Midland Power Co. Ltd.

Environmental and Social Impact Assessment (ESIA) Study for 51 MW Gas Fired Power Plant





February 2015

Submitted by:

BETS Consulting Services Ltd.

House-10, Road-135, Gulshan-1
Dhaka-1212, Bangladesh

Phone : 9889923-24,
Fax : 880-2-9889967
E-mail : bets@betsbd.com
Web : www.betsbd.com

Environmental and Social Impact Assessment (ESIA) Study for 51 MW Gas Fired Power Plant

Table of Contents

LETTER OF TRANSMITTAL

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXES

ABBREVIATIONS

ADB	Asian Development Bank
ANSI	American National Standard Institute
BBS	Bangladesh Bureau of Statistics
BCA	Bangladesh Country Almanac
BMD	Bangladesh Meteorological Department
BOD	Biochemical Oxygen Demand
BOO	Build, Own and Operate
BPDB	Bangladesh Power Development Board
BRTC	Bureau of Research Testing and Consultation
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
COD	Chemical Oxygen Demand
CO	Carbon Monoxide
DCS	Distributed Control System
DESA	Dhaka Electric Supply Authority
DESCO	Dhaka Electric Supply Company
DGPS	Digital Global Positioning System
DLN	Dry Low NOx
DMDP	Dhaka Metropolitan Development Plant
DO	Dissolved Oxygen
DoE	Department of Environment
EA	Environmental Assessment
ECR	Environment Conservation Rules
EGCB	Electricity Generation Company of Bangladesh
EIA	Environmental Impact Assessment
EM	Emergency Manager
EMP	Environmental Management Plan
EMS	Environmental Management System
EMU	Environmental Management Unit
EPZ	Export Processing Zone
ERC	Emergency Response Cell
ERP	Emergency Response Plan
FGD	Focus Group Discussion
GIS	Geographic Information System
GoB	Government of Bangladesh
GPS	Global Positioning System
GE	Gas Engine
HYV	High Yielding Variety
IEE	Initial Environmental Examination
IPP	Independent Power Producer
kV	Kilo Volt
MPP	Midland Power Plant
MPCL	Midland Power Company Limited
NOx	Oxides of Nitrogen

OSHA	Occupational Safety and Health Administration
PCB	Poly Chlorinated Biphenyles
PGCB	Power Grid Company of Bangladesh
PM	Particulate Matter
QA/QC	Quality Assurance / Quality Control
REB	Rural Electrification Board
RMZ	Regulatory Mixing Zone
SIA	Social Impact Assessment
SOx	Oxides of Sulfur
SPM	Suspended Particulate Matter
ST	Steam Turbine
TPH	Total Petroleum Hydrocarbon
TSS	Total Suspended Solids
USDOT	United States Department of Transportation
USEPA	United Stated Environmental Protection Authority
USFHWA	United States Federal Highway Authority
WB	World Bank

EXECUTIVE SUMMARY

INTRODUCTION

In order to increase the capacity of electricity production, the Ministry of Power, Energy and Mineral Resources, GOB has given permission to the private entrepreneurs to establish new power plants of different generation capacities on a Rental and Build, Own and Operate (BOO) basis in private sector. Considering the Power shortfall in the country and government plans, authority of Midland Power Company Ltd. has constructeda **51 MW Gas Fired Power Plant** on BOO basis at Ashugonj, Brahmanbaria to narrow the ever-increasing gap between demand and supply of electricity through natural gasbased low cost generation.

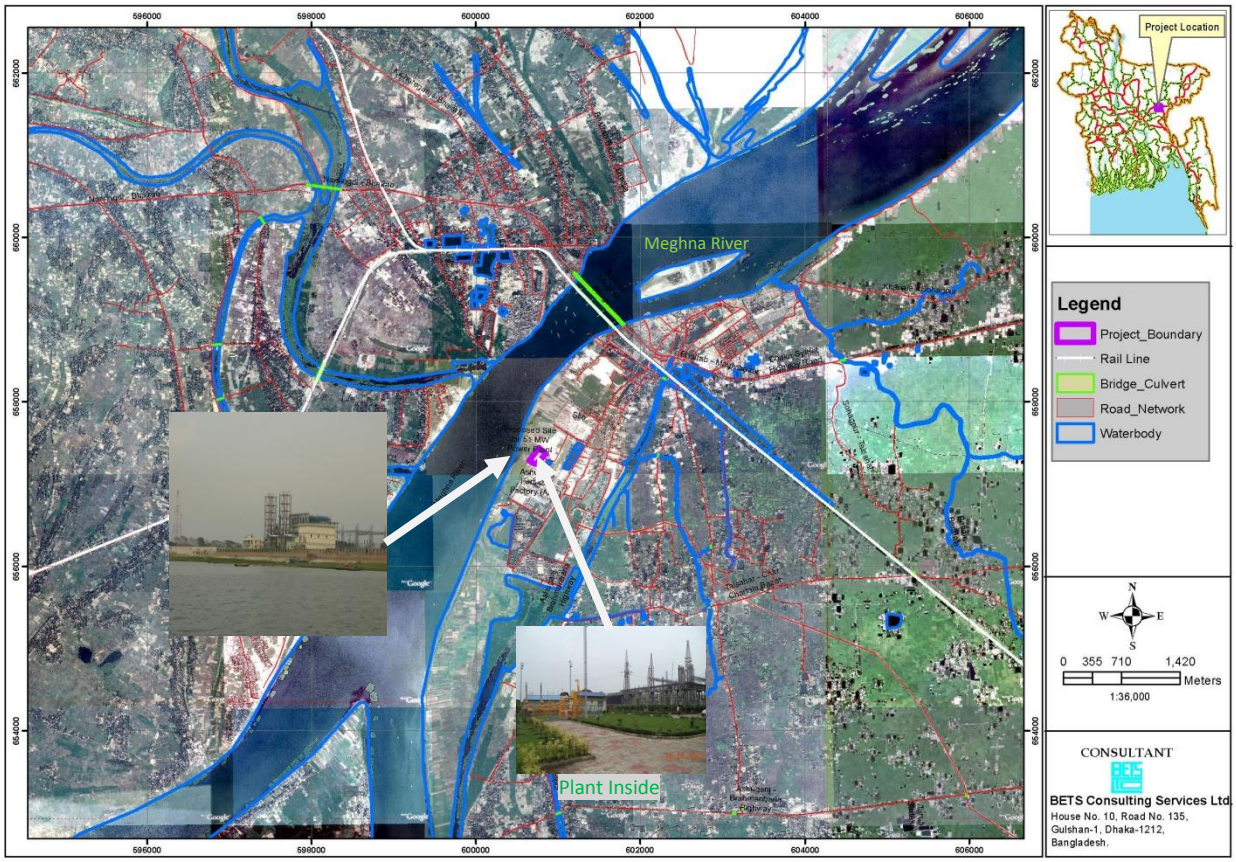
In early 2012, a full-scale Environmental Impact Assessment (EIA) of the plant was carried out by the Midland Power Company Ltd. It was carried out to assess the environmental concerns of the Power Plant. However, a number of issues were not appropriately addressed in that assessment (e.g., air and noise quality modeling) due to time constraints and lack of availability of necessary data. In this context, the World Bank suggested revision of the Environment and Social Impact Assessment (ESIA)document of the Power Plant following World Bank Guidelines. As the construction of the plant has been completed and it is in operation, a monitoring/compliance report of the EMP measures proposed in this ESIA report has also been prepared. This report also include the compliance status on the DOE conditions for EIA clearance. The report is submitted as a standalone accompanying document with this ESIA report(Annex-XVII).

Midland Power Co. Ltd. has appointed BETS Consulting Services Ltd. to update the existing Environmental and Social Impact Assessment document by:

(i) Revising the document to reflect the World Bank environmental and social guidelines;
(ii) Carrying out a cumulative impact assessment;
(iii) Including quality assured data on Air Quality and noise parameters;
(iv) Performing air and noise quality modeling; and
(v) Prepare a monitoring/compliance report for the construction period and operation until now.

PROJECT DESCRIPTION

The concerned power plant of the Midland Power Co. Ltd. is located at Ashugonj in the administrative district of Brahmanbaria under Chittagong Division. The selected site for Midland Power Co. Ltd. is about 5-6 km away from Brahmanbaria city centre. The proposed site of the project is on the south side of the Dhaka-Sylhet highway and quite close to the Ashugonj Fertilizer and Chemical Complex Ltd. (AFCCL). A largegrain SILO is located to the Northern side of the project site. To the eastern side of the project the NG distribution hub of the Gas Transmission Company Limited (GTCL)-Petrobangla Company of the GOB is located. Meghna River is just adjacent to the western side of the plant-site. Bhairab Railway Station is about 2 km away to the northwest of the project site. The project site enjoy's the infrastructural facilities such as electricity, water, telecommunication, etc. The access to the project site, project location sketch map with its surroundings is shown in the Satellite Image below. Project site is well connected with the national road linking system.



Satellite Image Depicting Project Location

ENVIRONMENTAL AND SOCIAL BASELINE DATA

Physical Environment

Climate Geology and Soil

Long-term average climatic data collected at the nearby Comilla weather station (2004 to 2013) reflect the monsoonal effects on climate in this region (Bangladesh Meteorological Department, Dhaka 2014): Mean maximum temperature is 35.5^{0}C; Mean daily minimum temperature is 6^{0}C; Mean annual relative humidity is 81% and Mean annual rainfall 2016 mm.

Data about wind speed and direction for the period from 2004 to 2013 as collected from Meteorological Department and the data indicates that the maximum wind speed recorded as 25 knots in the month of October, 2007. The prevailing wind direction is South and South-east in most part of the year.

Geology of Bangladesh is generally dominated by poorly consolidated sediments deposit over the past 10,000 to 15,000 years (Holocene age). The geology of the study area consists of Quaternary deltaic sediments, which have been strongly influenced by tectonic movements on deep-seated faults. The area lies on a tectonic block, which has been uplifted relative to the surrounding areas. The soil profile of the study area consists of about 12m thick clay deposit followed by sand, clay and progressively coarser sand as depth increases.

In terms of crop production, the soils of Bangladesh can be categorized into three main classes; floodplain, terrace and hill soils. Soils are mainly grey loamy on the ridges and gray to dark gray clayey in the basins. Gray sands to loamy sands with compact silty topsoils occupy areas of the old Brahmaputra Char floodplain or alluvial soils. In adjoining southern part soil mainly comprises sandy barns and sandy clay barns and tends to be gray to dark gray in poorly-drained basins and brown on higher and better drained land.

