to structural damage to the road surface. This may have impact on the terrestrial ecology due to the continuous heavy duty vehicles flow.

6.6 WATER QUALITY

6.6.1 SURFACE WATER

A) CONSTRUCTION PHASE

It is observed that there is no site runoff at present due to waterlogged but may increase during monsoon. The ponding water bodies on the proposed site are formed due to the low lying and marsh area. Presently, the stream (Mora Nalha) passing through the site is almost stagnant leading to the water logging in the proposed area. The activities responsible for polluting the surface waters are physical disturbance, i.e. diversion, realignment, run-off and also deposition of air pollutants. These activities have first order as well as second order impacts, viz. changes in hydrology- water flow, velocity level, retention time and flood peak, addition of contaminant, etc. these may further have effects on soil, and other amenity.

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 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.
- Spillage of oil and grease from the vehicles and wastewater stream generated from on-site activities such as vehicles washing, workshop etc.

Construction and Development of site

Development of the proposed site could lead to stockpiling and filling activity on site. The run off from the site may contain high quantity of suspended solids (SS). The impact of runoff may not be very significant except during rainy season. Further construction of garland drains will reduce the runoff from the stockpiles.

Labour Activities

During construction phase, wastewater shall be generated from labour activities on site. Wastewater generated would be characterized by high levels of BOD,Suspended Solids, Nitrogen and E. Coli. Significant water quality impact will occur, if the sewage is disposed without any prior treatment. Since most of the people would be deployed locally, impact from labour colony is not anticipated to be very high. Temporary soak pits and septic tanks shall be constructed on the site during construction phase to mitigate the impact.

The project implementation would involve various construction activities. The following section summarizes the water requirement, its sources and management of wastewater.

B) OPERATION PHASE

During the operation phase of the project, the plant water requirements includes plant cooling water make up requirements, potable & service water requirements. The quantity of plant water requirement is about 2000 m3/day including the requirement for power plant & RDF Plant. This water will be taken from the groundwater sources. The plant potable requirement of about 20 m3/day will be also met from groundwater. The details of water requirements and waste water generation are presented in **Table 6.6 (A)**

TABLE 6.6 (A) ESTIMATED WATER REQUIREMENT

Sr. No.	Activities	Water Requirement (m^3/day)	Estimated Wastewater generation (m^3/day)	Final Discharge water after Treatment (m^3/day)
1	RDF Plant	55	44.16	700.8
2	Cooling Tower make up Water	1113	273	
3	Boiler make up Water	667	360	
4	Miscellaneous	103	-	
	Total	1938	700.8	

Effluent Generation

During the operation phase, wastewater will be generated from the following activities

- RDF Plant - Blow down water from aspirators and dust washers
- Effluent from Water Treatment Plant.

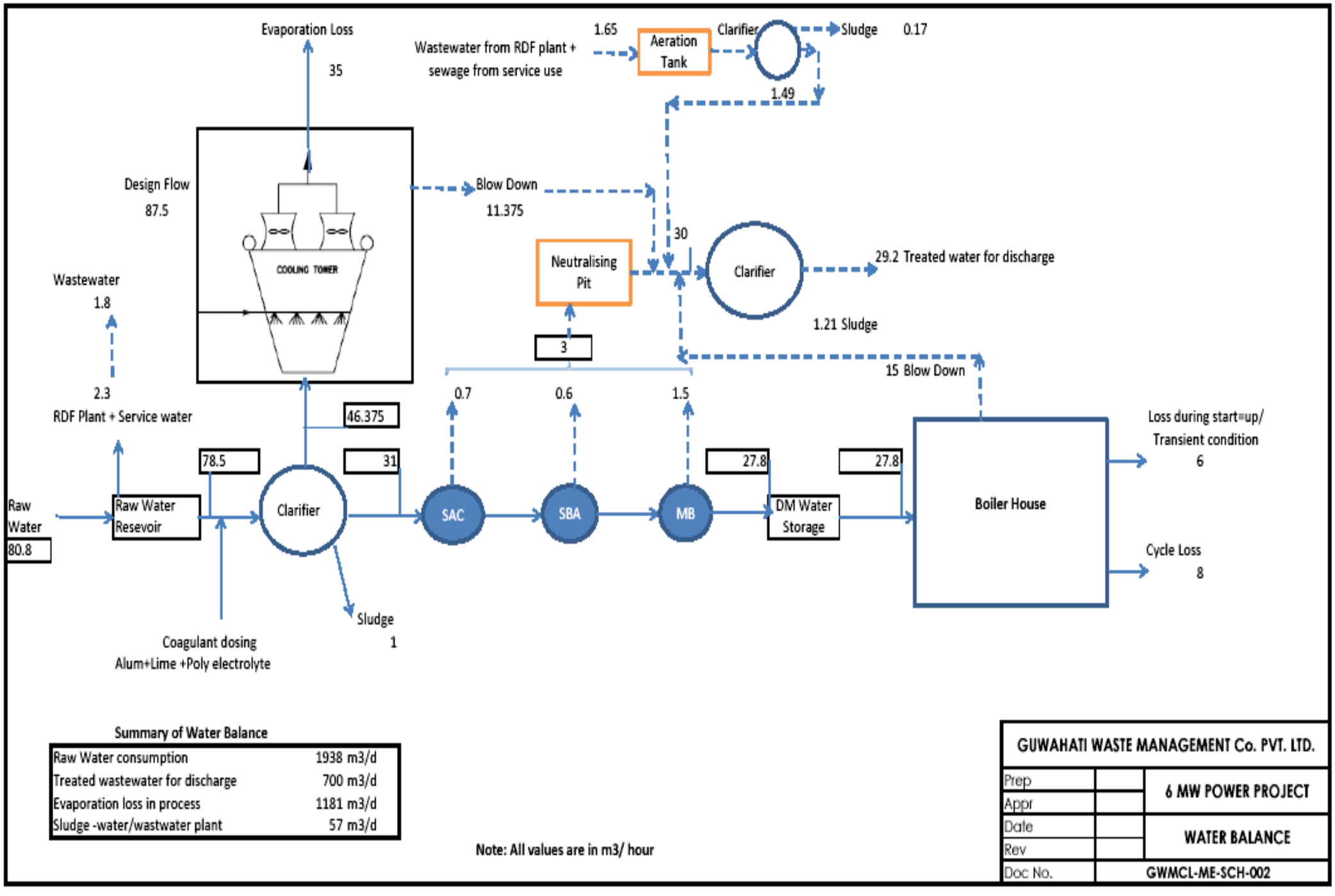
Approximately 700 m^3/day of effluent will be generated due to the proposed plant. The details regarding sources and characteristics of wastewater and description of treatment facilities are given below:

Effluent from RDF Plant: Effluent generated from the process include blow down water from the aspirator and dust washer. Wastewater from the process would be recirculated back to the RDF plant. Spill over from the process (if any) would be collected and treated prior disposal.

Effluent from Power Plant: For the power plant, liquid effluent generated from DM unit regeneration waste and boiler blow down will be discharged into drain after suitable treatment. Filter backwash water and cooling tower blow down will be discharged into drain after treatment.

The effluent from the integrated plant will be treated as per the required standards before letting out in to a Nallah. The water balance diagram for the project is enclosed at Fig 6.6

Fig 6.6 WATER BALANCE



Activities responsible for the impact on the surface waters are, uncontrolled discharge of surface waters, leachate level break out to surface, leakage from the engineered drainage systems, runoff from the raised landfill areas, deposition of air pollutants and removal of vegetated areas. During this phase, these activities may cause significant change in the surface water quality.

The landfill actually is a very large construction site, if soil erosion occurs, could be detrimental to the aquatic resources that are downstream of the site. The waste contained within the facility may be transported off-site into the nearby water body. In most severe cases, entire landfill may get washed away in floods. A landfill may aggravate the local flooding of adjacent lands.

6.6.2 GROUND WATER

A) Construction Phase

During this phase, activities responsible for the impact are, site development work, landfill development work, which includes, removal of topsoil, and exposure of lower permeability subsoil, soil compaction. These activities, which may have impacts on the ground water quality, are leaching of contaminant in soils, leakage of hydraulic fluids, and contaminated drainage from rain fall on unpaved areas. Groundwater may also be contaminated from the machine maintenance and the domestic wastewater resulting from workers.

B) OPERATION PHASE

There will be no ground water contamination as almost 80% waste to be processed and only 20% of waste comprises of only inerts and rejects from processing facility will go to the landfill site. Hence no ground water contamination has been expected from the proposed project.

6.7 LAND ENVIRONMENT

6.7.1 IMPACTS ON LAND USE & AESTHETICS

The proposed project will be developed on the existing waste disposal site and in foothill and flood prone site; hence, no change in the landuse of the site due to the proposed project is anticipated. With the site development for the proposed plant, green belt would be developed and other aesthetic changes would be made at the plant site, there by creating overall positive impact on the aesthetics of the site.

6.7.2 IMPACTS ON TOPOGRAPHY & GEOLOGY

The proposed site being undulating and in the foothill and flood prone land, hence the topography as well as geology is anticipated to change due to proposed project. No additional environmental stresses will be imposed by the project on these parameters and hence positive significant impacts are expected from the project as soil erosion would be stopped.

6.8 SOIL QUALITY

A) CONSTRUCTION PHASE

The physical effects of developments can lead to changes in local topography and soil damage and erosion. This can arise from changes in ground conditions, land-lake clearance, compaction by heavy machinery during construction and soil movement, deep digging for foundation and piling, removal of vegetation, trees and hedges, etc. Such physical disturbances may lead to changes in the density of soil, its moisture retaining ability, natural drainage, and in organic matter content and also soil biota. Erosion of soil from the surface and removal or change at depth, may further lead to surface subsidence.

The effects of physical disturbance of soil can have impacts upon soil microorganisms, natural flora and fauna, crops and livestock, groundwater and surface hydrology and quality, landscape and visual amenity as well as upon engineering works and buildings.

The proposed plant will be developed on the existing waste dumping site, hence no negative impact due to the development is anticipated.

B) Operation phase

No significant impact is expected on the soils on and around the site, due to the following management measures:

- All solid wastes and hazardous wastes from the plant complex are collected properly collected, 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

Hence, no negative impact on soil quality on the project site is expected due to the proposed project activities.

6.9 IMPACTS DUE TO WASTE DISPOSAL

A) CONSTRUCTION PHASE

During the construction phase, the typical solid waste will be generated from the project includes waste from land clearing activities and construction waste. Impact from construction waste may arise owing to storage on site, transportation, workshops, etc. Proposed mitigation plan suggest maximum reuse/recycle of construction waste on site or removal of waste at the site and proper disposal, which would reduce the impact significantly.

B) OPERATION PHASE

The details of solid waste generated and proposed disposal options during the operational phase are detailed in **Table 6.7**.

TABLE 6.7: EXPECTED WASTE CHARACTERISTICS & LOAD – OPERATIONAL PHASE*

S. No.	Source of Waste	Components	Disposal Option
1	Segregation Level I and II	Organic Components	Sent to compost plant for composting
		Woody shell, textile etc	Used as fuel in HAG
		Sanitary wares	Crushed and sold
		Stones	Crushed and sold
		Others	Appropriate disposal
2	Tromel I,	Sand /grit Soil +Fine Bio Mass	Will be sold for filling of low lands during urban development activities and presently fetches a price of Rs. 20-30 per m^3 at site
3	Hot Air Drying	Fine and lighter particles produced during primary shredding, removed from the exit gases by cyclones and bag filters.	Disposed along with rejects from Tromel I.

S. No.	Source of Waste	Components	Disposal Option
4	Tromel III	Soil +Fine Bio Mass	Excellent soil conditioner and can be sold to nearby pulverized coal based power plants- at a price of Rs. 20-30 per m^3.
5	Ballastic rejects	Stone	Sold as Soleing Material
		Brick Bats	Sold to building industry
		Leather	Sold for shredded filler
		Rubber	Rubber reclaim industry
		Sanitary wares	Insulator industry
		Others	Appropriate disposal
6	HAG Ash	Inert Ash	Will be sold for use in construction industry
7	Boiler ash	Boiler	Will be sold at market at local market for use in construction industry
8	Fly ash	ESP	Supply to the existing Brick making Units
9	Solid waste	ETP	Disposal to Landfill Site

* Quantity are mentioned in Fig 8.2

The proposed project will not have significant impacts, owing to the following measures:

- Door to Door collection of waste
- Transportation of waste in closed/covered vehicles to the processing & disposal site
- Unloading of incoming municipal waste in a 9 M deep covered pit
- Spray of Herbal pesticide in the receiving pits for reducing odour, pest and rodents
- The small quantities of leachate generated, will be collected in the sump and treated before disposal.
- Appropriate management of solid rejects (approx 34% of the total waste) from different processing activity

- Fly ash generated from the plant will be supplied to the existing brick making units
- Bottom ash will be used for onsite and offsite construction activities.
- The solid waste generated (Sand and Silt) from the ETP would be disposed off at a landfill site.
- Providing ultrasonic hooters will mitigate bird menace around the project site

6.10 FLORA AND FAUNA

A) CONSTRUCTION PHASE

Potential primary and secondary impacts from the proposed project on the biological environment have been identified and the significant ecological impact is evaluated based on:

- Habitat Quality
- Species affected
- Size/abundance of habits/organisms affected
- Duration of Impacts
- Magnitude of environmental changes

However, this being rapid EIA impacts is ranked here as “minor”, “moderate” or “severe”, although in a few cases a ranking may be minimal. The ranking of a given impact will vary based on the criteria used. For example, an impact might be ranked as “minor” if it affected only common species and habitat, or if it affected small number of individuals or small area, whereas it might be ranked as “severe” if it affected rare species or habitat of large number of individuals or large area.