Air Quality

The existing ambient air quality of the study area was monitored at three locations (September 2014- October 2014) and at the Plant gate (January 2015 to February 2015) during the monitoring period. The monitoring parameters included Particulate Matter (PM10 and PM2.5), Sulphur Dioxide (SO2), Oxides of Nitrogen (NOx), and Carbon Monoxide (CO). All the parameters were monitored on 24-hourly basis except Carbon Monoxide (CO) during the duration of the study.

$PM_{2.5}$

The 24-hourly PM2.5 concentration in ambient air in the study area was recorded 146 ± 36 µg/m3. The Annual measured concentration was 54 ± 32 µg/m3 which is higher than BNAAQS.

PM_{10}

The 24-hourly PM_{10} concentration in ambient air in the study area was recorded 191± 48 µg/m3. The Annual measured concentration was 105± 56 µg/m3 which is higher than BNAAQS. .

SO_2

The 24-hourly SO_2 concentration was recorded in the range of 8.02 – 27.45 µg/m^3. Average concentration of $SO_2$are reported slightly higher due to the industrial setup. During the monitoring period, the maximum SO_2 concentration is reported at power plant site as27.45 µg/m^3. SO_2 concentrations at all the monitoring locations were reported well below 365µg/m^3, which is a 24-hourly National Ambient Air Quality Standard (NAAQS) for SO_2 in Bangladesh.

NOx

The 24-hourly NOx concentration was recorded in the range of 10.26–42.61 µg/m^3. Average concentration of $SO_2$are reported slightly higher due to the industrial setup. During the monitoring period, the maximum NOx concentration is reported at power plant site as 42.61µg/m^3. There are no stipulated standards for 24-hourly NOx concentration in Bangladesh. The annual Bangladesh standard value for NOx is 100 µg/m^3 and present average concentrations at all the locations are well below these values.

CO

The 8-hourly CO concentration was recorded in the range of 40.0 – 340.0 µg/m^3. Average concentrations of CO are reported low at all the monitoring locations while comparing with the Bangladesh Standards (10 mg/m^3).

Noise

Excessive noise is a potential issue for both human and biological receivers and can cause a range of negative issues, from mild annoyance and moderately elevated levels of agitation to significant disturbance of behavioral patterns and, in severe cases, temporary or permanent hearing loss. According to the World Health Organization Guidelines for Community Noise (1999), daily sound pressure levels of 50 decibels (dB) or above can create discomfort amongst humans, while ongoing exposure to sound pressure levels over 85 dB is usually considered the critical level for temporary hearing damage.

Noise levels were recorded at nineteen locations in the study area during the monitoring period. Noise levels were recorded in the form of sound pressure levels with the help of a digital sound level meter. Noise level were recorded for two hours at day and night time in the closest settlement area indicated as NL17, NL18 and NL19 monitoring locations and rest of the locations were recorded for 20 minutes both day and night times.

The summarization of the monitoring results revealed that the project area falls into Industrial zone according to Bangladesh Environmental Quality Standard ECR'97 categorization. Noise levels of all locations were within the standard limit of ECR'97 (subsequent amendment in 2006).

Water Quality

Groundwater aquifers in Bangladesh are constantly recharged by major river systems and by infiltration of rainwater. Groundwater is usually available within 5m below ground surface (mbgs). This level fluctuates seasonally but approaches close to the surface in most parts ofthe country from July to September. At Ashuganj, the groundwater level is about 6 mbgs surface during the dry season, with levels returning to their normal position before the end of the monsoon season. This fall in ground levels is an entirely natural process that arises because of the hydrological link with the river. The ground water quality is within the standard of ECR.

The surface water Quality was compared with the Bangladesh ECR standard for best practice based classification criteria. Some of the water analysis parameters like pH of the Meghna River is within the permissible limits of 6.5 to 8.5. The DO of the sample of Meghna River is 6.7 mg/l and thus meets the surface water classification for different usages. The BOD level is 3.0 mg/l for the Meghna River and thus is well below the permissible limits. Comparison of the data with the surface water quality standards of government of Bangladesh reveal the fact that water of the water bodies are fit for supply after conventional treatment, Water usable by fisheries, Industrial process and cooling industries and Water usable for irrigation.

Ecological Environment

Approximately 12-15 families of the plant species are present in the study area. These are: Gramineae, Leguminosae, Moraceae, Myrtaceae, Cyperaceae, Euphorbiaceae, Rutaceae, Solanaceae, Labiatae, Rubiaceae, Malvaceae, Compositae, etc. The most common roadside plantation trees are Koroi (*Albizia procera*), Sisso (*Dalbergia sissoo*), Mahogany (*Sweitonia*

mahagoni), Katanote (*Amaranthus spinosus*), Dhutura (*Datura meteloides*), Apang (*Achyranthus aspera*), Chorekanta (*Chrysopogon aciculatus*), Jagadumur (*Ficus glomoreta*), Swetadrun (*Leacus lavendulifolia*), Tulsi (*Ocimum sanctum*), Titbegun (*Solanum indicum*), Benna (*Veteveria zizanioides*), Bot (*Ficus benghalensis*) etc. Koroi (*Albizia procera*), Sisso (*Dalbergia sissoo*), Mahogany (*Sweitonia mahagoni*) are the dominant road side plant species in the study area.

A variety of lizards and skinks were observed during the survey. Among the lizards identified was the Common garden lizard *(Calotes versicolor*). Lizards were observed in bushes and the lower canopies of trees in various vegetated areas around the study area. Other common geckos including Brook's House Gecko (*Hemidactylus brookii*), the Common House Gecko (*Hemidactylus frenatus*) were seen within homesteads.

Common skink (*Eutrophis macularia*) was found in several of the terrestrial habitats around the study area. Their niche habitat is low-lying vegetation, leaf litter, grassy areas, bushes, stream banks, under logs and burrows. The burrow-dweller Bengal monitor (*Varanus bengalensis)* was seen basking in the study area.

A large number of aquatic fauna was observed in the study area. Many are totally dependent on wetlands (beels, river, ponds) and species are partially dependent on wetlands. There are little available aquatic habitats for faunal species. Wetlands are intensively exploited and the habitat is highly disturbed. Despite this, some species have adapted to the altered environment, and others have even flourished.

Among the amphibians the skipper frog (Rana cyanophyctis) is common-being found in most of the wetland habitats and has been the most successful in adapting to the altered environment. The common roof turtle (*Kachuga tecta*) and the flat-shelled spotted turtle (*Lissemys punctata*) are the most common of the reptiles. These freshwater turtle species face problems of migration during summer when water levels are inadequate.

Socio-economic Environment

As per the survey data it can be observed that almost 27% of the respondents are involved in agricultural labour followed by business (20%), Non Agricultural labour (14%) Agricultural activity (9%), Private Service (4%) and Fisherman (2%) in the study area. 24% are of other professions including rickshaw-puller, construction worker, driver etc. It can also be observed that majority of the women respondents are housewives or involved in household activities.

Majority of the respondents have a positive perception about the power plant. They express their opinion that the power plant is a national asset and support to meet our electricity demand. Only who lives in adjacent to the power plant provide their opinion regarding the noise level and odor problem those mostly comes from other industry located near to the settlement and they inform that noise level from the power plant is tolerable. Positive expectations of the surveyed household are primarily with respect to overall development in the area, improved road facilities and employment opportunity for the local people.

The team consulted with a diverse range of stakeholders associated with the project. These included governmental agencies and departments, local administration, NGO, as well as the community. Furthermore, in order to assess the community and household level impacts, a socio-economic survey for a sample household size of 52 within the close settlement of the

existing power plant was undertaken. This survey was of much help to establish the baseline conditions of the community living in the vicinity of the project footprint and their opinions, expectations and apprehensions about the existing power plant. The analyses of this data and the inferences drawn have been provided in the following sections.

ANTICIPATED ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

Environmental Impact during Construction Phase

Ecological Impacts

The proposed Power Plant project site has aquatic habitat which supports few common aquatic floral species and none of them are threatened in Bangladesh. No long-term adverse impacts to the floral and faunal species or their ecosystem are expected.

Physico-chemical Impacts

Impact on Water Quality and General Environmental Waste and wastewater generated during the construction phase of the project include construction debris and wastes, and some other solid wastes (e.g., from labor sheds), human wastes from people working at the project site (e.g., from labor sheds), and some liquid waste from construction processes. These waste/ wastewater could lead to pollution of water and general environment, if not properly disposed.

Air Quality Impacts

During the construction phase, the important sources of emissions would include those from the operations of construction equipment and machineries, project vehicles carrying construction materials/ debris to/ from the site. Particulate matter may be generated from stone (aggregate) crushing, earthworks, material storage areas, and unpaved roads.

Noise Level

For assessment of noise level during construction phase, the project activities were divided into two major classes–(i) general site and plant construction and (ii) access road construction. Mitigation measures have been suggested to reduce noise exposure at the nearest residence.

Socio-economic Impacts

Transport and communication:

During construction phase, some additional traffic will be generated for bringing in construction material and equipment. This traffic will pass through heavily traveled Sylhet-Dhaka road. However, the negative impact of the increased traffic flow would be mostly concentrated mainly within the MPP complexand affecting people in residential areas located close to the project site.

Navigation:

Large barges are likely to be used to carry the power plant equipment to the plant site via the Meghna River. So there will be some crowding of in the navigation channel. However, such crowding is expected to be minor in nature and easily manageable.

Public Health:

The construction activities are likely to have some impact on health and well being due to increased noise pollution and vibration, and local air pollution. Solid wastes generated by the construction activities may create environmental pollution and thus affect public health, if not

properly disposed. Proper measures including regular maintenance of equipment and use of protective gear are needed to reduce the risk of accidents during the construction phase.

Employment:

Some job opportunities will be created for labors as well as skilled manpower (including engineers) for construction of the proposed project. Installation of power plant will require relatively small number of skilled personnel and laborers; as such installation is highly automated.

Environmental Impact during Operation Phase

The impacts of project activities on most ecological parameters (e.g., floral and faunal habitat and diversity) are mostly insignificant. The effects of project activities a number of physicochemical environmental parameters have been assessed. These parameters include noise level, water quality, and air quality. The impact of the power plant project at its operation phase on socio-economic parameters will be mostly beneficial. Increased power supply will promote wellbeing of the people suffering from lack of power supply or serious load shedding; it is also likely to have positive impact on industrial activities and employment.

Noise Impacts

During the operational phase exceedingly high level of noise is expected to be generated within the confines of the turbine and generator installations. Prolonged exposure to such high level of noise may cause permanent hearing loss. Noise generated by the power plant will not affect the locales on the southern side of the plant. However, future population outside the project site may be affected by the noise during operational phase.

Air Quality

The proposed 51 MW Power Plant is a relatively cleaner technology for electricity production, especially when natural gas with no sulfur content (as is the case here) is used as fuel. It is expected to produce minimal impact on the air quality of the surrounding environment. The effect of stack emissions (NOx during operation of only the GT; and NOx, CO and PM during operation of the gas fired power Plant) on ambient air quality has been assessed using AERMOD model.

Public Consultations

Discussions were held with the communities who are lives in close to the power plant. Two focus group discussions were held in the Char Chartala village. The overall outputs from the FGD are given below:

1. Main environmental concern is noise pollution that is generated from the power plant. Overall the noise of this power plant is comparatively low rather than other industry.
2. During construction stage all of the affected households got proper compensation
3. During winter season transmission line wire make noise which is often cause panic
4. This plant do not causes any surface water pollution
5. The plant authority should be develop the existing connecting road
6. Few local people have been provided with job in this power plant.
7. Require more job opportunity in the plant specially jobless young people
8. Proper fire fighting system is to be preserved in the plant for safety

MITIGATION MEASURES AND ENVIRONMENTAL MANAGEMENT

Environmental management and monitoring activities for the proposed power plant project could be divided into management and monitoring: (a) during construction phase, and (b) during operation phase. The environmental management program should be carried out as an integrated part of the project planning and execution. For this purpose, it is recommended that it is recommended that the MPCL for this specific project should take the overall responsibility of environmental management and monitoring.

The MPCL through its team will make sure that the Contractor undertake and implement appropriate measures as stipulated in the contract document, or as directed by the GM, MPCL to ensure proper environmental management of the project activities. It should be emphasized that local communities should be involved in the management of activities that have potential impacts on them (e.g., traffic congestion in the surrounding areas). They should be properly consulted before taking any management decision that may affect them. Environmental management is likely to be most successful if such decisions are taken in consultation with the local community. The environmental management during the construction phase should primarily be focused on addressing the possible negative impacts arising from:

(a) Generation and disposal of sewage, solid waste and construction waste (b) Increased traffic (c) Generation of dust (particulate matter) (d) Generation of noise and (e) Deterioration of water quality.

E-1 Potentially significant environmental impact during construction phase and mitigation measures

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
Influx of workers	• Generation of sewage and solid waste	• Construction of sanitary latrine and septic tank system (one latrine for 20 persons) • Erecting "no litter" sign, provision of waste bins/cans, where appropriate • Waste minimization, recycle and reuse • Proper disposal of solid waste (in designated waste bins)	Contractor (Monitoring by MPCL)
	• Possible spread of disease from workers	• Clean bill of health a condition for employment • Regular medical monitoring of workers	Contractor (Monitoring by MPCL)
Transportation of equipment, materials and personnel; storage of materials	• Increased traffic/navigation • Generation of noise	• Speed reduction to 10 km per hour within the MPCL complex	Contractor (Monitoring by MPCL)
	• Deterioration of air quality from increased vehicular movement, affecting people in the surrounding areas • Wind-blown dust from material (e.g., line aggregate) storage areas	• Keeping vehicles under good condition, with regular checking of vehicle condition to ensure compliance with national standards • Watering unpaved/dusty roads (at least twice a day; cost estimate provided) • Sprinkling and covering stockpiles • Covering top of trucks carrying materials to the site and carrying construction debris away from the site	Contractor (Monitoring by MPCL)
Construction activities, including operation of construction	• Generation of noise from construction activities (general plant and access road construction)	• Use of noise suppressors and mufflers in heavy equipment • Avoiding, as much as possible, construction equipment producing	Contractor (Monitoring by MPCL)

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
equipment		excessive noise during night • Avoiding prolonged exposure to noise (produced by equipment) by workers • Creating a buffer zone around the construction site to reduce disturbance to protect from the health hazard	
	• Deterioration of air quality from wind-blown dust and possible use of equipment, such as stone (aggregate crushers)	• Not using equipment such as stone crushers at site, which produce significant amount of particulate matter • Keeping construction equipment and generators in good operating condition • Using equipment, especially generators with high levels of emission control (e.g., TIER-4). • Immediate use of construction spoils as filling materials • Immediate disposal/sale of excavated materials • Continuous watering of bare areas	Contractor (Monitoring by MPCL)
	• Generation of construction waste	• Hauling of construction debris away from the site and their appropriate disposal in asanitary landfill	Contractor (Monitoring by MPCL)
	• Accidents	• Regular inspection and maintenance of equipment • Environmental health and safety briefing • Provision of protective gear	Contractor (Monitoring by MPCL)
	• Spills and leaks leading to soil and water contamination with hydrocarbon and PAHs	• Good house keeping • Proper handling of lubricating oil and fuel • Collection, proper treatment, and disposal of spills	Contractor (Monitoring by MPCL)
	• Employment of work/labor force	• Local people should be employed in the project activities as much as possible.	Contractor (Monitoring by MPCL)
	• I f cultural resources are found during construction	• Follow the "Chance Find Procedure" World Bank Operational guidelines OP 4. 11	Contractor (Monitoring by MPCL)

The environmental management during the operation phase should primarily be focused on addressing the following issues: a. Emission from the power plant b. Generation of noise c. Waste generation at the plant.

Table E-2 summarizes the potentially significant environmental impacts during operation phase, the measures needed to eliminate or offset adverse impacts and enhance positive impacts.

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
Power Generation	• Emission from the power plant	• Using stack as specified in the bid document • Using low nitrogen oxide burners, as specified in the bid document • Installation of stack emission monitoring equipment for major pollutants. An in-house Continuous Air Monitoring Station (CAMS) may be established.	MPCL

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
		• In stack design due consideration should be given to proper insulation • Planting of trees around the project site • Restrictions may also be imposed on installation of industries in the area that emit significant amount of particulate matter.	
	• Generation of noise	• Provision of silencers for generators and turbines • Planting of trees around the project site (number and cost estimate provided) • Regular plant maintenance • Regular noise monitoring • Use of ear-muffs and ear-plugs by plant personnel working in the generator and turbine facilities of the plant	MPCL
Water Consumption	• Depletion of groundwater resources	• Regular monitoring of groundwater level	MPCL
Waste generation	• Inappropriate disposal of sewage causing environmental pollution • Generation of solid waste including sludge from demineralizer. • Possible water pollution	• Good housekeeping • Proper construction and maintenance of wastewater disposal system for the plant premises • Ensuring proper storage, treatment, and disposal of all solid waste • Monitoring of effluent quality from treatment plant (monitoring requirement and cost estimate provided) • Monitoring of river water quality (monitoring requirement and cost estimate provided)	MPCL

Table E-3&**Table E-4 provides the** Monitoring plan during construction phase and operational phase of the project.

Table E-3 Monitoring plan during construction phase of the project

Issue	Parameters	Monitoring Frequency
Ambient air quality	CO, NOx, PM10 and PM2.5	Once a month
River water	Water temp., DO, BOD5, COD, Oil and Grease	Once a month
Groundwater	Groundwater level	Once every two months during October to May
Soil Quality	Cr, Cd, Pb and Oil and Grease	Twice during the construction phase
Noise level	Noise at different locations	Every week, particularly during operation of heavy equipment
Process waste	Solid waste	Every week
Occupational health and Safety (worker health, working environment)	Noise, air quality, worker health status check	Once in a month (surveillance of workplace environment)

Table E-4 Monitoring plan during operational phase of the project

Issue	Parameters	Monitoring Frequency
Meteorological measurements	Wind direction and speed, temperature, humidity and precipitation.	Continuous monitoring by installing appropriate instrument
Stack emissions	CO, NOx, PM10, PM2.5and temperature	Once a month
Ambient air quality	CO, NOx, PM10, PM2.5, temperature	Once a month
River water	Water temperature and DO	Once a month (March-May, October-December)
Effluent quality	pH, DO, Sulfate, TSS, TDS, BOD, COD, Total N, Total P	Once a week
Groundwater	pH, Color, Turbidity, TDS, Ammonia, Nitrate, Phosphate, As, Fe , Mn and Coliforms; Groundwater level	Twice a year

Issue	Parameters	Monitoring Frequency
Noise level	Noise at different locations	Once every three months
River morphology	River cross-section	Once a year during design life of the plant
Vegetation	Number and Condition	Once a year
Occupational health and safety	Health status and safety	Twice a year

CONCLUSION AND RECOMMENDATION

Conclusions

In this study, the effects of the project activities on physico-chemical, ecological and socioeconomic (i.e., human interest related) parameters during both construction and operation phases have been assessed. The impacts have been identified, predicted and evaluated, and mitigation measures suggested for both construction and operation phases of the proposed power plant. The important physico-chemical environmental parameters that are likely to be affected by the project activities include air quality and noise level.

The study suggests that most of the adverse impacts on the physico-chemical environment are of low to moderate in nature and therefore, could be offset or minimized if the mitigation measures are adequately implemented. Since the project site is located in a developed area that does not appear to be very sensitive ecologically, the impacts of project activities on most ecological parameters (e.g., floral and faunal habitat and diversity) are mostly insignificant.

Noise level has been identified as a significant potential impact of the proposed power plant during both the construction and operation phases. The noise generated from construction activities during the construction phase might become a source of annoyance at the habitat located close to the project site.

Some adverse impact during the operation phase of the plant will come from thermal emission and NO_x and PM emission from the power plant. However, modeling study suggests that the effect of increased NO_x and PM in the ambient air due to emission from the power plants will not be very significant.

The power plant has been constructed within a designated area inside the MPCL owned complex. So there was no need for land acquisition. Additionally, there was no settlement in this designated area, and the area was not used for any income generation activities. Therefore, no population has been displaced and no resettlement was required for the construction of the power plant, and no loss of income was associated with the project.

During operation phase, no significant negative impact is anticipated on socio-economic environmental parameters. Significant positive impacts are expected due to improvement in power supply. This will reduce load shedding in Dhaka city and contribute to the national economy. Well-being of the surrounding population, especially Dhaka city, will be significantly improved due to generation of electricity during peak hours. Currently Dhaka city is reeling under unbearable load shedding.

Recommendations

The environmental assessment carried out for the proposed Midland Power Plant at Ashugonj, suggests low to moderate scale of adverse impacts, which can be reduced to acceptable level through recommended mitigation measures as mentioned in the EMP. Further, since the

project is expected to be financed by the World Bank as well, it has to comply with the concerned operational policy statements of the Bank in force so that it is environmentally sound and sustainable and thus to enable the project proponent in improving their decision making in all its operational activities. It is therefore recommended that the proposed 51MW gas fired power plant may be installed at the MPCL owned land at Ashugonj, Brahmanbaria provided the suggested mitigation measures are adequately implemented. It is also recommended that the environmental monitoring plan be effectively implemented in order to identify any changes in the predicted impacts and take appropriate measures to off-set any unexpected adverse effects.