The sources of activities responsible for the ecological impacts are surface excavations, construction activity, disturbance and damage, site engineering, restoration, dust, litter, etc. This phase has the potential to have the most direct impact in terms of physical loss and disturbance. The disturbance to the flora and fauna may cause due to occupation of land and changes in water levels and flow, landform, etc. damage to the habitat around the site can also be possible resulting from various aspects of normal construction, such as temporary storage of stripped topsoil and bulk access to working areas and incursion of workers into ecologically sensitive areas. Loss of habitat can arise from direct removal of habitat, rearrangement of topography and surface features by grading of an area, or as a result of loss of vegetation. Physical changes to the drainage on a site associated with construction, and installation of new services, can affect drainage of surrounding areas with subsequent effects on habitat damage. The temporary site drainage may cause the local water resources polluted. Flora and fauna may

be exposed to the high levels of dust during excavations of landscaping and access roads. The removal of the soil cover will in turn destruct the vegetation and destroy the terrestrial inhabitants. More general disturbance is likely to result from the noise, dust and movements of vehicles and personnel. The excavation of the landfill could lead to the loss of breeding or nesting sites.

B) OPERATION PHASE

Site formation: The existing land cover and physiognomy support plant species typical of habitats and having a low plant diversity and simple structure. Due to commonness of the species recorded and small area of habitats for herbs and shrubs to be lost, potential impacts to flora are considered minor. During the construction stage; removal of (shrubs and herbs) will reduce the habitat for a few faunal species. It will be temporary and suitable alternatives are available in nearby areas. The proposed peripheral greenbelt will provide a much better habitat for those species than earlier.

Noise, Air Pollution and other Disturbances: Air, noise and visual disturbance may be generated during the site development that can affect the behavior of fauna (especially bird, butterflies and other insects, reptiles and very small mammalian species) of the adjacent habitats. Small mammalian species such as mongoose and palm squirrel were recorded from the site premises. 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 minor.

6.11 SOCIO CULTURAL

The project would influence the socio-economic conditions and socio cultural conditions in the local areas.

A) Construction Phase

The direct impacts involved are due to the continuous construction activities, nuisance of noise, dust and traffic may cause stress level to increase in the near by residents. However, the site clearing and grading may create employment in the area. The indirect impact beneficial to the community is the provision of skilled/unskilled workforce. The workers may be exposed to the high levels of noise and dust during landscaping, access road and site preparations. The issue of

visual impact will result from the disposal of debris and dispersion of solid waste generated from workers.

B) Operation phase

The facility does not require the displacement of residents or any such commercial activity. The facility as would produce severe traffic, change the landscape, create litter and noise nuisance may lead to the annoyance in the community. The implications of social impacts may therefore be the effect on community cohesion and stability marginally. The locals will be concerned about job opportunities. The stress caused by trucking operations and odor problems may be of significant concern.

6.12 IMPACTS ON SOCIO-ECONOMIC ENVIRONMENT

This section discusses the project activities and the extent of the potential impacts anticipated from these. Based on the nature and type of impacts, the assessment has been divided into three category i.e. positive, negative and negligible impacts. For example, the positive impacts are: job creation for men and women, better utilization of land, preservation of environment, and infrastructure development. Long term impacts have taken into account i.e. demography, aesthetics, accessing utilities and impact on archeological sites. Negative impacts include adverse impacts on health, air pollution including noise, road safety and odor. Matrix relating project stage to social impact assessment variables is provided in **Table 6.8**

A) POSITIVE IMPACTS

Job Opportunity: During the social impact assessment process, locals raised the question regarding more job opportunities. The occupational profile of the region is such that the locals can be good sources of labour during construction phase specially the one's residing in the nearby locality and villages and can look forward to benefit due to more jobs availability. The benefit relate to the direct employment associated with the construction.

During the operations phase, one of the project activities would comprise of manual segregation of waste. The locals inhabiting or rag pickers, who have been performing the task of informal waste collection, can be harnessed for this specific activity during the operational phase.

The plant would therefore provide employment opportunities during construction and operation phase. Thus, the impact on employment due to construction and operation of the plant can be considered as "significantly positive".

Benefits to women / poor section: The proposed facility would generate jobs for the women laborers / poor section during construction as well as operation phase. Women are also likely to get job during construction phase. This will considerably reduce their travel time and therefore enable them to attend to their children and other household chores.

B) NEGATIVE IMPACTS

Traffic and Transport: With the construction of the plant, the traffic in the area is likely to increase, particularly during the construction phase. The increase in traffic may create congestion, potential delays and inconvenience for the residents accessing the localities. This probability of inconvenience faced due to the movement of trucks during construction phase would be negligible, since the trucks would be allowed to transport construction material during night and non-peak hours. Furthermore, the traffic study and Transportation Management Plan being developed for the project would further reduce the negative impact of the traffic increment.

Transient Labour population: Labours for the project would be from Guwahati nd surrounding areas. A maximum of 250 labours would be working on the site and most of them would be locals. No significant pressure on local infrastructure is envisaged if a small percentage of labourers settle in and around the site during construction phase.

Health: Health impacts are envisaged during the operations phase, particularly the effects of air pollutants on the employees working within the plant and the effects of release of certain polluting components in the localities surrounding the plant. However, inbuilt precautions have been designed for the same. Since adequate measures have been envisaged in the project design, this is unlikely to happen and therefore no likely adverse impact on people's health is predicted. Therefore, the impact significance of the operation stage vis-à-vis public health is very low. Public consultations were conducted in order to inform them about the proposed project. Locals were also communicated about the safety aspects incorporated in the project design.

Noise: The noise levels expected from the planned operating conditions are likely to be within acceptable levels.

Odor: Odor is one of the main concerns of those staying in close vicinity to the plant. Considering this, the design of the facility would be such that the odor will be contained within the boundaries of the facility. Therefore, there is little possibility of odor.

C) NEGLIGIBLE IMPACTS

Demography: During construction phase, about 250 workers could be deployed. Majority of the labour is likely to be recruited locally and only skilled workers would be from outside, which is anticipated to be very small and will not alter the existing demographic profile of the area. During the operation phase also, the facility would not lead to migration or relocation of any group to the proposed site. A very small fraction of people working in the complex may come and settle near the site. Therefore, the project is not likely to significantly alter the

existing demographic profile and the existing population density. Therefore, the impact on demography due to construction and operation of the proposed integrated waste management facility can be considered as "no impact".

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 upcoming of the project in the area. Hence, impact on existing utilities due to construction and operation of the proposed waste management facility can be considered as "no impact".

Impact on Historical, Archeological and Architectural Sites: There are no historical or archeological monuments of significance within the study area and hence no negative impact in this regard is anticipated.

TABLE 6.8: MATRIX RELATING PROJECT STAGE TO SOCIAL IMPACT ASSESSMENT VARIABLES

Social Impact variable	Implementation/construction	Operation/maintenance
Population characteristics		
Population change	No noticeable change	No noticeable change
Influx/outflow of temporary workers	Majority of unskilled workers will be from the surrounding localities	Outflow of temporary workers
Community and institutional structures		
Voluntary association	-	-
Interest group activity	NGOs in the region may raise concerns about the facility in the region.	
Size and structure of local government	No change	No change
Employment/ income characteristics	Employment to construction labour and support staff.	Employment to specialists, support staff within the facility
Industrial/commercial diversity	Sourcing of material and services for design and construction	Sourcing of material and services for operation of the facility
Individual and family changes		
Displacement/relocation concerns	No relocation /displacement	No relocation/ displacement

Social Impact variable	Implementation/construction	Operation/maintenance
Residential stability	Would not be altered	Shall not be altered
Attitudes towards policy/project	Would generate goodwill if creates employment opportunities and if community can be assured that the facility shall not create health problems for the community.	Would generate goodwill if creates employment opportunities and if community can be assured that the facility shall not create health problems for the community.
Social well being	Project shall provide employment opportunities to people at various levels hence shall empower them to access facilities for their well-being.	Project shall provide employment opportunities to people at various levels hence shall empower them to access facilities for their well being
Community resources		
Change in community infrastructure	No change	No change
Land use patterns	No noticeable change in the vicinity	No change

6.13 OVERALL ASSESSMENT

The following points are observed and summarizes from the foregoing description of impacts identification and also from the existing environmental status of the study region,

The area is a wetland and flood prone. There is also likelihood that the area may be disturbed moderately due to seismic disturbance. The proposed site is within the 500m of the proposed landuse property line. The area however is less populated with little agricultural and recreational activities. It is also observed that there is a likelihood of water contamination from the proposed activity due to the high water table especially in monsoon. There is also a small water stream, namely Mora nalha passing through the proposed landfill site. Among all the components, in case of landfills, significant weightage is normally given to the 'hydrological' parameters considering their most adverse impacts. This generally affects the design of the landfill. The higher annual precipitation although may lead to the higher leachate generation, the rainfall in the Guwahati city is in the range of 80 to 150 cm/yr, which may not create very severe problems in controlling the surface or contact water.

The maximum groundwater table observed to be up to about 7m below the normal ground level in monsoon, which may not cause severe problem to the bearing surface of the landfill. However, the clearance between the ground level and the post monsoon water depth is (which goes up to 1 5m) expected to be sufficient to provide more depth for the landfill excavation. Facilities in such conditions are generally provided with the stock-pile. The flow direction of the groundwater is from east to west. The downstream villages on the west side are far beyond the site (about 4km). Apart from these, there are few sensitive locations at and near the sites, i.e. Deepar beel about 1.5km from the site, airport base about 10km from the site, and the forest within the 2 to 3km from the sites. However, there is a proper access road to the sites of about 1km, which does not pass through the dense populated areas. The available area at and near the proposed site is adequate to allow for the various construction and operation activities of the proposed facilities. The infrastructure required for the site operations are power supply and the access roads, which are adequate at the site.

The soil morphology and characteristics depict that it may not subject to the subsidence and also loose strength with compaction. The depth of bedrock is sufficiently high to prevent any problems to the construction of the facility. The seismic intensity of about 5 on ritcher scale may not disturb the design and construction of the facility on the proposed sites. The clayey nature of the soil mixed with brownish sandy loom associated with a saturated (water logged) strata may not cause to leaching the leachate to contaminate the groundwater.

The demography besides other features is equally important in choosing the site. The distance of the site from the populated zones is around 1 km, which is generally considered to be good for the Setting waste management facility. Moreover, the land cover of the proposed site is of the less economic importance, provides more suitability for the site. A single crop, i.e. paddy

farming is observed at the site, which is temporarily done by local and or outsider people. The transportation of waste from the source of generation (transfer stations) is one of the important factor to decide the economic location of the site. Since the site is within the 12km from the city center, is relatively at economical locations. The site is in the low lying area with a little depression but has no slope and therefore is the ideal one. The site is in the flood prone area and therefore may contaminate the water. Though the generation of toxic waste is not expected due to the very nature of the waste to be disposed off on the landfill, handling may create dust formation. However, due to the predominant downwind direction (NE and E), the population settlements may not be affected. The nearby villages are within the 1 km from the site but not directly on the downwind side hence are least affected as shown in the modeling results. The transportation of waste therefore would pose threat to the areas through it passes but to a minimal level.

CHAPTER 7

MITIGATION MEASURES

7.0 MITIGATION MEASURES

It is apparent from the discussion of chapter 5, almost every sector of environment would be affected. In view of this, in order to reduce the potential negative impacts identified, some mitigation steps are suggested for all the major valued environmental components. Most of these measures essentially need to be adopted in order to bring down the adverse negative impacts to the minimum level to create such facilities that are in harmony with the environment. These measures are described in the following section.

7.1 PHYSICO-CHEMICAL (PC) COMPONENT

7.1.1 Air quality and fugitive dust

Generally studies have found no significant effect associated with air quality issues

Construction phase:

i. Fugitive dust is the most prominent type of nuisance during construction phase and hence controlling is the challenge. It is, therefore, daily sprinkling of water on the unpaved roads as well as while site preparation would reduce the dust pollution drastically. Sprinkling water twice a day could reduce the dust by 40 to 50% and thrice a day could reduce it up to 68 to 70%. Dust can also be better managed in the landfill's interior by dust control chemicals.

ii. The most cost-effective dust suppressant is water, because a source of water tends to be readily available on a construction site. Water can be applied using water trucks, handheld sprays and automatic sprinkler systems. Furthermore, incoming loads could be covered to avoid loss of material in transport, especially if material is transported off-site.

iii. To mitigate effects of dust as SPM the following measures are recommended for implementation.

- A dust control plan

- Procedural changes to construction activities.