CHAPTER-1
INTRODUCTION

1.1 BACKGROUND

In order to increase the capacity of electricity production, the Ministry of Power, Energy and Mineral Resources, GOB has given permission to the private entrepreneurs to establish new power plants in different generation capacities on a Rental and BOO basis in private sector. Considering the Power shortfall in the country and government plans, authority of Midland Power Company Ltd. has constructed a**51 MW Natural Gas Fired Power Plant** on Build, Own and Operate (BOO) basis at Ashugonj, Brahmanbaria to narrow the ever-increasing gap between demand and supply of electricity through gas-based low cost generation.

In early 2012, a full-scale Environmental Impact Assessment (EIA) of the plant was carried out by the Midland Power Company Ltd. It was carried out to assess the environmental concerns of the Power Plant. However, a number of issues were not addressed in that assessment (e.g., air and noise quality modeling) due to time constraints and lack of availability of necessary data. At present, the World Bank suggested revision of ESIA of the Power Plant to comply with the World Bank Environmental and Social Guidelines to qualify for refinancing under the IPFF project. As the plant is operational now, a EMP compliance/monitoring report during the construction stage and operational period until now has to provided as part of this revision.

Midland Power Co. Ltd. has engaged BETS Consulting Services Ltd. to update the existing environmental and social impact assessment by: (i) revising the document to reflect the World Bank environmental and social guidelines including ;(ii) Carrying out a cumulative impact assessment; (iii) performing air and noise quality modeling.

The proposed power plant falls under "red category" and require carrying out EIA in accordance with the Environment Conservation Act 1995 and the Environment Conservation Rules 1997 (ECR, 1997). The EIA of the proposed power plant project presented in this report has been carried out considering the guidelines of the Department of Environment (DoE) of GoB (GoB, 1997) and the relevant safeguard policies and operational guidelines of the World Bank [e.g., Environmental Assessment, OP 4.01; Involuntary Resettlement, OP 4.12; World Bank (1997; 1999a, 1999b; 2003; 2004a; 2004b)].

1.2 PROJECT OUTLINE

The major component of the 51 MW Power plant at Ashugonj includes the following:

- Gas Engines are connected directly to generators by a flexible coupling
- Medium voltage current is led to low voltage switchgear station service Station Transformer
- Direct current system is for medium voltage switchgear operations and for instrumentation
- Station delivered with an auxiliary cooling arrangement by dry cooler
- 230KV outdoor substation
- Security fencing and gatehouse

- Generator and Substation control room, administration, amenities, and workshop facilities
- Fire protection tank, water tank and septic tank
- Emergency generator and transformers
- Internal roads

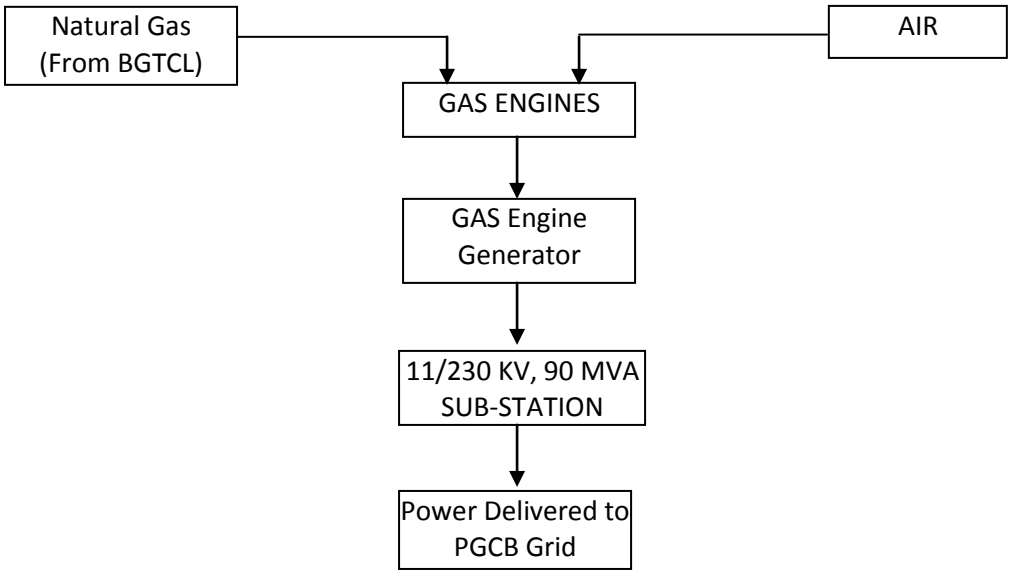


Figure: 1.2-1 Process Flow Diagram of Electricity Generation

The development is comprised of six industrial gas engine generators with the electricity generated fed into the 230 kV transmission network via a new switchyard on the project site that is included high voltage transformers and circuit breakers. Attached to the gas engine is an electrical generator that generates electricity when rotated by the engine. The engine generators were assembled off site and delivered to the project site as the six-engine generators sets. There is a back start generator, which is a diesel generator (enclosed in a container-like structure) used to start the plant or power auxiliaries under exceptional conditions when there are outages on the local distribution networks. The gas engine generator set is connected to a switchyard operating at 230 kV. The high voltage switchyard has the step-up transformers (2x45MVA) and switching equipment necessary to connect to the high voltage network. These transformers is located in a switchyard adjacent to the existing 230 kV lines running through the site with appropriate switchgear to ensure safe and reliable connection to the electricity network.

Natural gas is the fuel for the Gas Engines. To facilitate the extreme combustion conditions, air is to be compressed and cooled before entering into the combustion chamber of the gas engine. The gas fuel is supplied to the combustion chamber mixing with the compressed air and gets ignited by the spark plug. Hence power is produced by combustion of the air-fuel mixture in the engine cylinder which transmits to its crankshaft which is connected to the generator. Hence the electricity is produced by generator. The generated electricity is transmitted through the 11kV indoor switchgear and 230kV outdoor substation to the 230kV transmission line connected to the national grid of Bangladesh. The Process flow diagram of electricity generation is shown in **Figure 1.2-1**.

1.3 PROJECT RATIONALE

The supply of electricity has a great impact on the national economy of any country. Presently in Bangladesh, only 48.5% of the total population has access to electricity and per capita generation is only 236 kWh (inclusive of captive)which is very low compared to other developing countries. The GOB has given highest priority to power sector development in the country and has committed to making electricity available to all citizens by 2021. With this in mind, the government has initiated the implementation of reform measures in the power sector, including significant development programs ofwhich this Project constitutes an important part.
The total installed capacity of power plants in Bangladesh, as of July 2012, is 7,551 MW (de-rated capacity). This can be further broken down to 4,304 MW of generation operated by the public sector and 3,247 MW operated by the private sector. In the public sector a number of the generation units have become very old and have been operating at a much-reduced capacity. As a result, their reliability and productivity have also been poor. For the last few years actual demand has not been met due to a shortage of available generation capacity. In addition, due to a shortage of gas supply some power plants are unable to operate at full capability.

To meet this demand with reasonable reliability, the GOB has prepared a Power System Master Plan and also amended its industrial policy to encourage private investment in the power sector. The GOB has committed to attracting private sector investment to install new power generation capacity on a BOO basis.

1.4 PURPOSE and SCOPE of the ESIA

Midland Power Co. has approached the WB for raising investment capital for the Project. As per the WB's environmental and social screening criteria, the proposed project fall under Category "B" and thus requires a comprehensive Environmental and Social Impact Assessment (ESIA) study. Hence, this ESIA study was carried out to meet the environmental and social safeguard requirements of the WB as well as the national applicable laws. The applicable reference framework used for the study is as follows:

- Operational Directive (OD) 4.00: Environmental Assessment, environmental assessment (EA) has become a standard procedure for Bank financed investment projects. The directive was amended as OD 4.01 in 1991 and was converted into Operational Policy (OP) 4.01 in 1999 (World Bank, 1999).
- The IFC General EHS Guidelines (2007);
- The IFC EHS Guidelines for Power Plant (2008); and
- Applicable Bangladesh national, state and local regulatory requirements

1.5 Scope of the ESIA

The detailed scope of the ESIA study is as outlined below:

- Screening of the Project based on applicable reference framework based on reconnaissance survey and desk based review of Project documents;

- Scoping for the ESIA study;
- Development of an integrated project description of the Project components including its sub-components, which are under the purview of the Project Proponent (PP);
- Development of a regulatory, policy and administrative framework relevant to the Project;
- Monitoring, analysis and reporting of the environmental and social baseline data of the study area including consultation with local communities and other stakeholders;
- Assessment of the environmental impacts of the Project in the study area;
- Assessment of social impacts on the local community as well as project affected people and any other stakeholders, which have been identified during the social consultation process;
- Risk assessment and consequence analysis of the Project;
- Formulation of an Environment and Social Management Plan and associated/specific mitigation plans for identified impacts; and
- Formulation of Stakeholder Consultation and Grievance Redress Mechanism for the Project.

1.6 Approach and Methodology

As the first step, project screening and scoping exercise was undertaken to identify the parameters needed to be considered for the study and to outline the activities for collecting data on each parameter. Data pertaining to all facets of the environment and social viz. physical, ecological and socioeconomic environment were collected from the study area (10 km for overall environmental baseline, 5 km for ecological baseline and 7 km for social baseline) through both primary and secondary sources.
The stepwise activities are detailed in the following subsections:

1.6.1 Preliminary Discussions with Project Proponent

- Discussions held with Midland Power Co., to understand the proposed project, current status of agreements (i.e. implementation, land, water, gas supply, power purchase etc), Project milestones, legal requirements and scope; and
- Collation of relevant project documents such as the project feasibility report, land records, copy of agreements etc.

1.6.2 Screening and Scoping Exercise

- Desk based review of the relevant documents and available imagery of the project site and its surroundings;
- Reconnaissance survey of the site, surrounding areas, gas valve station, approach road and preliminary discussions with locals, stakeholders;
- Meetings and discussions with World Bank and Department of Environment (DOE) of Bangladesh, to understand sensitivities and regulatory requirements associated with the proposed project;
- The outcome of the screening was then used to identify the study area, key data to be collected and the categorization of the project; and

- A preliminary stakeholder mapping exercise was also undertaken to identify key stakeholders from the Government, relevant Governmental Agencies, Non-Governmental Organizations (NGOs) as well as the community at the local, regional and national level. This information was then used for consultation during different stages of the project.