Operation phase:

i. Trucks carrying waste need to be inspected and maintained periodically to control the emissions.

ii. The disposal routes need to be paved to reduce the dust nuisance drastically.

iii. The unloading as well as processing of the waste would generate dust and odours. These activities will be carried out under covered areas with proper ventilation, which are under negative pressure as well

iv. In RDF plant following pollution control equipment will be installed:

a) Chimney with height of 65 meters.

b) The dust discharge from dryer will be collected by cyclones, dust settling chamber and final cleaning of air will be carried out in bag filters. The air from ballistic separator cyclone will also be sent to the dust filtration system.

c) Secondary shredder will be provided with bag filters before air is let out to atmosphere

d) The dust collection will be carried out at the following points:

- Rotary Trommels
- Dryer solids discharge chute
- Discharge chute of Rotary Trommel (Secondary)
- Coarse fluff discharge chutes
- Secondary cyclone discharge duct
- All material transfer points

v. Power plant will have the modern pollution control equipments including The dioxin and furans emission control equipments and European norms to be followed

Air from these points will be directed to cyclone for primary collection and air bag filters. Emission rates are much below the norms as the gases are scrubbed with water.

7.1.2 Environmental noise

Construction phase:

i. The limiting of site working hours

ii. The use, where necessary and practicable, of enclosures and screens around the noisy fixed plant and or equipment.

iii. Locating points of vehicle carrying construction materials and soils ingress and egress away from the sensitive receptors, such as schools and residents

Operation phase:

i. The use of screening bunds between the plant site and the noise sensitive locations such as schools, etc.

ii. The proper maintenance of plant, i.e. special attention to the diesel and exhausts silencers, lubrication of conveyer trolleys, etc.

iii Locating points of vehicle ingress and egress away from the sensitive receptors, such as schools and residents

iv) Construction equipment producing the maximum noise level should be fitted with noise shields.

v) Noisy construction equipment should not be permitted during night hours.

vi) Working hours of the workers employed in high noise areas will be rotated. Earplugs/muffs, or other hearing protective wear will be provided to those working very close to the noise generating machinery.

vii) there are a number of sources of noise pollution such as truck traffic, blowers, and shredders. Where necessary, enclosures would be provided to ensure that noise levels do not exceed the prescribed standards (85 dBA at 1 m distance from the equipment). For the workers' safety, earplugs would be provided and equipments would be maintained to ensure optimum working conditions.

viii) Green belt development around the project will further reduce noise pollution

7.1.3 Land transformation

When considering the protection of the air, water and land in waste management project site vicinity, it is to be remembered that it is a public facility that benefits the entire community. However, if it significantly impacts then it can be detrimental to the community.

Construction phase:

i. There is a small agricultural land and fishing water body nearby the site, the

care should be taken during construction phase that some necessary screening bunds should be provided to avoid the direct contact with these land uses. ii. The use of good soil handling techniques to minimize the deterioration of soil quality, i.e. minimizing soil storage, careful placement.

iii. Installation of adequate drainage would also minimize the damage to the surrounding land uses.

iv Retention of landscape features as far as possible on site.

Operation phase:

i. The design of operation plant to minimize the impact on adjacent agricultural Land

ii. Proper bunding is required in order to screen visual impact on the nearby Residents

iii. Planting of trees and shrubs to reduce the visibility of working areas.

iv. Litter control and cleaning of litter fencing, regular checking of fencing, buildings, screens, bunds any landscape features which are part of the site, i.e. ponds, etc.

7.1.4 Water resources - surface and ground

Construction phase:

Following management, measures are suggested to protect the water quality during the construction phase.

i. Solid waste generated during this phase from workers activities and consumable parts should be collected in closed bins to be disposed at the safe place.

ii. Domestic wastewater generated from workers at the site during the construction and operation phases should be handled and disposed in an environmentally safe manner. It can be collected in close tanks and handled to the nearest place, iii. The waste oil produced from vehicles and machines should not be allowed to spill over the sites

iv. The site drainage control measures would help to reduce the impacts of polluted site run-off and the changed run-off characteristics of the site.

v. Adequate containment is necessary to collect the vehicle washing effluents and others, i.e. routing of off site drainage.

vi. Avoid excavation during monsoon season

vii. No discharge of wastewater to soil and ground water body

viii. Check dams will be provided to prevent construction runoff from the site to the surrounding water bodies.

ix. Pit latrines and community toilets with temporary soak pits and septic tanks will be constructed on the site during construction phase to prevent wastewater from entering the ground water or surrounding water bodies.

x. To prevent surface and ground water contamination by oil/grease, leak proof containers will be used for storage and transportation of oil/grease. The floors of oil/grease handling area will be kept effectively impervious.

xi. All stacking and loading areas should be made impervious and provided with proper garland drains equipped with baffles to prevent run off from the site to contaminate surface or ground water resources.

Operation phase:

The operational mitigation measures for protecting water resources are based on two objectives, one is, to ensure that run-off from the site does not exceed the existing run-off from the undeveloped site and two is, to contain and control the contaminated water that may be generated on the site.

i. The storm water that contacts the solid waste should be handled as a to be treated in the wastewater treatment facility prior disposal. However, some surface water that does not come in contact with waste should be diverted separately to a run-off system.

ii. Groundwater should be monitored periodically by taking samples from monitored well.

iii. Landfill runoff is destructive to the aquatic environment within the system.

iv. Under surface water management systems, any water that cold flow towards the landfill (i.e. Mora nalha in present case) should be diverted around the site to minimize the amount of liquid that may become runoff.

v. It is also feasible to have detention ponds at the site to receive facility runoff. These ponds allow sediments to settle, then release water at a slower rate than would naturally occur. This prevents the deposit of sediments in downstream environments and minimizes potential downstream flooding.

vi. To minimize the amount of water that enters the waste, all landfills now have the covers constructed from either soil and or geomembranes, which are placed over the active portions of cells.

vii. Maintenance of grassed and landscaped areas on large treatment facilities can help to maintain the infiltration rate to groundwater on part of the site

viii. Site monitoring both for groundwater and surface waters on a regular basis should also provide for detection of leakage.

ix. A detailed "Storm Water Management Plan" will be developed while considering the following sources

- Leachate generated from the waste.
- Diesel and oil spills in the Diesel Power Generator & fuel storage area.
- Waste spills in the solid/ hazardous waste storage area.
- Oil spills and leaks in vehicle parking lots and washing area.

x. Effluent generated from the process include blow down water from boiler blow down, cooling tower blow down, R.O. rejects etc. Wastewater from the process would be after treatment in effluent treatment plant would be recirculated back to the RDF plant.

7.1.5 Soil and Geology

Construction phase:

i. Minimization of construction site working areas and time of exposure to base soils.

ii. Careful placement and management of soils in store

iii Soil movement at times of suitably dry conditions only

vi. Sprinkling of water during construction

Operation phase:

i. Green belt development

ii. Design of site so as to retain the areas of soil sensitivity

iv. Numbers of options are available for conserving the geological faces in landfill, however, the provision of bunding around the face using either clay or granular materials with appropriate liners to protect the face

7.1.6 Odour nuisance

i. Good management practices, The careful operations and favorable general conditions would minimize the nuisance of odours.

ii. The trucks carrying the waste to the compost facility should be covered while transporting

iii. Providing enclosures to the area would sufficiently reduce the odour as well as noise in the areas

iv. Spraying of some anti odour chemicals would also help in controlling the odour, Pesticides and Herbicides will be used to control odur

v. Plant would be designed under negative pressure

7.2 BIOLOGICAL AND ECOLOGICAL (BE) COMPONENT

7.2.1 Flora and fauna& damage to habitats

The adverse ecological impacts are not necessarily irrecoverable.

Construction phase

i. restrict the activities as much as possible to the project site and allocate the track roads for construction

ii. Routing of surface drainage from the water courses and ponds

iii. Briefing of site workers about any ecologically sensitive areas

Operation phase:

i. Design of plant that produces clean emissions

v. Maintenance of buffer zone particularly around the site to minimize the disturbance to grazing animals

vi. Minimization of litter blow by good cover, fencing and hand-picking

vii. use of localized variations in soil type, differing, drainage properties and vegetation cover across landfill restoration areas to encourage ecological diversity

7.3 SOCIOLOGICAL AND CULTURAL (SC) COMPONENT

7.3.1 Public Health

Construction phase:

i. Control of dust during construction activities and transportation of materials as suggested before

Operation phase:

i. Proper handling of dispersed solid waste during transportation and storage

ii. Proper handling of the solid waste to prevent odour generated

iii. All Plant facility would be totally enclosed.

iv. Applying of the continuous cover over the cell during operation to prevent odour impact

vi Noise levels should be controlled

vii A monitoring program should be implemented covering the monitoring of noise levels as well as air quality

viii. Implementation of safety equipment and procedures for workers

ix Training and awareness of workers on proper handling of biodegradable waste

x. Applying routine medical exams for workers

x. The domestic wastewater resulting during construction and operation should be collected and managed in safe manner

7.4 ECONOMICAL AND OPERATIONAL (EO) COMPONENT

7.4.1 Socio-economic conditions

Unlike many of the other environmental impacts, social and economic impacts are less amenable to control by planning condition because they are less amenable to physical condition. However, the project would have positive impacts on the local environment.

i. The project would increase the economic activities of the locals in different sectors such as transportation, commerce, repair maintenance, etc.

ii. There would be generation of electricity & manure from the compost plant

iii. To ensure the acceptability of the project the mitigation of these impacts should rely on the developer's awareness of his responsibilities and willingness to work with a local community.

iv. Management commitment to recruit locally as far as possible should help to ensure beneficial economic impact

vi. Good management practice in terms of sensitive design and control and monitoring of the plant site will be primary means of ensuring that stress and concern about problems are mitigated

vii. The instigation of a formal complaints system which responds quickly and directly to the complainants about odour, noise, or other nuisance will assist in building confidence in the management

vii. As evidence to effective management, site monitoring and publication of data and reports on environmental performance can also be important

CHAPTER 8

ENVIRONMENTAL MONITORING PLAN

8.0 INTRODUCTION

Environment Management Plan (EMP) is a site specific plan developed to ensure that the project is implemented in an environmental sustainable manner. EMP also ensures that project implementation is carried out in accordance with design by taking appropriate mitigation measures to minimize impacts on the environment during construction and operational phase. EMP will outline Environmental aspects of concern as well as their level of risk and environmental protection measures to diminish this risk. It emphasizes how the development may impact on relevant environmental factors and how these impacts may be mitigated and managed so as to be environmentally acceptable.

Environment Management Plan (EMP) plays a vital role in safeguarding the environment and ensures, where all contractors and subcontractors including consultants, understand the potential environmental risks arising from the proposed project. The proposed project of setting up an Integrated Municipal Solid Waste Management facility in Guwahati in itself is a project for environmental and social betterment of the city. However, any activity aimed at development will have repercussions on the environment, both positive and negative. This section attempts to briefly analyse the environmental impacts of the proposed project and suggest the possible mitigative measures and management plans for perceived negative impacts. This section also highlights the positive project impacts and serves as a management tool for project implementation with environmental safeguard.

The construction of the integrated facility at Boragaon site is expected to take about two year. The major activities during this phase include site preparation, construction of roads, compost plant, RDF Plant, Power Plant and sanitary landfill area. The site is proposed to have both waste processing and landfill operations. Environmental monitoring, mitigation program and implementation arrangements are also dealt with in the subsequent section.

8.1 EMP FOR AIR ENVIRONMENT

(A) CONSTRUCTION PHASE

During construction phase, the main air emissions anticipated is dust. To mitigate effects of dust as SPM the following measures are recommended for implementation.

- A dust control plan
- Procedural changes to construction activities.

The most cost-effective dust suppressant is water, because a source of water tends to be readily available on a construction site. Water can be applied using water trucks, handheld sprays and automatic sprinkler systems. Furthermore, incoming loads would be covered to avoid loss of material in transport, especially if material is transported off-site. It is also suggested to follow the following procedural changes to construction activities:

Idling Time Reduction - Construction equipment is commonly left idling while the operators are on break or waiting for the completion of another task. Emissions from idling equipment tend to be high, since catalytic converters cool down, thus reducing the efficiency of hydrocarbon and carbon monoxide oxidation. Existing idling control technologies, which automatically shut the engine off after a preset time can reduce emissions, without intervention from the operators.

Improved Maintenance - Recognizing that significant emission reductions can be achieved through regular equipment maintenance, contractors will be asked to provide maintenance records for their fleet as part of the contract bid and at regular intervals throughout the life of the contract. A monetary incentive/disincentive provision will be established to encourage contractors to comply with regular maintenance requirements.

Reduction of On-site Construction Time - Rapid on-site construction would reduce the duration of traffic interference and therefore, reduce emissions from traffic delay. Off-site fabrication of structural components can also enhance the quality of work, as the production takes place in controlled settings and external factors such as weather and traffic do not interfere.

B) OPERATION PHASE

Air emission standards envisaged for the project are far more superior to the applicable National Standards, resulting in better air quality management. The potential sources of air pollution are likely to occur from the boiler and fugitive emissions during material handling and processing.

i) Fugitive Dust and Odour from waste transportation, handling and processing

The collection, transportation, unloading as well as processing of the waste would generate dust and odours. These activities will be carried out in covered vehicles, under covered areas with proper ventilation, which are under negative pressure as well.