Categorization

Categorization of the Project was completed based on the screening assessment, reconnaissance survey, environmental and social sensitivities, limited consultation and the DOE categorization; WB's categorization criteria based on environmental assessment (EA) checklist for Gas power plant, involuntary resettlement (IR) impact categorization checklist and indigenous peoples (IP) impact screening checklist; as well as with reference to the IFC's approach to categorization.

Scoping

The categorization with respect to WB and IFC classifications was further used as a basis for defining scope for the impact assessment, planning and implementation of mitigation, monitoring and reporting mechanisms for the project to meet potential lender's requirements as well as those of the GOB.

1.6.3 Baseline Data Collection

- Identification of the monitoring locations for air, water and noise as per sensitive receptors, key locations for water intake and outfall etc;
- The baseline data collection, monitoring and analysis for environmental parameters was completed during the period from end of September to October 2014;
- Socio-economic data collection and consultation was carried during September to October 2014;
- Secondary data was also collected from different government departments, local bodies and through literature surveys etc; and
- All the data was compiled and compared with applicable standards where relevant, and is presented in **Chapter 3** of this report.

1.6.4 Stakeholder Consultation

- Extensive consultation was conducted with key stakeholders' including the local population, government departments/agencies, fishermen, and NGOs;
- Stakeholder consultation was completed with the intent of collecting baseline information on the environmental and social conditions and sensitivities, developing a better understanding of the potential impacts, informing the public of the proposed project and to gain an understanding of the perspectives/concerns of the stakeholders;
- A summary of the stakeholder engagement process and the profile of the groups and their opinions forms a part of the Information Disclosure, Consultation and Participation Chapter of this report **(Chapter 7);** and
- Information gathered was used for formulating mitigation measures and environmental and social management plan/s.

1.6.5 Impact Assessment and Mitigation Measures

- Analysis of the baseline results and the incremental impacts of the project were assessed in accordance with the Bangladesh national guidelines for air, water and noise emissions; standards stipulated in the Environment Conservation Rules (ECR), 1997 and amendments thereof and with reference to the IFC's Performance Standards, WB Safeguard Policy Statement and the IFC's Environmental, Health and Safety (EHS) Guidelines, including both the General Guidelines and those for Power Plants;
- The impact assessment involved the prediction and evaluation of impacts from the project in different phases, including site preparation, construction and operation phase, decommissioning of project and included consideration of mitigation measures towards the same;
- Impact prediction covered residual impacts (impacts remaining after all possible mitigation has been incorporated) and took into account control measures that are part of the project design (e.g. acoustic enclosures for major equipment). Additional measures aimed at further avoiding, minimizing and mitigating predicted impacts were proposed where necessary or appropriate;
- Impact assessment also involved risk assessment covering hazard identification, consequence analysis and risk reduction measures and recommendations; and
- Impacts have been further classified as insignificant, minor, moderate or major based on the criteria for rating of impacts.

1.6.6 Analysis of Alternatives

Analysis of alternative options was considered to minimize impacts of the project while undertaking the EIA study. The alternative options assessed in the study ranged from technology, transportation methods, project site and operations, including the no project alternative. Alternatives are considered in terms of their potential environmental impacts, the feasibility of mitigating these impacts alternatives for mitigation measures for high residual impact/risk, if any etc.

1.6.7 Management Plans and Grievance Redress Mechanism

- Environmental and Social Management Plan (ESMP) were developed for the mitigation measures suggested and included defined roles and responsibilities for implementation;
- A grievance redress mechanism was developed to address any complaints and concerns from all stakeholders;
- Based on the risk assessment, risk reduction measures and recommendations for a disaster management plan (DMP) were also developed; and
- Institutional review and finalization of the EMP and grievance

1.6.8 Information/Data Sources

Key relevant information sources have been summarized in Table 1.6-1.

Table 1.6-1 Key Data Sources

Parameters	Information sources	Remarks
Project Background, Technical details on project and associated components	• Midland Power Plant EIA Report • Project specification documents from Midland Power Co. Ltd. • Project Execution milestones, Plot Plan layout, Organizational Structure	Midland Power Co. Ltd. (MPCL) provided other information required during the course of the study
Study area features and sensitivities	• Ground physical Survey • Satellite imageries • National web portal of Bangladesh: www.bangladesh.gov.bd	Details of the satellite data used is included in Baseline Chapter
Legal framework	• Department of Environment • Board of Investment, Bangladesh • IFC and WB documents	In discussion with the DOE andlocal Govt. departments, WB and
Land use /Land cover Details, Meteorology and climatic conditions	• Ground Physical Survey • GIS based land-use analysis • Bangladesh Meteorological department • Observatory Surface Meteorological Data	Details of the satellite data used is included in Baseline chapter
Geology, Topography, Hydrology and drainage	• MPCL EIA report, Location Map • Bangladesh water development board • Web portal of National Encyclopedia of Bangladesh (Banglapedia)	In association with field observations
Natural hazards	• Web portal of National Encyclopedia of Bangladesh (Banglapedia) • Bangladesh Meteorological Department	Included in consultation with locals
Environmental baseline as Air quality, water quality, soil and sediment quality	• Primary data collection • Applicable Standards from DOE, Bangladesh	Monitoring was completed from September to October 2014
Ecological parameters	• Primary data collection, observations, surveys and local consultations • Websites of birdlife international • IUCN Data base	Survey was carried out in month of September-October 2014, Endangered, critical status was checked from the website www.iucnredlist.org
Social-economic parameters	• Primary data collection surveys, extensive consultations, meetings and discussions held with stakeholders • Bangladesh population Census for 20011 for Brahmanbaria District • Fisheries Census data • Implementation manual of Rural Social, Program, Brahmanbaria, • Land Regulation Policy, Bangladesh • Land Acquisition and Compensationdata for the project site • OPD data from local HealthcareDepartment • Website of Department of SocialServices • Web portal of National Encyclopediaof Bangladesh (Banglapedia)	Primary Socio-economic Surveywas carried out in month of September-October 2014. Details provided in baselineenvironmental and socialconditions chapter.

1.7 Content of ESIA Report

The content of the ESIA has been largely structured based on the WB's Operational Policy Statement(Outline of an Environmental Impact Assessment Report). The layout of the Report is as follows:

- Chapter 1 Introduction, Background, Purpose and Scope and Approach and Methodology
- Chapter 2 Policy, Legal and Administrative Framework
- Chapter 3 Project Description
- Chapter 4 Analysis of Alternatives
- Chapter 5 Environmental and Social Baseline Data
- Chapter 6 Anticipated Environmental Impacts and Mitigation Measures
- Chapter 7 Information Disclosure, Consultation and Participation
- Chapter 8 Environment and Social Management Plan
- Chapter 9 Risk Assessment and Management
- Chapter 10 Grievance Redress Mechanism
- Chapter 11 Conclusions and Recommendations

CHAPTER-2
POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 INTRODUCTION

To address the environmental and social risks of any proposed project and its associated components; any protect and conserve the environment from any adverse impacts, the GOB has specified regulations, policy and guidelines. Potential Lenders' also have their own set of requirements (such as the WB's Operational Policy and IFC's Performance Standards) to which any project funded by them must operate.
This Chapter focuses on policy, regulations and the administrative framework under the purview of which the proposed project will fall and this ESIA study will be governed, namely:

- Bangladesh national and local, legal and institutional framework;
- WB Policies and framework; and
- IFC Performance Standards and EHS Guidelines

2.2 ENVIRONMENT-RELATED POLICIES IN BANGLADESH

The GOB has developed a policy framework that requires environmental issues to be incorporated into economic development planning. The Key tenets of the various applicable policies are detailed in the following subsections.

2.2.1 National Environmental Policy, 1992

The Bangladesh National Environmental Policy, approved in May 1992, sets out the basic framework for environmental action together with a set of broad sectoral action guidelines. Key elements of the Policy are:

- Maintaining ecological balance and ensuring sustainable development of the country through protection, conservation and improvement of the environment;
- Protecting the country from natural disasters;
- Identifying and regulating all activities that pollute and destroy the environment;
- Ensuring environment-friendly development in all sectors;
- Ensuring sustainable and environmentally sound management of the natural resources; and
- Promoting active association, as far as possible, with all international initiatives related to environment.

The Environmental Policy of 1992 requires specific actions with respect to the industrial sector which are as follows:

- To phase-in corrective measures in polluting industries;
- To conduct Environmental Impact Assessments (EIAs) for all new public and private industrial developments;
- To ban, or find environmentally sound alternatives for, the production of goods that cause environmental pollution; and
- To minimize waste and ensure sustainable use of resources by industry.

- The policy also states that EIA's should be conducted before projects are undertaken and the DOE is directed to review and approve all Environmental Impact Assessments.

2.2.2 National Environment Management Action Plan, 1995

The National Environmental Management Action Plan (NEMAP) is a wide-ranging and multi-faceted plan, which builds on and extends the statements, set out in the National Environmental Policy. NEMAP was developed to address issues and management requirements related to the environment during the period 1995 to 2005; it also sets out the framework within which the recommendations of the National Conservation Strategy are to be implemented. NEMAP was developed to achieve the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural environment;
- Conservation of habitats and bio-diversity;
- Promotion of sustainable development; and
- Improvement of the quality of life of the people.

To attain the above mentioned objectives, the plan groups all the relevant necessary actions under four headings, namely: institutional, sectoral, location-specific and long-term issues.
The institutional aspects reflect the need of inter- sectoral cooperation to tackle environmental problems which need new and appropriate institutional mechanisms at national and local levels. The sectoral action reflects the way the Ministries and agencies are organized and makes it easier to identify the agency to carry out the recommended actions. The location-specific action focuses particularly on acute environmental problems at local levels that need to be addressed on a priority basis. The long-term actions include environmental degradation to such degree that might become even more serious and threatening, if cognizance is not taken immediately.

2.2.3 National Conservation Strategy, 1992

The National Conservation Strategy, 1992, provides recommendations for sustainable development of the industrial sector. The key aspects of the strategy are as follows:

- All industries shall be subject to an EIA and the adoption of pollution prevention/control technologies shall be enforced;
- Hazardous or toxic materials/wastes shall not be imported as raw materials for industry;
- Import of appropriate and environmentally-sound technology shall be ensured; and
- Dependence on imported technology and machinery should gradually be reduced in favor of sustainable local skills and resources.

2.2.4 Other Policies relevant to Environment

Additional Bangladesh policies, their key features and applicability to the subject Project are detailed in Table 2.2-1.