To control the odour and also for convenient uploading of MSW from trucks to the processing plant, the waste will be dropped into one of the two specially designed pits and immediately on unloading the fresh lot , MSW will be sprayed with a herbal insecticide through fogging nozzles. This confinement of MSW, thus exposing its minimum surface area will produce much less smell and the herbal spray felicitates its elimination by discouraging further decomposition of MSW. These pits will be sheltered inside the building and to enable the unloading of MSW from trucks each pit

will be provided with a separate mechanized collapsible shutter. These shutters will be opened only during the unloading of MSW.

Furthermore, the entire process building will be kept under negative pressure which will allow fresh air to enter the building and the inside air along with any residual odour will be taken outside the building and will be passed through filters/water washed before it is allowed to escape into the atmosphere. Wherever logistically possible, this exhaust air will be put into boiler or Hot Air Generator (HAG) to destroy its volatile organic vapours causing odour. In addition, the process operation has been so designed that raw MSW is not allowed to stay in the storage pits for not more than 12 hours.

Once the material is dried after segregation and homogenization and thermally treated with simultaneous deposition of tar particulate present in hot flue gases, MSW gets totally sterile with no further onset of its decomposition.

ii) Emissions from RDF plant

The Rotary dryer in the RDF plant will have a Hot Air Generator (HAG) in which biomass segregated from MSW will be combusted to generate hot air.

The following pollution control equipment will be installed:

a. A Chimney of Height 68 M

b. The dust discharge from dryer will be collected by cyclones, dust settling chamber and final cleaning of air will be carried out in bag filters. The air from ballistic separator cyclone will also be sent to the dust filtration system.

c. Secondary shredder will be provided with bag filters before air is let out to atmosphere

d. The dust collection will be carried out at the following points:

- Rotary Trommels
- Dryer solids discharge chute
- Discharge chute of Rotary Trommel (Secondary)
- Coarse fluff discharge chutes
- Secondary cyclone discharge duct
- All material transfer points

Air from these points will be directed to cyclone for primary collection and air bag filters. Emission rates are much below the norms as the gases are scrubbed with water.

iii) Emissions from Compost plant

In compost plant odour and dust is the main emissions and to control the odour, the waste will be dropped into designed receiving platform and MSW will be sprayed with a herbal insecticide through fogging nozzles. This confinement of MSW, thus exposing its minimum surface area will produce much less smell.

iv) Emissions from Power Plant

a) SPM

The power plant boiler will be provided with electrostatic precipitator, which will remove most of the dust content and the clean flue gas will be discharged through chimney of minimum height 68Meter. The SPM emission from boiler will be controlled to less than 50 mg/Nm^3. Number of fields in ESP will have one spare field, so that even in case of one field down condition SPM levels are maintained at 50 mg/Nm^3.

b) Oxides of Sulphur (SO_2)

According to the CPCB norms the Chimney height of the boiler is calculated using the formula $Height = 14 \times Q^{1/3}$, where Q= Qty of Sulphur Dioxide in kg/hr. The stack height for the boiler will be 68 m to assimilate any contaminants.

c) Oxides of Nitrogen

The formation of Nitrogen Oxide is controlled by admission of secondary air and maintaining temperature balance in the boiler.

d) Carbon Monoxide

The Boiler will have a Gas recirculation system to recirculate the flue gas thus enabling the reduction in unburnt carbon, reduction in the excess air required. Thus, provision of a gas recirculation system will increase the Boiler efficiency. The correct proportion of primary and secondary air will reduce CO formation.

e) Dioxin and Furans

The dioxin and furans emission is controlled in three stages in the entire project flow:

- Extensive segregation techniques to remove all plastic and other chlorinated compounds such as PVC, rubber, etc. so that it doesn't form part of the RDF. This reduces the dioxins/furans production substantially in the boiler flue gases.
- Controlling the SPM levels to further control any potential emission of dioxins and furans, as a large extent of dioxins and furans are adsorbed onto the surface of SPM.

The SPM level will be maintained at 50 mg/Nm^3 which is much below the national standards will control of dioxins/furans to a great extent.

- Furnace design at with 2 sec retention and temperature of 850 ^oC after secondary air injection will ensure further destruction of any Dioxin formed.

8.2 EMP FOR NOISE ENVIRONMENT

To mitigate the impact of noise from construction equipment during the construction phase the following measures are recommended for implementation:

Noise Shields - Construction equipment producing the maximum noise level should be fitted with noise shields.

Time of Operation **-** Noisy construction equipment should not be permitted during night hours.

Job Rotation and Hearing Protection **–** Working hours of the workers employed in high noise areas will be rotated. Earplugs/muffs, or other hearing protective wear will be provided to those working very close to the noise generating machinery.

During operation phase, there are a number of sources of noise pollution such as truck traffic, blowers, and shredders. Where necessary, enclosures would be provided to ensure that noise levels do not exceed the prescribed standards (85 dBA at 1 m distance from the equipment). For the workers' safety, earplugs would be provided and equipments would be maintained to ensure optimum working conditions.

In the power plant, major noise producing equipment such as turbo generator, compressors will be provided with suitable noise abatement enclosures. 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 heat loss and noise pollution. The above abatement measures will ensure that noise levels are kept below standards from the rotating equipment.

Further, green belt development around the project will further reduce noise pollution, and the following species can be used in a greenbelt to serve as noise breakers:

- *Butea monosperma* (Palash);
- *Leucana leucocephala* (Subabual);and
- *Dalbergia Sissoo* (Shisham).

8.3 EMP FOR WATER ENVIRONMENT

A) CONSTRUCTION PHASE

To prevent degradation and maintain the quality of the water source, adequate control measures have been proposed to check the surface run-off, as well as uncontrolled flow of water in the surrounding areas and nearby water bodies. Following management, measures are suggested to protect the water quality during the construction phase.

- Avoid excavation during monsoon season
- No discharge of wastewater to soil and ground water body
- Check dams will be provided to prevent construction runoff from the site to the surrounding water bodies.
- Pit latrines and community toilets with temporary soak pits and septic tanks will be constructed on the site during construction phase to prevent wastewater from entering the ground water or surrounding water bodies.
- To prevent surface and ground water contamination by oil/grease, leak proof containers will be used for storage and transportation of oil/grease. The floors of oil/grease handling area will be kept effectively impervious.
- All stacking and loading areas should be made impervious and provided with proper garland drains equipped with baffles to prevent run off from the site to contaminate surface or ground water resources.

B) OPERATION PHASE

***Storm Water Management*:**

Adequate storm water will be generated from the project site. Contamination of storm water is possible from the following sources:

- Leachate generated from the waste.
- Diesel and oil spills in the Diesel Power Generator & fuel storage area.
- Waste spills in the solid/ hazardous waste storage area.
- Oil spills and leaks in vehicle parking lots and washing area.

A detailed "Storm Water Management Plan" will be developed after considering the above sources. The plan incorporates best management practices which includes the following:

- Regular inspection and cleaning of storm drains.
- Cover waste storage areas.
- Avoid application of pesticides and herbicides before wet season.

- Secondary containment and dykes in fuel/oil storage facilities.
- Conducting routine inspections to ensure cleanliness.
- Preparation of spill response plans, particularly for fuel and oil storage areas.
- Good housekeeping in the above areas.

Effluent Treatment

Effluent treatment plant: Ground water will be used after treatment to make the water fit for process use. Processes followed for treatment will be as follows:

a) Chlorine dosing: For Disinfection

b) Coagulant dosing: for reduction in suspended solids content.

c) Lime dosing: for pH control

d) Polymer dosing: for sedimentation and clarification process.

Effluent from Power Plant

- For the power plant, liquid effluent generated from the RO rejects, MB unit regeneration waste and boiler blow down will be send to ETP for pH correction,
- Filter backwash water and cooling tower blow down will be treated in effluent treatment plant for discharge in public sewerage

8.4 SOLID WASTE MANAGEMENT

The three main streams of waste generation in the project are:

- Sludge from Effluent Treatment Plant
- Inerts and rejects from the waste segregation system/ RDF plant
- Fly and bottom ash from the power plant and HAG

Rejects from Waste Segregation System/ RDF plant:

It is estimated that of the total MSW received at the facility, around 99 TPD of rejects and inerts will be generated. The strategy for utilization of rejects is provided in **Figure 7.2**.

Inerts from Power Plant:

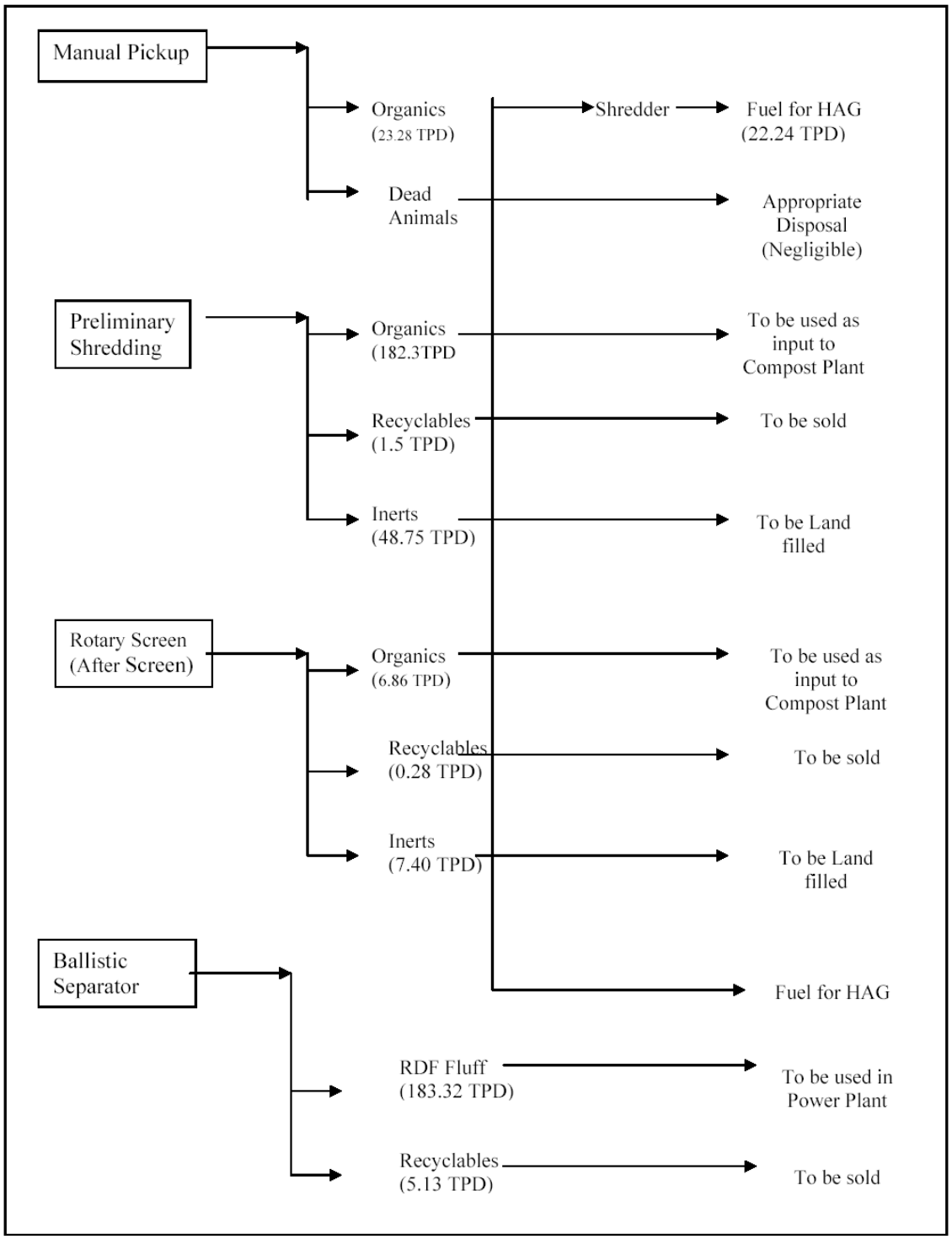
Other inerts that are generated are mainly ash after burning of RDF in boiler and hot air generator. Their envisaged quantities are:

Total ash generated	:	1.604	TPH
Bottom ash	:	1.04	TPH
Fly ash	:	0.62	TPH

Fly Ash: Quantity of fly ash generated is too small to support an independent commercial viable plant. However, fly ash is proposed to supply to the nearby market/ brick plant.

Bottom Ash: The bottom ash from Power plant and HAG may not be difficult to dispose. Its low bulk density makes it a preferred material in low cost housing. (It is being used in bathrooms & toilets as soleing material). Alternately, the ash generated and the amount unutilized will be sent for landfilling.

Figure 8.2: Proposed Treatment of Segregates and Strategies for their Utilization



8.5 EMP FOR ECOLOGICAL ENVIRONMENT

8.5.1 PERIPHERAL GREENBELT AND LANDSCAPING

Selection of the plant species will be based on their adaptability to the existing geographical conditions and the vegetation composition of the forest type of the region. During the development of the green belt within the project area, it has to be emphasized that those native plant species should be planted which are having good ornamental values and are fast growing with excellent canopy cover.