Table 2.2-1 Policies Relevant to Environment

Policy	Key Features	Applicability
The National Forest Policy, 1994	• Afforestation of 20% land • Bio-diversity of the existing degraded forests • Strengthening of the agricultural sector • Control of Global warming, desertification • Control of trade in wild birds and animals • Prevention of illegal occupation of the forested land, tree felling and hunting of wild animals	Applicable when considering global warming and the protection of forests
National Land Transport Policy, 2004	• All new roads and major improvements will be subjected to an EIA • Funding will be provided for mitigation measures • The Government will publish environmental standards for new roads and new design standards addressing environmental issues	Not directly applicable, however, the standards may apply for the new approach road
The National Water Policy, 1999	• Protection, restoration and enhancement of water resources • Protection of water quality, including strengthening regulations concerning agrochemicals and industrial effluent • Sanitation and potable water • Fish and fisheries • Participation of local communities in all water sector development	Applicable for the preservation of water quality
National Land use Policy, 2001	• Deals with several land uses including: agriculture (crop production, fishery and livestock), housing, forestry, industrialization, railways and roads, tea and rubber • Identifies land use constraints in all these sectors	Applicable as land use change from agricultural to industrial
Draft Wetland Policy, 1998	• Establishment of principles for the sustainable use of wetland resources • Maintenance of the existing level of biological diversity • Maintenance of the functions and values of wetlands • Promotion and recognition of the value of wetland functions in resource management and economic development	Not directly applicable, however may be applicable once the draft policy is finalized
National Fisheries Policy, 1998	• Preservation, management and exploitation of fisheries resources in inland open water • Fish cultivation and management in inland closed water. • Prawn and fish cultivation in coastal areas • Preservation, management and exploitation of sea fishery resources	Not directly applicable
National Agriculture Policy, 1999	• The act deals with the programs related to make the nation self-sufficient in food through increasing production of all crops, including cereals, and ensure a dependable food security system for all	Not applicable

Policy	Key Features	Applicability
The Energy Policy, 1996	• Provides for utilization of energy for sustainable economic growth, supply to different zones of the country, development of the indigenous energy source and environmentally sound sustainable energy development programs • Highlights the importance of EIA's for any new energy development project	Applicable as subject Project is a Power Plant
The Power Policy, 1995	• Is an integral part of the Energy Policy and deals with policy statement on demand forecast, long term planning and project implementation, investment terms, fuels and technologies, load management, institutional issues, private sector participation, technology transfer and research program, environmental policy and legal issues	Applicable as subject Project is a Power Plant
Industrial Policy, 1999	• Deals with industrial development, direct foreign investments, investment by public and private sector, introduction of new appropriate technology, women's participation, infrastructure development and environmentally sound industrial	Applicable as the Project is a public and private partnership, industrial development

2.3 ENVIRONMENT AND SOCIAL RELATED LEGISLATIONS IN BANGLADESH

The main Acts and Regulations guiding environmental protection and conservation in Bangladesh are outlined in the following subsections and **Table 2.3-1.**

2.3.1 The Environment Conservation Act, 1995 (subsequent amendments in 2000 and 2002)

The provisions of the Act authorize the Director General of Department of Environment (DOE) to undertake any activity that is deemed fit and necessary to conserve and enhance the quality of environment and to control, prevent and mitigate pollution. The main highlights of the act are:

- Declaration of Ecologically Critical Areas;
- Obtaining Environmental Clearance Certificate;
- Regulation with respect to vehicles emitting smoke harmful for the environment;
- Regulation of development activities from environmental perspective;
- Promulgation of standards for quality of air, water, noise, and soils for different areas and for different purposes;
- Promulgation of acceptable limits for discharging and emitting waste; and
- Formulation of environmental guidelines relating to control and mitigation of environmental pollution, conservation and improvement of environment.

2.3.2 Environment Conservation Rules (ECR), 1997 (subsequent amendments in 2002 and 2003)

The Environment Conservation Rules, 1997 are the first set of rules promulgated under the Environment Conservation Act, 1995. These Rules provide for, inter alia, the following:

- The National Environmental Quality Standards (EQS) for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhaust;
- Categorization of industries, development projects and other activities on the basis of actual (for existing industries/development projects/activities) and anticipated (for proposed industries/development projects/activities) pollution load;
- Procedure for obtaining environmental clearance;
- Requirements for undertaking IEE and EIA's as well as formulating EMP's according to categories of industries/development projects/activities; and
- Procedure for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.

Depending upon the location, size and severity of pollution loads, projects/activities have been classified in ECR, 1997 into four categories: Green, Orange A, Orange B and Red respectively as nil, minor, medium and severe impacts on important environmental components (IECs).

2.3.3 Acquisition and Requisition of Immovable Property Ordinance, 1982

The basic principles behind compensation of property in Bangladesh are founded in Articles 42 and 47 of the Constitution (1972). The current legislation for governing land acquisition in Bangladesh is the "Acquisition and Requisition of Immovable Property Ordinance (ARIPO), 1982 and amended in 1983, 1993 and 1994. Key features of the ordinance are as follows:

- This Ordinance provides the Deputy Commissioner (DC) with the power to initiate the acquisition of any property in any locality within his district that is likely to be needed for a public purpose or in the public interest.
- It also defines the process to claim compensation.
- It describes the entire procedure of notice and intimations prior to acquisition of any property and process and timeframes for raising objections.
- It defines the role and authority of Divisional Commissioner in decision making, compensation issues and in case of dispute. Among the matters to be considered in determining compensation are the following:
    - The damage that may be sustained by the person interested, by reason of the taking of standing crops or trees which may be on the property at the time of taking possession thereof by the Deputy Commissioner,
    - The damage that may be sustained by reason of the acquisition injuriously affecting his other properties, movable or immovable, in any other matter, or his earnings; and
    - If in consequence of the acquisition of the property, the person interested is likely to be compelled to change his residence or place of business, the reasonable expenses, if any, incidental to such change; In terms of compensation, the Ordinance explicitly states that the DC, when determining compensation, shall neither consider any disinclination of the person to part with the property, nor any increase in the value of the property to be acquired likely to accrue from the use of it after it has been acquired.
- The Ordinance also covers the case of temporary acquisition of property for a public purpose or in the public interest.

Property (Emergency) Acquisition Act, 1989

The Act was formulated to expedite the emergency acquisition of land to enable the Government 'to control inundation, flood and upsurge caused by natural calamity and to prevent river erosion." The 1989 Act was not meant to replace the 1982 Ordinance, but to complement it for special circumstances. Normally, acquisition of land for development purposes would not come under the 1989 Act. Use of this Act to acquire land for development would require extremely compelling reasons.

2.3.4 Administrative and Regulatory Guidelines and Instructions

In addition to the provisions in the law, the land acquisition process is regulated by certain administrative instructions and procedural requirements. The most important of these are summarized here.

- In 1976, the Government constituted land allocation committees at the district, divisional and central levels to control what was regarded as too lavish taking of land for public purposes. The committees were charged with ensuring 'the most rigid measures of economy in the use of land for purposes other than agriculture."
- The District Land Allocation Committees (DLACs) are chaired by the DC and have seven other members. These members include Executive Engineers of the R&H Department and the Public Works Department, and the Civil Surgeon. They are entrusted with land allocation within the district not exceeding two acres.
- The Divisional LACs are chaired by the Divisional Commissioner and have technical representation at the Superintending Engineer and Deputy Director level. These committees consider land acquisition cases involving between two and five acres of land. All cases of more than five acres go to the Central Land Allocation Committee (CLAC). This committee is chaired by the Minister of Land Administration and has technical representation at the Secretary level. In 1989, the Government ordered that in all cases involving the acquisition of land exceeding 10 bighas, the President would have to give consent.

2.3.5 Framework for Leasing of Government (Khas) Agricultural Land

The rules for managing and leasing Government-owned (khas) land are framed in two notifications in the Bangladesh Gazette: (1) Notification: Bhumo/Sha-8/Kha-jo-bo/46/84/261, Bangladesh Gazette Extra Edition, May 12, 1997, pp 1527-1536; and (2) Notification: Shuno/Sha-4/Kri-kha-jo--bo-1/98-264, Bangladesh Gazette, September 15, 1998.

Under these regulations, the Government leases cultivable agricultural land in the rural areas to landless farming households. The allotments cannot be more than one acre, except in the southern districts where up to 1.5 acres of char land can be allotted. A landless family is defined as one that works in agriculture and may own a homestead, but has no arable land of its own. Given this basic definition, five groups of landless families are given priority in the allotment of leases:

- families of freedom fighters;
- families who have lost all their land due to erosion;
- widows with an adult son capable of working the land;
- farmers with homesteads but no land;' and
- farmers who have lost all their land due to land acquisition under the eminent domain laws.

The regulation further defines the structure and responsibilities for the management and leasing of Khas Lands at the National, District, and Thana levels.

2.3.6 Other Relevant National Legal Instruments for the Project

Table 2.3-1 presents an outline of other National legal instruments that will have relevance to the proposed Project with respect to the social and environment considerations.

Table 2.3-1 National Legal Instruments relevant to the Project

Act/ Rule/ Law/ Ordinance	Enforcement Agency – Ministry/ Authority	Key Features	Applicability to proposed Project
The Environment Conservation Act, 1995 and subsequent amendments in 2000 and 2002	Department of Environment Ministry of Environment and Forests,	• Define Applicability of environmental clearance • Regulation of development activities from environmental perspective • Framing applicable limits for emissions and effluents • Framing of standards for air, water and noise quality • Formulation of guidelines relating to control and mitigation of environmental pollution, conservation and improvement of environment • Declaration of Ecologically critical areas	Applicable
Environmental Conservation Rules, 1997 and subsequent amendments in 2002 and 2003	Department of Environment Ministry of Environment and Forests	• Declaration of Ecologically critical areas • Requirement of environmental clearance certificate for various categories of projects • Requirement of IEE/EIA as per category • Renewal of the environmental clearance certificate within 30 days after the expiry • Provides standards for quality of air, water and sound and acceptable limits for emissions/discharges from vehicles and other sources	Applicable Projects falls under Red Category and require environmental clearance
Environment Court Act, 2000 and subsequent amendments in 2002	Ministry of Environment and Forests and Judiciary	• GOB has given highest priority to environment pollution • Passed 'Environment Court Act, 2000 for completing environment related legal proceedings effectively	Applicable for completing environmental legal requirements effectively
he Vehicle Act, 1927; The Motor Vehicles Ordinance, 1983; and The Bengal Motor Vehicle Rules, 1940	Bangladesh Road Transport Authority	• Exhaust emissions • Vehicular air and noise pollution • Road/traffic safety • Vehicle Licensing and Registration • Fitness of Motor Vehicles • Parking by-laws.	Applicable for proposed Project in relation to road transport
The Removal of Wrecks and Obstructions in inland Navigable Water Ways Rules 1973	Bangladesh Water Transport Authority	• Removal of wrecks and obstructions in inland navigable waterways	Applicable as canal- inland navigable waterway will be used for transport of equipment for the Project
Water Supply and Sanitation Act, 1996	Ministry of Local Government, Rural Development and Cooperatives	• Management and Control of water supply and sanitation in urban areas.	Not directly applicable, however, indirectly applicable when considering water usage management and sanitation facilities