8.5.2 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 there by facilitating settling of the particles on the leaf surfaces and allowing absorption of the pollutant gases. It also serves to cool the atmosphere by transpiration from the leaf surface and also provide habitat for birds, reptiles and insects. The advantages of a green belt are given below:

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 places to wild life.

- 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.

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 plants 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 tolerance 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.
7. There should be no large gaps for the air to spill through.

8. Trees with high foliage density, leaves with larger leaf area and hairy on both the surfaces.
9 Ability to withstand conditions like inundation and drought.
10. Soil improving plants (Nitrogen fixing, rapidly decomposable leaf litter).
11. Attractive appearance with good flowering and fruit bearing.
12. Bird and insect attracting tree species.
13. Sustainable green cover with minimal maintenance

SUGGESTED TREES FOR PERIPHERAL GREEN BELT DEVELOPMENT

SN	Scientific Name	Standard Name	Time when flowering-fruiting occurs
1.	*Ailanthus excelsa*	Maharuk	January-March
2.	*Albizia lebbeck*	Sirish	January-March
3.	*Albizia procera*	Safed Sirish	January-March
4.	*Azadirachta indica*	Neem	June-July
5.	*Bauhinia variegata*	Kanchan	May-June
6.	*Butea monosperma*	Palash	February-April
7.	*Cassia fistula*	Amaltas	March-June
8.	*Emblica officinalis*	Amla	January
9.	*Erythrina indica*	Dadap	July-August
10.	*Grevillea robusta*	Silver oak	February-April
11.	*Leucaena leucocephala*	Subabul	February-May
12.	*Mangifera indica*	Aam	April-July
13.	*Nyctanthes arbortristis*	Harsingar	Throughout the year
14.	*Pongamia pinnata*	Karanj	February-May
15.	*Syzygium cumini*	Jamun	June-July
16.	*Terminalia arjuna*	Arjun	April-July

8.6 MANAGEMENT PLAN FOR SOCIO-ECONOMIC ENVIRONMENT

The social management plan has been designed to take proactive steps and adopt best practices, which are sensitive to the socio-cultural setting of the region.

8.6.1 SOCIAL INVESTMENT STRATEGY

The project envisages addressing the wider goal of environmental protection through a social investment strategy for the communities around the proposed project. By investing in social projects in the neighboring community, seeks to increase the benefits to the local population and contribute towards meeting community's expectation of benefits from the project.

These are taking into perspective concerns of the local community and requirement of the overall population of Guwahati.

a) Proper collection & transportation of waste to processing & disposal site
b) Door to Door collection has been envisaged as one of the components of the project
c) Waste will be transported in covered/closed vehicles
d) Water treatment
e) Demand for employment opportunities
f) Training Rag pickers and low level workers at plant

8.6.2 EMPLOYMENT OPPOTUNITIES

Project will provide job opportunities to those people from adjoining areas during construction and operation phase that fulfills the desired requirements on preferential basis.

8.6.3 TRAINING TO RAG PICKERS AND WORKERS

To implement effective waste management in Guwahati city it is imperative to make people aware of the benefits of the segregated waste and importance of source segregation and collection (door to door collection) of waste. So policy has been prepared to implement effective waste segregation at source and it is planned to carry out awareness campaigns on segregation of waste at source from time to time for the residents of Guwahati and training will also be provided to rag pickers operating in the nearby areas for safe handling of waste.

Workers involved in non-mechanical work at plant will be trained and provided with protective gears.

Informal recyclers and dismantlers will also be taken into loop and they will be educated to adopt scientific methods and safe technology to recycle.

8.6.4 SANITATION AND HEALTHCARE AT WORKERS CAMPS

The following measures will be taken to ensure health aspects of workers.

- The contractor shall install adequate lavatories and baths at the construction camp.
- The contractor shall treat the waste in package type treatment system at the worker colony and construction yard.
- All organic waste generated at construction yard and worker camp should be compost composted in trench
- Community canteen to be made and contractor to provide gas cylinders and diesel for chullas
- Quarterly health check-ups of construction workers should be organized at workers colony.
- Adequate provision of water supply should be made at workers colony.
- The living space at workers camp should meet the norms of Indian Labour Law.

During Operational Phase following measures will be taken

- Protective personal gear such as hand gloves, gumboots and aprons to be provided to the personnel handling waste
- Periodic health check up to be conducted to ensure health and safety of the workers

8.7 ENVIRONMENTAL MANAGEMENT SYSTEM AND MONITORING PLAN

For the effective and consistent functioning of the project, an Environmental Management System (EMS) should be established at the site. The EMS should include the following:

- An Environmental management cell
- Environmental Monitoring
- Personnel Training
- Regular Environmental Audits and Corrective Action

- Documentation – Standard operating procedures Environmental Management Plans and other records

8.7.1 ENVIRONMENTAL MANAGEMENT CELL

Apart from having an Environmental Management Plan, it is also necessary to have a permanent organizational set up charged with the task of ensuring its effective implementation of mitigation measures and to conduct environmental monitoring. The major duties and responsibilities of Environmental Management Cell shall be as given below:

- To implement the environmental management plan,
- To assure regulatory compliance with all relevant rules and regulations,
- To ensure regular operation and maintenance of pollution control devices,
- To minimize environmental impacts of operations as by strict adherence to the EMP,
- To initiate environmental monitoring as per approved schedule.
- Review and interpretation of monitored results and corrective measures in case monitored results are above the specified limit.
- Maintain documentation of good environmental practices and applicable environmental laws as ready reference.
- Maintain environmental related records.
- Coordination with regulatory agencies, external consultants, monitoring laboratories.
- Maintain of log of public complaints and the action taken

8.7.2 ENVIRONMENTAL MONITORING

The purpose of environmental monitoring is to evaluate the effectiveness of implementation of Environmental Management Plan (EMP) by periodically monitoring the important environmental parameters within the impact area, so that any adverse affects are detected and timely action can be taken.

In consultation with the Assam Pollution Control Board (APCB), the GWMPCL will monitor ambient air quality, noise levels, groundwater quality, and solid wastes in accordance with an approved monitoring schedule. The monitoring protocol and location selection will have to done carefully. The monitoring sampling program should be discussed and approved by APCB. A suggested monitoring protocol, based on the predicted impacts, is given in **Table 8.2**.

TABLE 8.2: SUGGESTED MONITORING PROGRAM

Sr. No.	Type	Locations	Parameters	Period and Frequency
1.	Ambient Air Quality	Project Site	Criteria Pollutants: SO_2, NOx, SPM, CO, HCl ,	24-hr average samples every quarter during operation
2.	Stack emission monitoring	Stack of Boiler and HAG	SO_2, NOx, SPM, CO, HCl	24 hr average every quarter.
3.	Ambient Noise	NH- 37 near the site Project site main gate	dB(A) levels	Hourly Day and Night time Leq levels every quarter during operation phase.
4.	Surface Water Quality	3 stations in project Site	▪ Physical and chemical Parameters. ▪ Bacteriological parameters. Heavy metals and toxic constituents.	Once a month. Once in a year Once in 3 months
5.	Ground Water Quality and depth of Water Table	3 stations The ground water monitoring wells needs to be drilled	▪ Physical and chemical Parameters Total Organic matter concentration ▪ Bacteriological parameters. ▪ Heavy metals and toxic constituents.	Once a month. Once in a year Once in 3 months

Sr. No.	Type	Locations	Parameters	Period and Frequency
6.	Terrestrial Ecology		The health and the density of the vegetation, forest cover through satellite imagery	Once a year
7.	Aquatic Ecology	Deepar Beel	Densities and diversities of fish, plankton, zooplankton, and macro-invertibrates in Deepar Beel	Once a year
8.	Waste Characterization	Rejects	Physical and Chemical composition	Annual

8.7.3 RECORD KEEPING AND REPORTING

Record keeping and reporting of performance is an important management tool for ensuring sustainable operation of the proposed facility. Records should be maintained for regulatory, monitoring and operational issues. Typical record keeping requirements for the proposed facility is summarized in **Table 8.3**.

TABLE 8.3: RECORD KEEPING REQUIREMENTS

Parameter	Particulars
Solid Waste Transportation	• Daily quantity of waste transported • No. of trips made to site per vehicle
Solid Waste Handling and Disposal	• Daily quantity of waste received • Daily quantity treated and recycled • Daily quantity sent for landfill
Waste Water	• Daily quantity of treated sewage received • Daily quantities of treated effluent disposed • Quantity and point of usage of treated

Parameter	Particulars
	wastewater • Treated wastewater quality
Regulatory Licenses (Environmental)	• Environmental Permits / Consents from APCB
Monitoring and Survey	• Records of all monitoring carried out as per the finalized monitoring protocol.
Accident reporting	• Date and time of the accident • Sequence of events leading to accident • Chemical datasheet assessing effect of accident on health and environment • Emergency measure taken • Step to prevent recurrence of such events
Other	• Log book of compliance • Employee environmental, health and safety records • Equipment inspection and calibration records, where applicable • Vehicle maintenance and inspection records

8.7.4 ENVIRONMENTAL AUDITS AND CORRECTIVE ACTION PLANS

To assess whether the implemented EMP is adequate, periodic environmental audits will be conducted by GWMCPL. These audits will be followed by Corrective Action Plans (CAP) to correct various issues identified during the audits.

CHAPTER 9

RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

9.0 INTRODUCTION

As part of the Integrated Municipal Waste Processing project, it is important to identify associated safety hazards and carry out a basic risk assessment. The main safety hazards arise due to boiler hazard. RDF will be the dedicated fuel for Boiler from the hazard standpoint. Other "mechanical" and 'electrical" hazards pertaining to heavy lift equipment, electrical fires, electrical shocks, trips and falls and other standard occupational hazards in compost plant and during landfill operations also play role in the overall hazard profile of the project. Basic emergency response actions for the identified scenarios are described later.

Release consequence analysis pinpoints the nature and seriousness of the release. It must be understood that these studies only perhaps project part of the picture- other critical aspects include safety culture, training and awareness, relationships and training of contractor staff and many others.

In spite of the safety measures, possibility of accidents either due to human errors and/ or due to equipment/ system failure cannot be ruled out. The imperative need of a disaster management and response plan is to minimize the adverse impacts due to an unfortunate incident. Disaster Management aspects are described later.

BOILER HAZARDS: RDF will be used as a heating fuel in boilers.

9.1 CONSEQUENCE ANALYSIS

The boiler explosion damage details along with the distance are given in Table – 9.1

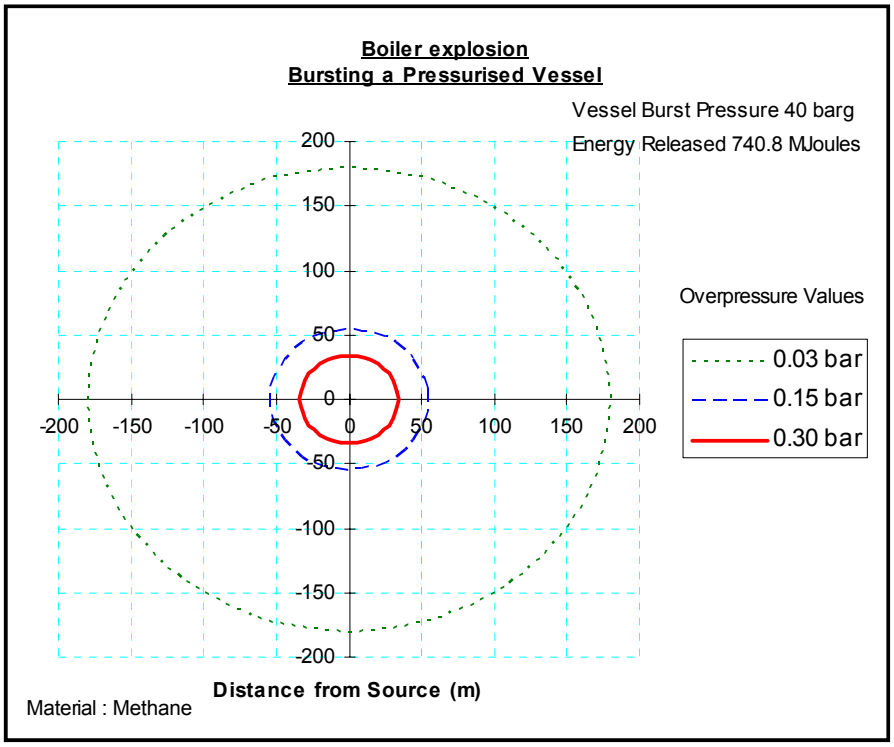
SUMMARY OF CONSEQUENCE ANALYSIS RESULTS

Table 9.1: boiler explosion damage details

SCENARIO	
Boiler explosion- See **Figure 8.1**	0.3 bar overpr. (heavy damage)-----33 m 0.15 bar overpr. (Moderate damage)- 55m 0.03 bar overpr. (Light damage)----180 m

Major results are displayed graphically in Figure 9.1

FIGURE 9.1: BOILER EXPLOSION



As can be seen from the results, the area of concern is primarily is a radius of about only 8.5 meters is likely to be vulnerable in the event of the jet fire scenario. Materials and equipment falling within this distance could be vulnerable to secondary fires.

For the Flash fire scenario, the affected distance is nil as the flash fire scenario is not likely to sustain and the gas concentration will not be within flammable limits.

In the case of a boiler explosion, a radius of 33 m is highly vulnerable-this could include equipment within the radius and persons working in the boiler area. Up to 180 meters radius could be affected in terms of light damage. Structural inspections are necessary subsequent to such an explosion.

Largely, the affected distances are all within the complex and may be managed by the Onsite emergency plan of the complex.

9.1.2 ESTIMATED PROBABILITIES

The releases from pipelines can be from a number of sources and can vary in leak size. The categories that are usually considered are small leaks and large or catastrophic leaks. Generic failure rate base data is available from many sources- some typical values suggested are described below:

PROCESS PIPING, 4'' TO 11'' (INCLUSIVE)

Type	Size, %	Frequency/ year
Base Frequency		3.60E-05
Minor Leak	5	1.44E-05
Significant Leak	22	5.40E-06
Major Leak	45	1.80E-06
Catastrophic Failure	100	3.60E-07

VALVES

Type	Size, %	Frequency/ year
Base Frequency		2.30E-04
Minor Leak	5	8.05E-05
Significant Leak	10	2.76E-05
Major Leak	20	1.38E-05
Catastrophic Failure	100	2.30E-06

9.2 SAFEGUARDS TAKEN IN DESIGN STAGE

Some of the important safeguards provided for the project include those mentioned below.

The main feature of the facility is the safe design of the equipment and pipelines. Equipment is designed, inspected stage wise, tested and certified by an independent third party in accordance with relevant codes and standards. Intrinsic safety is largely built in into the design itself through use of time tested standards and codes, which inherently incorporate a good margin of safety. Apart from the equipment design and selection (only well known, reputed vendors with proven safe and trouble free track record in similar service will be selected), there are other features related to safety in the layout, operation, and shutdown systems etc. that are provided.

Fire fighting system:

Fire protection system will be provided as per LPA (Loss Prevention Association) norms. For every 100-m^2 area of plant, one DCP type and one CO_2 type fire

extinguisher will be provided. "No Smoking" and hazard / danger warning stickers will be put up at appropriate places. All personnel deployed for the construction, erection and operation of biogas plant will be given proper training for fire drill. Emergency numbers will also be put up at appropriate places. Empty fuel drums / tanks and other inflammable material will be put in an earmarked place and removed from the premises as soon as possible. Storage yard for chemicals and fuel lubricants will also be provided with fire extinguishers and sand bucket racks.

9.3 DISASTER MANAGEMENT PLAN

Emergency prevention through good design, operation, maintenance and inspection are essential to reduce the probability of occurrence and consequential effect of such eventualities. However, it is not possible to totally eliminate such eventualities and random failures of equipment or human errors, omissions and unsafe acts cannot be ruled out. An essential part of major hazard control has therefore, to be concerned with mitigating the effects of such Emergency and restoration of normalcy at the earliest.

The overall objective of a disaster management plan is to make use of the combined resources at the site and outside services to achieve the following:

1. To localize the emergency and if possible eliminate it;
2. to minimize the effects of the accident on people and property;
3. effect the rescue and medical treatment of casualties;
4. safeguard other people;
5. evacuate people to safe areas;
6. informing and collaborating with statutory authorities;
7. provide authoritative information to news media;
8. initially contain and ultimately bring the incident under control;
9. preserve relevant records and equipment for the subsequent enquiry into the cause and circumstances of the emergency;
10. investigating and taking steps to prevent reoccurrence

The DMP has therefore to be related to the identification of sources from which hazards can arise and the maximum credible loss scenario that can take place in the concerned area. The plan takes into account the maximum credible loss scenario - actions that can successfully mitigate the effects of losses/ Emergency need to be well planned so as they would require less effort and resources to control and terminate emergencies, should the same occur.

9.3.1 ACTUATION OF THE PLAN

Any emergency starts as a small incident that may become a major accident if not controlled in time. At the initial stages, the fire organization chart (would be prepared

separately for each facility) shall need to be put into action. If the incident goes beyond control, the Main Incident Controller will need to actuate the on-site plan at the appropriate stage as considered necessary. During idle shift/ holidays, the security personnel will combat the incident as per the fire organization chart below and at the same time inform various emergency controllers for guidance and control the situation.

An organogram needs to be drawn once the site is operational by appointing key personnel and defining their specific duties that will be handy in emergency.

9.3.2 EMERGENCY EQUIPMENT

The site controller will maintain a list of emergency handling equipment including details of fire extinguishers, protective clothing, and personal protective equipment for emergency handlers etc. Details of fire management services of Guwahati city and neighboring hospitals will be available with site controller in his operating checklist.

9.3.3 EMERGENCY RESPONSE

A) DANGEROUS SITUATIONS

These are defined as the following:

- Any fire or explosion in the facility
- Any fire in the service buildings
- Fire or explosion in the boiler area
- Fire in the RDF storage area
- Exercise fire drill.

B) ACTIONS IN THE EVENT OF FIRE:

- Basic actions as detailed above.
- Extinguishing fires: A small fire at a point of leakage should be extinguished by enveloping with a water spray or a suitable smothering agent such as CO_2 or DCP. Fire fighting personnel working in or close to un-ignited vapor clouds or close to fire, must be protected continuously by water sprays. Fire fighters should advance towards the fire downwind if possible- BE CAREFUL TO AVOID H_2S EXPOSURE.
- In case the only valve that can be used to stop the leakage is surrounded by fire, it may be possible to close it manually. The person attempting the closure should be continuously protected by water sprays, fire entry suit, water jet blanket and SCBAs etc. The person must be equipped with a safety belt and a manned lifeline. In case of

rapid increase in decibel level, evacuate the area, as there would have been over pressurization.

C) RESPONSE SEQUENCE FOR DANGEROUS SITUATIONS

1. Person noticing the fire should attempt to isolate and extinguish the fire with the available equipment and Inform or arrange to inform the leader/ senior representative regarding the
   - Location of the fire
   - What is burning
   - The extent of fire
   - Callers name and number
   - Do not disconnect unless the person on the other side repeats the message or acknowledges it.

2. Security on duty coordinators will

(i) Respond to the scene of the incident

(ii) Arrange to send the necessary fire fighting equipment to the scene of the incident

(iii) Extinguish the fire with the available equipment.

3. Security Officer will:

(i) Sound the Siren as per the Siren Code

(ii) Inform the Site Main / Incident Controller and act as per his instructions

(iii) To ensure closure of gates immediately to regulate traffic in such a way that free movement of outside assistance like fire tenders, ambulance etc is available.

4. Security should cordon off the area and local city fire fighting staff should be notified. The facility will have the fire fighting water system but may not be equipped with staff to operate it. Local fire fighters may need to be notified.

5. All Other Management / Asst./ Labour Staff on hearing the siren, should STOP their operations/ work, switch off lights, fans, engines, air conditioners etc., close all doors, pipeline valves and line up in front of their working places and meet at a pre-arranged location. These people will assist in evacuating the residents if necessary.

D) POST EMERGENCY FOLLOW UP

- All cases of fire occurrence, no matter how small, must be reported promptly to the Coordinator for follow up.
- Under no circumstances should fire extinguishing equipment once used be returned to its fixed location before it is recharged/ certified fit by the Fire chief/ Safety Manager.
- Used fire extinguishers must be laid horizontally to indicate that they have been expended.

E) EARLY WARNING / ALARM SYSTEM

An audible electric alarm (siren) should be located in the main gate. The different sounds that should be generated by the alarm are:

SMALL FIRE :	No Siren
MAJOR FIRE:	A wailing Siren for two minutes. Sirens will be sounded three times for thirty seconds with an interval of 15 seconds in between
EMERGENCY:	Same type of Siren as in case of major fire but the same will be sounded for three times at the interval of two minutes.
ALL CLEAR (For Fire):	Straight Run Siren for two minutes.
TEST :	Straight run Siren for two minutes.

8.3.4 EMERGENCY CONTROL CENTRE (ECC)

The Control Room will be nominated as the ECC. At the time of the emergency On-site Controller assisted by other designated coordinators shall take position to perform their duties. The security office at the gate shall be the standby. The Emergency Control Center will be the focal point in case of an emergency from where the overall operations to handle the emergency are directed and coordinated. It will be located outside the area of potential hazards and easily approachable.

The Emergency Control Center should have the following resources available:

- Copies of the DMP
- Layout Plan of the complex.
- Information regarding Safety Equipment, Fire Fighting material
- A list of telephones of key and essential staff of the company along with their residential numbers.

- Copies of the local Telephone Directories.
- A list of important telephone numbers like those of neighboring industries, Fire Brigade, Hospitals etc.
- Personal Protective Equipment.
- First – Aid Kit.
- Communication equipment – Internal and External telephones and other communication equipment.
- Requisite stationary items.
- Personnel to act as messengers.

The communication equipment is checked periodically to ensure that they are functional. The ECC is capable of being activated within a few minutes upon declaration of an emergency.

8.3.5 MEDICAL RESOURCES

The medical management for the possible emergency situations essentially consists of treatment for burns and maybe some asphyxiation cases. They could cause burns injuries.

Material Safety Data Sheets and other relevant information would also be available at the facility to enable ready treatment of any casualty, should the unfortunate need arise. It is also proposed to circulate any important Health and Toxicology material available through the latest research to all Doctors.

8.3.6 RESPONSE EVALUATION, TESTING AND UPDATING OF THE PLAN

Formulation of a Disaster Management Plan cannot possibly be an end by itself. It needs to be tested by holding of periodical mock emergency simulation and drill. Any shortcomings revealed during such exercise should thereafter be corrected by amending the plan. The plan should be for times to come; hence, it must be reviewed at periodic intervals. The plan should be also reviewed and updated when:

- Major alteration or extension of plant is carried out.
- Major change in habitation or land use of the neighborhood takes place.
- Important telephone numbers used are altered, facilities are changed.

Mock drills activating the Disaster Preparedness Plan will be conducted periodically for ensuring its efficiency during emergency as well as for refinement and updation. These drills based on the plan will help achieve its objectives.

APPENDIX

APPENDIX I

WASTE WATER DISCHARGE STANDARDS

Table1: Quality of treated effluent

S.No	Parameters	Unit	Quality
1	pH	-	6.8-8.5
2	Total Suspended Solids	mg/l	<100
3	Oil & Grease	mg/l	<20
4	Free available chlorine	mg/l	<0.5
5	Copper	mg/l	<1.0
6	Iron	mg/l	<1.0
7	Zinc	mg/l	<1.0
8	Chromium	mg/l	<0.2
9	Phosphate	mg/l	<5.0

APPENDIX II

NATIONAL AMBIENT AIR QUALITY STANDARDS

Table II: National Ambient Air Quality Standards

Pollutants	Time-weighted average	Concentration in ambient air		
		Industrial Areas	Residential, Rural & Other Areas	Sensitive Areas
Sulphur Dioxide (SO_2)	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3
	24 hours**	120 µg/m^3	80 µg/m^3	30 µg/m^3
Oxides of Nitrogen as NO_2	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3
	24 hours**	120 µg/m^3	80 µg/m^3	30 µg/m^3
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m^3	140 µg/m^3	70 µg/m^3
	24 hours**	500 µg/m^3	200 µg/m^3	100 µg/m^3
Respirable Particulate Matter (RPM) (size less than 10 microns)	Annual Average*	120 µg/m^3	60 µg/m^3	50 µg/m^3
	24 hours**	150 µg/m^3	100 µg/m^3	75 µg/m^3
Lead (Pb)	Annual Average*	1.0 µg/m^3	0.75 µg/m^3	0.50 µg/m^3
	24 hours**	1.5 µg/m^3	1.00 µg/m^3	0.75 µg/m^3
Ammonia	Annual Average*	0.1 mg/m^3	0.1 mg/m^3	0.1 mg/m^3
	24 hours**	0.4 mg/m^3	0.4 mg/m^3	0.4 mg/m^3
Carbon Monoxide (CO)	8 hours*	5.0 mg/m^3	2.0 mg/m^3	1.0 mg/m^3
	1 hour**	10.0 mg/m^3	4.0 mg/m^3	2.0 mg/m^3

**Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval*

***24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days*

APPENDIX III

AIR QUALITY MODELING RESULTS
&
WIND DATA

Air Quality Modelling resuls of PA1.2.0 for the proposed project site at Paschim Bongaon, Ganchuk Annexure 3.1

Fugitive Dust (During construction Phase without mitigation) Concentrations at receptors, ug/cum.