Act/ Rule/ Law/ Ordinance	Enforcement Agency – Ministry/ Authority	Key Features	Applicability to proposed Project
The Ground Water Management Ordinance, 1985	Upazila Parishad	• Management of ground water resources • Installation of tube-wells at any place after license from Upazila Parishad only	Proposed Project will use surface water source however, should groundwater also be required then licenses will need to be obtained prior to installation of any tube-wells.
The Forest Act, 1927 and subsequent amendments in 1982 and 1989	Ministry of Environment and Forests	• Categorization of forests as reserve, protected and village forests • Permission is required for use of forest land for any non-forest purposes	Not applicable as proposed Project is not on forest land
The Private Forests Ordinance Act, 1959	Regional Forest Officer, Forest Department`	• Conservation of private forests and for the afforestation on wastelands	Not Applicable
Bangladesh Wild Life (Preservation) Act, 1974	Ministry of Environment and Forest; Bangladesh Wild Life Advisory Board	• Preservation of Wildlife Sanctuaries, Parks, and Reserves	Not applicable as the Project study area does not have any wildlife areas
National Biodiversity Strategyand Action Plan (2004)	Ministry of Environmentand Forest Bangladesh Wild LifeAdvisory Board	• Conserve, and restore the biodiversity of the country for well being of the present and future generations • Maintain and improve environmental stability for ecosystems • Ensure preservation of the unique biological heritage of the nation for the benefit of the present and future generations • Guarantee the safe passage and conservation of globally endangered migratory species, especially birds and mammals in the country • Stop introduction of invasive alien species, genetically modified organisms and living modified organisms	Applicable for conservation of bio-diversity
National Water Bodies Protection Act, 2000	Town development authority/Municipalities	• The characterization of water bodies as rivers, canals, tanks or flood plains identified in the master plans formulated under the laws establishing municipalities in division and district towns shall not be changed without approval of concerned ministry	Applicable due to the proximity to and use of surface water bodies
The Protection and Conservation of Fish Act 1950 subsequent amendments in 1982	Ministry of Fisheries and Livestock	• Protection and conservation of fish in Government owned water bodies	Applicable for the conservation of fish as the intake and outfall point will be the canal
The Embankment and Drainage Act 1952	Ministry of Water Resources	• An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion and other	Applicable due to the site location

Act/ Rule/ Law/ Ordinance	Enforcement Agency – Ministry/ Authority	Key Features	Applicability to proposed Project
		damage by water	
Antiquities Act, 1968	Ministry of Cultural Affairs	• This legislation governs preservation of the national cultural heritage, protects and controls ancient monuments, regulates antiquities as well as the maintenance, conservation and restoration of protected sites and monuments, controls planning, exploration and excavation of archaeological sites	Not applicable as the study area does not have any likely cultural heritage or ancient monuments of national or international significance. However in case, any such evidence of archaeological findings arise, the Project will act in consonance to the Act
The Acquisition and Requisition of Immovable Property Ordinance 1982 and subsequent amendments in 1994, 1995 and 2004	Ministry of Land	• Current GOB Act and Guidelines, relating to acquisition and requisition of land	Applicable
Administrative and Regulatory Guidelines and Instructions for Land Acquisition	Ministry of Land	• Regulation of land acquisition process by certain administrative instructions and procedural requirements	Applicable
Framework for Leasing of Government (Khas) Agricultural Land	Ministry of Land	• The rules for allotting and leasing Government-owned (khas) land to land less families	Not directly applicable but indirectly if a family becomes landless in the process of acquisition
The Building Construction Act 1952 and subsequent amendments	Ministry of Works	• This act provide for prevention of haphazard construction of building and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh	Applicable
The Factories Act, 1965 Bangladesh Labour Law, 2006	Ministry of Labour	• This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions	Applicable
Ozone Depleting Substances (Control) Rules, 2004	Ministry of Environment and Forests	• Ban on the use of Ozone depleting substances • Phasing out of Ozone depleting substances	Applicable
Noise Pollution (Control) Rules 2006	Ministry of Environment and Forests	• Prevention of Noise pollution • Standards for noise levels	Applicable

Source: Websites of DOE, Legislative and Parliamentary Affairs Division:: Bangladesh Laws and Bangladesh Board of Investment: Business laws

2.4 ADMINISTRATIVE FRAMEWORK RELATED TO ENVIRONMENT IN BANGLADESH

The Ministry of Environment & Forests (MoEF) is the nodal agency in the administrative structure of the GOB, for overseeing all environmental matters relating to national environmental policy and regulatory issues in the country. The MoEF oversees the activities of the following technical/implementing agencies:

- Department of Environment (DOE);
- Forest Department (FD);
- Bangladesh Forest Industries Development Corporation (BFIDC);
- Bangladesh Forest Research Institute (BFRI); and
- Bangladesh National Herbarium (BNH).

Other Related Organizations

There are several other organizations under the administrative framework which would govern social and environmental functions related to the proposed Project, namely:

- Forest Department;
- Ministry of Land: Land reform and land acquisition directorate;
- Ministry of water resources: Bangladesh Water Development Board; and
- Local Government Engineering Department (LGED).

2.4.2 Department of Environment (DOE)

The DOE has been placed under the MoEF as its technical wing and is statutorily responsible for the implementation of the Environment Conservation Act, 1995. The Department was created in 1989, to ensure sustainable development and to conserve and manage the environment of Bangladesh.
The principal activities of the DOE are:

- Defining EIA procedures and issuing environmental clearance permits the latter being the legal requirement before the proposed Project can be implemented;
- Providing advice or taking direct action to prevent degradation of the environment;
- Pollution control, including the monitoring of effluent sources and ensuring mitigation of environmental pollution;
- Setting the Quality Standards for environmental parameters;
- Declaring Ecologically Critical Areas (ECAs), where the ecosystem has been degraded to a critical state; and
- Review and evaluation of Initial Environmental Examinations (IEEs) and EIAs prepared for projects in Bangladesh.

Environmental Clearance Process

As mentioned in the Section 2.3.2, ECR has classified projects to be assessed by the DOE in four categories based on the severity of impacts on IECs:

- Green: Nil;
- Orange A: minor;

- Orange B: medium; and
- Red: severe.

The applicability of Environmental clearance and the process in Bangladesh is described in Figure 2.4-1.

The EIA process consists of three stages, screening, IEE, and detailed EIA:

- Projects categorized as Green and Orange-A requires no IEE or EIA for environmental clearance however, the proponent has to submit an application in a prescribed format along with specified documents;
- Projects categorized as Orange-B require an IEE to be submitted to the DOE along with an application in a prescribed format and other specified documents; and
- Red category projects require both IEE and EIA. An IEE is required for the location clearance and an EIA is required for the environmental clearance.

As per the ECR 1997, power plants and the subject project fall under the Red category as they fall within the following:

- Item 6: power plants; and
- Item 64: construction/ replacement/ extension of natural gas pipelines.

The process for obtaining an Environmental Clearance Certificate (ECC) for the proposed Project is outlined in Figure 2.4-2.