S.No.	Period	Day	Wind Direction deg.	Wind Speed m/s	1	2	3	4	5	6	7	8	9
1	February	1	90	0.1285	0	0	0	5027	15.96	0	0	3190000	0
2		2	180	0.6424	0	22.35	801.8	1716000	0	0	0	575.4	995.2
3		3	187.5	1.0278	0	314.8	1024	1119000	0	0	0	6.802	961.2
4		4	67.5	0.4497	0	0	0	1870	812.6	0	0	2187	0
5		5	135	0.1285	0	0	0	6219000	0	0	0	15310	68.68
6		6	135	0.1927	0	0	0	4671000	0	0	0	11420	51.54
7		7	90	0.7708	0	0	0	1093	3.652	0	0	7397	0
8		8	45	0.2569	0	0	0	3078	2063	0	0	1078000	0
9		9	78.75	0.4497	0	0	0	1828	421.5	0	0	2138	0
10		10	120	0.7066	0	0	0	245000	0	0	0	815100	0
11		11	45	0.5139	0	0	0	1667	1119	0	0	513900	0
12		12	135	0.1927	0	0	0	4671000	11420	0	0	51.54	0
13		13	67.5	0.4497	0	0	0	1870	812.6	0	0	2187	0
14		14	45	0.1285	0	0	0	5221	3489	0	0	1760000	0

S.No.	Period	Day	Wind Direction deg.	Wind Speed m/s	1	2	3	4	5	6	7	8	9
15		15	41.79	2.0556	0	0	0	432.2	309.2	0	0	255000	0
16		16	45	0.4497	0	0	0	1887	1266	0	0	670600	0
17		17	90	0.1927	0	0	0	3729	12.11	0	0	2433000	0
18		18	56.25	0.5139	0	0	0	1724	941.4	0	0	4402	0
19		19	90	0.2569	0	0	0	2954	9.686	0	0	1952000	0
20		20	45	0.2569	0	0	0	3078	2063	0	0	1078000	0
21		21	56.25	0.5139	0	0	0	1724	941.4	0	0	4402	0
22		22	180	0.3212	0	39.46	1491	3214000	0	0	0	1082	1818
23		23	67.5	0.5781	0	0	0	1482	644.5	0	0	1736	0
24		24	78.75	0.6424	0	0	0	1313	303.7	0	0	1540	0
Average					0	15.69	138.2	912300	634.4	0	0	0609300	164.4
Pre-Monsoon													0
1.			45	1.5200	0	0	0	223.6	121.8	0	0	53080	0
2.			90.00	1.5300	0	0	0	244.7	10.92	0	0	159800	0
3.			135.00	1.5000	0	0	0	177300	0	0	0	19260	7.132
4.			180.00	1.5000	0	72.38	123.4	232200	0	0	0	103.1	988.8

Average		83.06	0.9248	0	18.09	30.86	102500	33.17	0	0	058050	249
Monsoon												
1.		45	1.5200	0	0	0	223.6	121.8	0	0	53080	0
2.		90.00	1.5300	0	0	0	244.7	10.92	0	0	159800	0
3.		135.00	1.5000	0	0	0	177300	0	0	0	19260	7.132
4.		180.00	1.5000	0	72.38	123.4	232200	0	0	0	103.1	988.8
Average		111.16	0.6353	0	18.09	30.86	102500	33.17	0	0	58050	249
Post Monsoon												
1		45.00	0.8600	0	0	0	1028	690.2	0	0	368700	0
2		67.50	0.8600	0	0	0	1020	450.3	0	0	198	0
3		90.00	0.8600	0	0	0	984.9	3.294	0	0	667400	0
Average		82.03	0.5227	0	0	0	1011	381.3	0	0	0345800	0
Winter								0			0	0
1		45.00	0.8600	0	0	0	1367	983.7	0	0	532200	0
2		67.50	0.8600	0	0	0	1355	655.9	0	0	1624	0
3		90.00	0.8600	0	0	0	1302	0.3291	0	0	635400	0
Average		81.97	0.3258	0	0	0	1341	546.6	0	0	389800	0

Air Quality Modelling resuls of PA1.2.0 for the proposed project site at Paschim Bongaon, Ganchuk **Annexure 3.2**

Carbon Monoxide (During operation phase) **Concentrations at receptors, ug/cu.m.**

S.No.	Period	Day	Wind Direction deg.	Wind Speed m/s	1	2	3	4	5	6	7	8	9
1	Februar y	1	90	0.1285	0	0	0	0	0	0	0	0	3.395
2		2	180	0.6424	0	0.000431	0	0	0	0	0	0	0.5287
3		3	187.5	1.0278	0	0.203	0	0	0	0	0	0	0.3384
4		4	67.5	0.4497	0	0	0	2.026E-08	0	0	0	0.006104	1.006
5		5	135	0.1285	0	0	0	0	0	0	0	0	3.201
6		6	135	0.1927	0	0	0	0	0	0	0	0	2.123
7		7	90	0.7708	0	0	0	0	0	0	0	0	0.5803
8		8	45	0.2569	0	0	0	4.357	0	0	0	0.3097	1.846
9		9	78.75	0.4497	0	0	0	0	0	0	0	1.91E-12	0.9967
10		10	120	0.7066	0	0	0	0	0	0	0	0	0.6619
11		11	45	0.5139	0	0	0	2.179	0	0	0	0.1549	0.9231
12		12	135	0.1927	0	0	0	0	0	0	0	0	2.123
13		13	67.5	0.4497	0	0	0	2.026E-	0	0	0	0.006104	1.006

								08					
14		14	45	0.1285	0	0	0	8.749	0	0	0	0.6216	3.707
15		15	41.79	2.0556	0	0	0	0.524	5.77E-22	0	0	0.01356	0.2318
16		16	45	0.4497	0	0	0	2.494	0	0	0	0.1773	1.057
17		17	90	0.1927	0	0	0	0	0	0	0	0	2.318
18		18	56.25	0.5139	0	0	0	0.2226	0	0	0	5.081	0.8963
19		19	90	0.2569	0	0	0	0	0	0	0	0	1.741
20		20	45	0.2569	0	0	0	4.357	0	0	0	0.3097	1.846
21		21	56.25	0.5139	0	0	0	0.2226	0	0	0	5.081	0.8963
22		22	180	0.3212	0	0.00086	0	1.574E-08	0	0	0	0	1.054
23		23	67.5	0.5781	0	0	0	0	0	0	0	0.004742	0.7813
24		24	78.75	0.6424	0	0	0	0	0	0	0	1.34E-12	0.6971
Average				0	0.008512	0	0.9627	2.4E-23	0	0	0.4902	1.419	
Pre-Monsoon							0				0		
1.			45	1.5200	0	0	7.23E-05	0.1364	0	0	0	0.07055	0.08093
2.			90.00	1.5300	0	0	0	5.864E-	0	0	0	8.44E-05	0.09161

								08					
3.			135.00	1.5000	0	4.92E-19	0	0	0	0	0	0	0.07665
4.			180.00	1.5000	0	0.01648	2.03E-08	0	0	0	0	0	0.06131
Average		83.06	0.9248	0	0.00412	1.81E-05	0.0341	33.17	0	0	0.01766	0.07763	
Monsoon							0				0		
1.			45	1.5200	0	0	7.23E-05	0.1364	7.71E-06	0	0	0.07055	0.08093
2.			90.00	1.5300	0	0	0	5.864E-08	0	0	0	8.44E-05	0.0.09161
3.			135.00	1.5000	0	4.92E-19	0	0	0	0	0	0	0.07665
4.			180.00	1.5000	0	0.01648	2.03E-08	0	0	0	0	0	0.06131
Average		111.16	0.6353	0	0.00412	1.81E-05	0.0341	1.93E-06	0	0	0.01766	0.07763	
Post Monsoon							0				0		
1			45.00	0.8600	0	0	0	1.302	0	0	0	0.09256	0.5517
2			67.50	0.8600	0	0	0	3.095E-08	0	0	0	0.005907	0.4974
3			90.00	0.8600	0	0	0	0	0	0	0	0	0.5202

Average		82.03	0.5227	0	0	0	0.4341	0	0	0	0.03282	0.5231	
Winter							0	0	0		0		
1			45.00	0.8600	0	0	0	1.302	0	0	0	0.09256	0.5517
2			67.50	0.8600	0	0	0	1.058E-08	0	0	0	0.003187	0.5251
3			90.00	0.8600	0	0	0	0	0	0	0	0	0.5202
Average		81.97	0.3258	0	0	0	0.4341	0	0	0	0.03192	0.5324	

Air Quality Modelling resuls of PA1.2.0 for the proposed lsite at Paschim Bongaon, Ganchuk **Annexure 3.3**

Oxide of Nitrogen as NO_2 (during Operation phase) **Concentrations at receptors, u g/cu m**

S.No.	Period	Day	Wind Direction deg.	Wind Speed m/s	1	2	3	4	5	6	7	8	9
1	February	1	90	0.1285	0	0	0	0	0	0	0	0	6.117
2		2	180	0.6424	0	0.000755	0	0	0	0	0	0	0.9252
3		3	187.5	1.0278	0	0.3552	0	0	0	0	0	0	0.5922
4		4	67.5	0.4497	0	0	0	3.546-08	0	0	0	0.01068	1.76
5		5	135	0.1285	0	0	0	0	0	0	0	0	5.602
6		6	135	0.1927	0	0	0	0	0	0	0	0	3.716
7		7	90	0.7708	0	0	0	0	0	0	0	0	1.016
8		8	45	0.2569	0	0	0	7.625	0	0	0	0.5421	3.231
9		9	78.75	0.4497	0	0	0	0	0	0	0	3.35E-12	1.744
10		10	120	0.7066	0	0	0	0	0	0	0	0	1.158
11		11	45	0.5139	0	0	0	3.813	0	0	0	0.271	1.615
12		12	135	0.1927	0	0	0	0	0	0	0	0	3.716
13		13	67.5	0.4497	0	0	0	3.546E-08	0	0	0	0.01068	1.76
14		14	45	0.1285	0	0	0	15.31	0	0	0	1.088	6.487

15		15	41.79	2.0556	0	0	0	0.917	1.01E-21	0	0	0.02373	0.4057
16		16	45	0.4497	0	0	0	4.365	0	0	0	0.3103	1.849
17		17	90	0.1927	0	0	0	0	0	0	0	0	4.057
18		18	56.25	0.5139	0	0	0	0.3896	0	0	0	8.891	1.569
19		19	90	0.2569	0	0	0	0	0	0	0	0	3.047
20		20	45	0.2569	0	0	0	7.625	0	0	0	0.5421	3.231
21		21	56.25	0.5139	0	0	0	0.3896	0	0	0	8.891	1.569
22		22	180	0.3212	0	0.001504	0	0	0	0	0	0	1.845
23		23	67.5	0.5781	0	0	0	2.755E-08	0	0	0	0.008298	1.367
24		24	78.75	0.6424	0	0	0	0	0	0	0	2.34E-12	1.22
Average					0	0.0149	0	1.685	4.21E-23	0	0	0.8579	2.483
Pre-Monsoon								0				0	0
5.			45	1.5200	0	0	0	15.31	0	0	0	1.088	6.487
6.			90.00	1.5300	0	0.000735	0	0	0	0	0	0	0.9252
7.			135.00	1.5000	0	0.3552	0	0	0	0	0	0	0.5922
8.			180.00	1.5000	0	0	0	3.546E-08	0	0	0	0.01068	1.76
Average			83.06	0.9248	0	0.089	0	3.828	0	0	0	0.2748	2.441

Monsoon							0				0	0
5.		45	1.5200	0	0	0.000127	0.2404	1.54E-05	0	0	0.1265	0.1416
6.		90.00	1.5300	0	0	0	1.027E-07	0	0	0	0.000148	0.1603
7.		135.00	1.5000	0	8.6E-19	0	0	0	0	0	0	0.1341
8.		180.00	1.5000	0	0.02884	3.55E-08	0	0	0	0	0	0.1073
Average		111.16	0.6353	0	0.007211	3.17E-05	0.06009	3.85E-06	0	0	0.03167	0.1358
Post Monsoon							0				0	0
1		45.00	0.8600	0	0	0	0.3255	0	0	0	0.02314	0.1379
2		67.50	0.8600	0	0	0	7.738E-09	0	0	0	0.001477	0.1243
3		90.00	0.8600	0	0	0	0.1085	0	0	0	0	0.1301
Average		82.03	0.5227	0	0	0	0	0	0	0	0.008206	0.1308
Winter							0	0	0		0	0
1		45.00	0.8600	0	0	0	2.279	0	0	0	0.0162	0.9655
2		67.50	0.8600	0	0	0	5.417E-08	0	0	0	0.01034	0.8704
3		90.00	0.8600	0	0	0	0	0	0	0	0	0.9104
Average		81.97	0.3258	0	0	0	0.7596	0	0	0	0.05744	0.9155

Air Quality Modelling resuls of PA1.2.0 for the proposed site at Paschim Bongaon, Ganchuk **Annexure 3.4**

PM 10 (during Operation phase) **Concentrations at receptors, u g/cu m.**

S.No.	Period	Day	Wind Direction deg.	Wind Speed m/s	1	2	3	4	5	6	7	8	9
1	February	1	90	0.1285	0	0	0	0	0	0	0	0	6.117
2		2	180	0.6424	0	0.000108	0	0	0	0	0	0	0.9252
3		3	187.5	1.0278	0	0.05075	0	0	0	0	0	0	0.5922
4		4	67.5	0.4497	0	0	0	5.066E-09	0	0	0	0.001526	1.76
5		5	135	0.1285	0	0	0	0	0	0	0	0	5.602
6		6	135	0.1927	0	0	0	0	0	0	0	0	3.716
7		7	90	0.7708	0	0	0	0	0	0	0	0	1.016
8		8	45	0.2569	0	0	0	1.089	0	0	0	0.07744	3.231
9		9	78.75	0.4497	0	0	0	0	0	0	0	4.78E-13	1.744

10		10	120	0.7066	0	0	0	0	0	0	0	0	1.158
11		11	45	0.5139	0	0	0	0.5447	0	0	0	0.03872	1.615
12		12	135	0.1927	0	0	0	0	0	0	0	0	3.716
13		13	67.5	0.4497	0	0	0	5.066E-09	0	0	0	0.01068	1.76
14		14	45	0.1285	0	0	0	2.187	0	0	0	1.088	6.487
15		15	41.79	2.0556	0	0	0	0.131	1.44E-22	0	0	0.02373	0.4057
16		16	45	0.4497	0	0	0	0.6235	0	0	0	0.3103	1.849
17		17	90	0.1927	0	0	0	0	0	0	0	0	4.057
18		18	56.25	0.5139	0	0	0	0.05566	0	0	0	8.891	1.569
19		19	90	0.2569	0	0	0	0	0	0	0	0	3.047
20		20	45	0.2569	0	0	0	1.089	0	0	0	0.5421	3.231
21		21	56.25	0.5139	0	0	0	0.05566	0	0	0	8.891	1.569

22		22	180	0.3212	0	0.000215	0	0	0	0	0	0	1.845
23		23	67.5	0.5781	0	0	0	3.935E-09	0	0	0	0.008298	1.367
24		24	78.75	0.6424	0	0	0	0	0	0	0	2.34E-12	1.22
Average					0	0.002128	0	0.2407	6.01E-24	0	0	0.8579	2.483
Pre-Monsoon						0		0				0	0
9.			45	1.5200	0	0	0	0.3237	1.83E-06	0	0	1.088	6.487
10.			90.00	1.5300	0	0	0	1.466E-08	0	0	0	0	0.9252
11.			135.00	1.5000	0	1.23E-19	0	0	0	0	0	0	0.5922
12.			180.00	1.5000	0	0.00412	0	0	0	0	0	0.01068	1.76
Average			83.06	0.9248	0	0.00103	0	0.08092	4.57E-07	0	0	0.2748	2.441
Monsoon								0				0	0

9.			45	1.5200	0	0	1.72e-05	0.0326	2.09E-06	0	0	0.1265	0.1416
10.			90.00	1.5300	0	0	0	1.467E-08	0	0	0	0.000148	0.1603
11.			135.00	1.5000	0	1.23E-19	0	0	0	0	0	0	0.1341
12.			180.00	1.5000	0	0.00421	5.07E-09	0	0	0	0	0	0.1073
Average			111.16	0.6353	0	0.00103	4.29E-05	0.00815	5.22E-07	0	0	0.03167	0.1358
Post Monsoon								0				0	0
1			45.00	0.8600	0	0	0	0.3255	0	0	0	0.02314	0.1379
2			67.50	0.8600	0	0	0	7.738E-09	0	0	0	0.001477	0.1243
3			90.00	0.8600	0	0	0	0	0	0	0	0	0.1301
Average			82.03	0.5227	0	0	0	0.1085	0	0	0	0.008206	0.1308

Winter								0	0	0		0	0
1			45.00	0.8600	0	0	0	0.3255	0	0	0	0.0162	0.9655
2			67.50	0.8600	0	0	0	2.645E-09	0	0	0	0.01034	0.8704
3			90.00	0.8600	0	0	0	0	0	0	0	0	0.9104
Average			81.97	0.3258	0	0	0	0.1085	0	0	0	0.05744	0.9155

Air Quality Modeling results of PAL2.0 for the proposed site at Paschim Boragaon, Garchuk Annexure 3.5

Fugitive Dust (During Operation Phase, without mitgation}Concentrations at receptors, micro.g/cu.m.

Sr. No.	*Period*	*Day*	*Wind Direction deg.*	*Wind speed m/s*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1	**February**	1	90	0.1285	0	0	0	5027	15.96	0	0	5770	0
2		2	180	0.6424	0	22.35	801.8	1255	0	0	0	575.4	995.2
3		3	187.5	1.0278	0	314.8	1024	806	0	0	0	6.802	659.3
4		4	67.5	0.4497	0	0	0	1870	812.6	0	0	2187	0
5		5	135	0.1285	0	0	0	5504	0	0	0	5138	68.68
6		6	135	0.1927	0	0	0	4107	0	0	0	3818	51.54
7		7	90	0.7708	0	0	0	1093	3.652	0	0	1285	0
8		8	45	0.2569	0	0	0	3078	2063	0	0	3311	0
9		9	78.75	0.4497	0	0	0	1828	421.5	0	0	2138	0
10		10	120	0.7066	0	0	0	1261	0	0	0	1395	0
11		11	45	0.5139	0	0	0	1667	1119	0	0	1800	0
12		12	135	0.1927	0	0	0	4107	0	0	0	3818	51.54
13		13	67.5	0.4497	0	0	0	1870	812.6	0	0	2187	0
14		14	45	0.1285	0	0	0	5221	3489	0	0	5576	0
15		15	41.79	2.0556	0	0	0	432.2	309.2	0	0	467.8	0
16		16	45	0.4497	0	0	0	1887	1266	0	0	2036	0
17		17	90	0.1927	0	0	0	3729	12.11	0	0	4323	0
18		18	56.25	0.5139	0	0	0	1724	941.4	0	0	1959	0
19		19	90	0.2569	0	0	0	2954	9.686	0	0	3441	0
20		20	45	0.2569	0	0	0	3078	2063	0	0	3311	0
21		21	56.25	0.5139	0	0	0	1724	941.4	0	0	1959	0
22		22	180	0.3212	0	1491	1491	2354	0	0	0	1082	1818
23		23	67.5	0.5781	0	0	0	1482	644.5	0	0	1736	0
24		24	78.75	0.6424	0	0	0	1313	303.7	0	0	1540	0
Average					0	15.69	138.2	2474	634.4	0	0	2536	151.8
	Pre Monsoon												
1			45	1.5200	0	0	0	223.6	121.8	0	0	234.8	0

Sr. No.	*Period*	*Day*	*Wind Direction deg.*	*Wind speed m/s*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
2			90	1.5300	0	0	0	217.7	10.92	0	0	236.6	0
3			135	1.5000	0	0	0	224.9	0	0	0	219.4	7.132
4			180	1.5000	0	13.85	122.9	216.5	0	0	0	103.1	97.5
Average			83.06	0.9248	0	3.396	30.73	220.7	33.17	0	0	198.5	26.16
	Monsoon												
1			45	1.5200	0	0	0	223.6	121.8	0	0	234.8	0
2			90	1.5300	0	0	0	217.7	10.92	0	0	236.6	0
3			135	1.5000	0	0	0	224.9	0	0	0	219.4	7.132
4			180	1.5000	0	13.85	122.9	216.5	0	0	0	103.1	97.5
Average			111.16	0.9248	0	3.396	30.73	220.7	33.17	0	0	198.5	26.16
	Post Monsoon												
1			45	0.8600	0	0	0	1028	690.2	0	0	1112	0
2			67.5	0.8600	0	0	0	1019	443.4	0	0	1196	0
3			90	0.8600	0	0	0	984.9	3.294	0	0	1158	0
4			82.03	0.5227	0	0	0	1011	379	0	0	1156	0
Average													
	Winter												
1			45	0.8600	0	0	0	1367	983.7	0	0	1495	0
2			67.5	0.8600	0	0	0	1530	647	0	0	1621	0
3			90	0.8600	0	0	0	1302	0.329	0	0	1564	0
Average			81.97	0.3524	0	0	0	1340	543.7	0	0	1560	0

APPENDIX IV

THE NOISE LEVEL MODEL

Annexure 4

THE NOISE LEVEL MODEL

The highway noise level model is used to estimate the daytime, nighttime and equivalent noise levels for the weekdays and weekend day. This model was developed Federal Highway Administration (FHWA). The model is based upon calculating the hourly Leq for automobiles, medium trucks and heavy trucks separately and then adding these logarithmically to obtain the overall hourly Leq. The model is defined below:

$L_{eq}(h)i = (L_0)E + 10 \log (Ni/ Si.T) + 10 \log (15 / d)^{1+ce} + A_s - 13$

Where,

Ni is the number of class i^{th} vehicle passing during the time T (It can be for 1 hour traffic flow or for different periods); Si, the average speed for the i^{th} vehicle class in km/h; T, the duration for which the L_{eq} is desired and must correspond to the count of vehicles during the time T; d, the perpendicular distance (in meters) from the centerline of the traffic lane to the location of the observer, i.e., the location where the noise level is desired; a, the factor related to the absorption characteristics of the ground cover between the roadway and the observer; A_s, the shielding factor such as provided by a noise barrier; L_{eq} (h)i is the L^ for the i^{lb} vehicle type, i.e., autos, medium trucks or heavy trucks and (LO)E is the reference mean energy level for the *i* vehicle type, which is calculated based on the vehicle speed from the graph below.

THE EQUIVALENT NOISE LEVEL MODEL:

The following model is used for adding the individual levels logarithmically to obtain the overall hourly Leq:

$$L_{eq} = 10 \log \left[\sum_{i=1}^{n} fi 10^{Li/10} \right] dB(A) \qquad (1)$$

Where,

fi is the fraction of time that the sound pressure level is in the I^{th} interval.

Table 4.1: The modeled DAY Time and NIGHT time noise levels along with

EQUIVALENT noise levels for WEEKDAYS

Sr. No.	Description	2-W	I LMV	I HMV	I Equivalent noise levels	I Noise Stds
1	Day time	61.65	63.88	68.08	70.14	75
2	Night time	44.66	53.88	71.5	71.59	70
3	Peak hour	59.32	61.85	66.51	68.36	75

Table 4.2: The modeled DAY time and NIGHT time noise levels along with EQUIVALENT noise levels for WEEKEND DAY

Sr. No.	Description	2-W	LMV	HMV	Equivalent noise levels	Noise Stds
1	Day time	61.22	63.5	67.03	69.35	75
2	Night time	44.12	53.5	70.46	70.55	70
3	Peak hour	58.8	61.07	64.59	66.92	75

It is observed that modeled values of noise levels are slightly less than the measured noise levels. It is due to the fact that the models' application is limited to free highway and does not account for honking. The measured high noise levels are recorded mainly because of the honking near the junction of access road and the NH37, wherein, users from either side villages are observed to be around the junction and also crossing the highway for the local shopping frequently.

APPENDIX V

DRINKING WATER STANDARDS
(IS 10500 : 1991)

Drinking water Standards (IS 10500 : 1991)

S.No.	Parameter	Requirements (Desirable Limits)	Permissible Limits in absence of alternative source
1.	Color, Hazen units, max	5	25
2.	Odour	Unobjection-able	-
3.	Taste	Agreeable	-
4.	Turbidity NTU, max	5	10
5.	pH value	5.5 to 9.0	5.5 to 9.9
6.	Total hardness (as CaCO3) mg/l, max	300	600
7.	Iron (as Fe) mg/l max	0.3	1.0
8.	Chlorides (as Cl) mg/l max	250	1000
9.	Free Chlorine mg/l, min	0.2	-
10.	Dissolved solids mg/l, max	500	2000
11.	Calcium (as Ca) mg/l, max	75	200
12.	Copper (as Cu), mg/l max	0.5	1.5
13.	Manganese (as Mn), mg/l max	0.1	0.3
14.	Sulphate (as SO4), mg/l max	200	400
15.	Nitrate (as NO3), mg/l max	45	100
16.	Fluoride (as F), mg/l max	1.0	1.5
17.	Phenolic compounds (as C_6H_5OH) mg/lt, max	0.001	0.002
18.	Mercury (as Hg), mg/l max	0.001	0.001
19.	Cadmium (as Cd), mg/l max	0.01	0.01

20.	Selenium (as Se), mg/l max	0.01	0.01
21.	Arsenic (as As) mg/l max	0.05	0.05
22.	Cyanide (as CN), mg/l max	0.05	0.05
23.	Lead (as Pb), mg/l max	0.05	0.05
24.	Zinc (as Zn), mg/l max	5.0	15.0
25.	Total chromium (as Cr), mg/lt, max	0.05	0.05
26.	Aluminum (as Al), mg/lt, max	0.03	0.2
27.	Boron, max	1.0	5.0

APPENDIX VI

AMBIENT AIR QUALITY STANDARDS IN RESPECT OF NOISE

Ambient Air Quality Standards in respect of Noise

Area Code	Category of Area/Zone	Limits in dB(A) Leq*	
		Day Time	Night time
(A)	Industrial Area	75	70
(B)	Commercial Area	65	55
(C)	Residential Area	55	45
(D)	Silence Zone	50	40

Note:-

1. Day time shall mean from 6.00 am to 10.00 pm.

2. Night time shall mean from 10.00 pm to 6.00 am.

3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority.

4..Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

*dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relateable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq : It is an energy mean of the noise level over a specified period.