Figure 2.4-1 DOE Environmental Clearance Applicability and Procedure

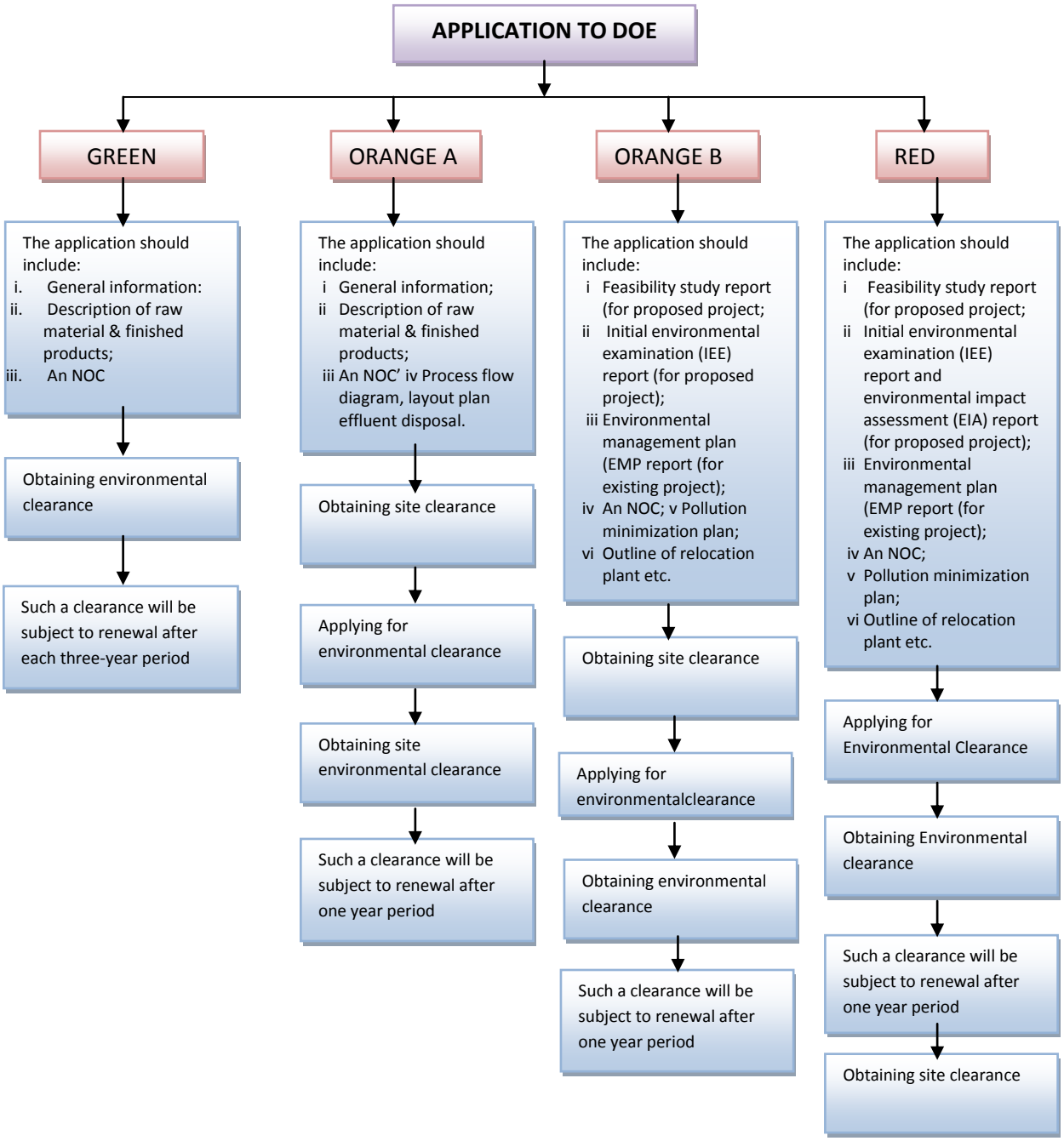
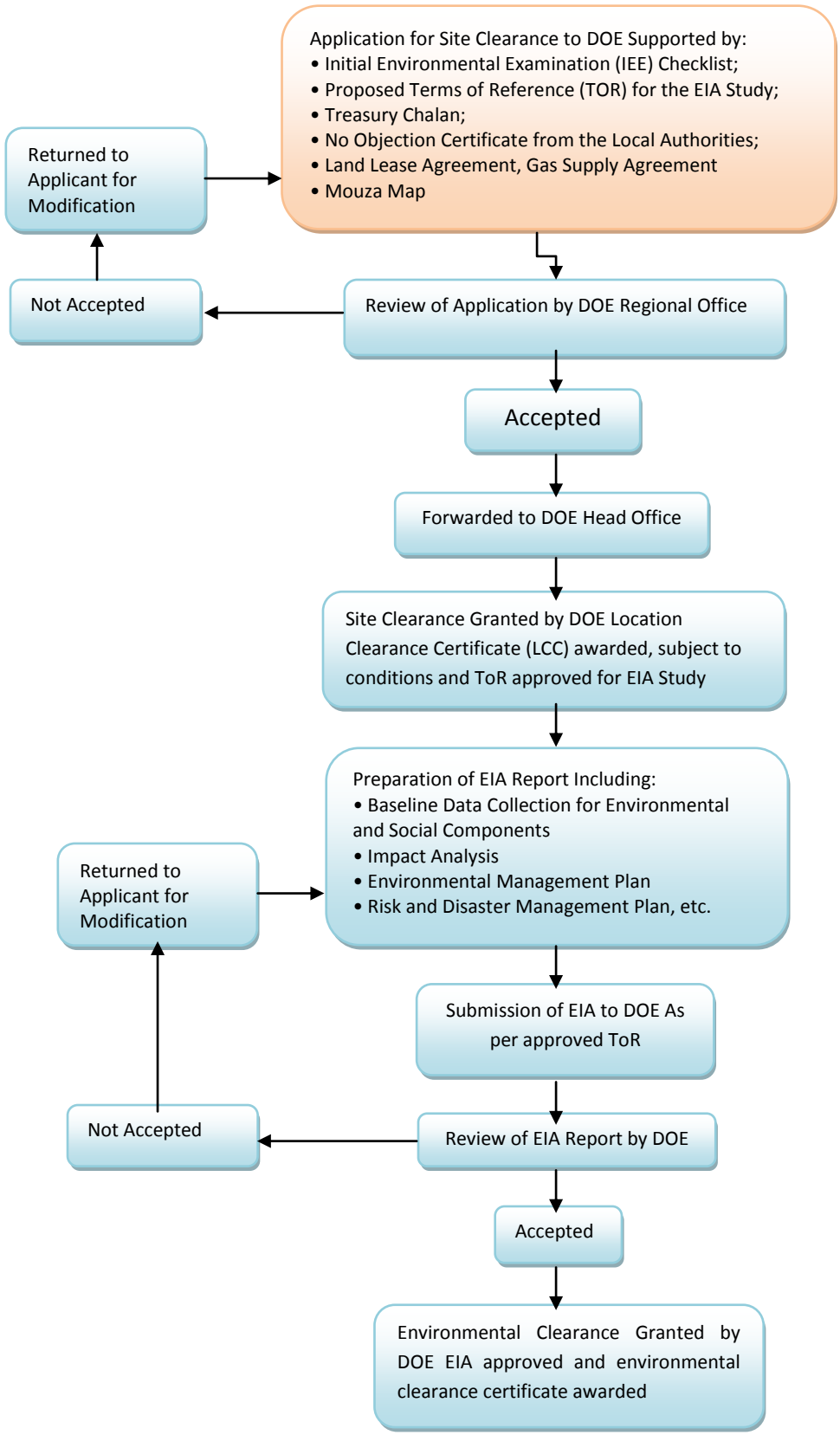


Figure 2.4-2 Flowchart of EIA Process Applicable to the Proposed Project



2.4.3 Status of Project Approval from DOE

The Project has received ECR from the DOE on 31st March, 2014 subject to conditions to be fulfilled during the plant operation. The management of the plant MCPL is determined to fulfill the conditions attached to EIA clearance.

This ESIA Report is a revised version of EIA report prepared for re-financing of the project under IPPF project funded by World Bank to fulfill the safeguard requirements of World Bank.

2.5 INSTITUTIONAL ARRANGEMENTS RELATED TO LAND ACQUISITION IN BANGLADESH

The administrative set up for land acquisition has two tiers under the Ministry of Land Administration. At the Division level, there is an Additional Commissioner dealing with land administration under the Commissioner. At the district level, there is an Additional Deputy Commissioner in charge of land administration. Under him, there is at least one Land Acquisition Officer and several Assistant Land Acquisition Officers. The number of officers depends on the size of the District. Non-gazette officers in the land administration include Kanungos and surveyors.

2.6 PROJECT RELEVANT INTERNATIONAL TREATIES AND CONVENTIONS

Bangladesh is party to a number (30) of international environmental convention, treaties and agreements. The Project relevant international treaties and conventions relevant to the project signed, ratified and in the process of ratification by Bangladesh are detailed in Table 2.6-1.

Table 2.6-1 Project Relevant International Treaties and Conventions

Environment related International convention and Treaties	Status
International Plant Protection Convention (Rome, 1951.)	01.09.78 (ratified)
International Convention for the Prevention of Pollution of the Sea by Oil (London, 1954 (as amended on 11 April 1962 and 21 October 1969.)	28.12.81 (entry into force)
Plant Protection Agreement for the South East Asia and Pacific Region (as amended) (Rome, 1956.)	04.12.74 (accessed) (entry into force)
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (Brussels, 1969.)	04.02.82 (entry into force)
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971) ("Ramsar Convention").	20.04.92 (ratified)
Convention Concerning the Protection of the World Cultural and natural Heritage (Paris, 1972.)	03.08.83 (accepted)03.11.83 (ratified)
Convention on International Trade in Endangered Species of Wild Fauna and flora (Washington, 1973.) ("CITES Convention")	18.02.82 (ratified)
United Nations Convention on the Law of the Sea (Montego Bay, 1982.)	10.12.82 (ratified)
Vienna Convention for the Protection of the Ozone Layer (Vienna, 1985.)	02.08.90 (accessed) 31.10.90 (entry into force)
Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal 1987.)	02.08.90 31.10.90 (accessed) (entry into force)
London Amendment to the Montreal Protocol on substances that Deplete the Ozone Layer (London, 1990)	18.03.94 (accessed) 16.06.94 (entry into force)
Copenhagen Amendment to the Montreal protocol on Substances that	27.11.2000 (accepted) 26.2.2001 (entry into

Environment related International convention and Treaties	Status
Deplete the Ozone Layer, Copenhagen, 1992	force)
Montreal Amendment of the Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1997	27.7.2001 (Accepted) 26.10.2001 (Entry into force)
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel, 1989.)	01.04.93 (accessed)
International Convention on Oil Pollution Preparedness, Response and Cooperation (London, 1990.)	30.11.90 (signed) In the process of ratification
United Nations Framework Convention on Climate Change, (New York, 1992.)	09.06.92 (signed) 15.04.94 (ratified)
Convention on Biological Diversity, (Rio De Janeiro, 1992.)	05.06.92 (signed) 03.05.94 (ratified)
International Convention to Combat Desertification, (Paris 1994.)	14.10.94 (signed) 26.01.1996 (ratification) 26.12.1996 (entry into force)
Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, (Geneva, 1976.)	03.10.79 (accessed) (entry into force)
Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 (New York, 1994.)	28.07.96 (signed)
Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (Paris, 1993.)	14.01.93 (signed)
Convention on persistent Organic Pollutants, Stockholm	23.5.2001 (signed) 12.03.2007 (ratified)
Kyoto protocol to the United Nations Framework Convention on Climate Change	21.8.2001 (accessed)

Source: DOE

2.7 World Bank REQUIREMENTS

Any project that would be implemented with financial assistance from the World Bank, the WB requires that the project needs to follow its operational policy. In 1989 the World Bank adopted "Operational Directive (OD) 4.00–Annex A: Environmental Assessment", Environmental Assessment (EA) has become a standard procedure for Bank financed investment projects. The directive was amended as OD 4.01 in 1991 and was converted into Operational Policy (OP) 4.01 (Annex-II) in 1999 (World Bank, 1999).

According to the World Bank policy, the primary responsibility for the Environmental Assessment (EA) process lies with the borrower. The Bank's role is to advise borrowers throughout the process and ensure that practice and quality are consistent with EA requirements and that the process is integrated effectively into project preparation and implementation. OP 4.01 **(Annex-I)** provides the principles and procedures for implementing the EA process. It states that the purpose of EA is to improve decision making and to ensure that the project options under consideration are environmentally sound and sustainable. The OP further notes that the EA is a sufficiently flexible process to allow environmental issues to be addressed in a timely and cost-effective fashion during project preparation and implementation and to help avoid costs and delays due to unanticipated environmental problems.

The Environmental, Health, and Safety (EHS) Guidelines of the International Finance Corporation (IFC) of the World Bank Group are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP) (2007). These

General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on EHS issues in specific industry sectors. The generally achievable performance levels and measures in new facilities using the existing technologies at a reasonable cost are provided in the EHS Guidelines. Site specific targets with an appropriate time frame are first established in applying the EHS Guidelines. As noted earlier, according to the World Bank (1999a) operational policy OP 4.01, this project has been classified as an Environmental Category-A project. Category-A projects are expected to have significant impacts that may be sensitive, diverse or unprecedented and require full EA.

World Bank's Pollution Prevention and Abatement Handbook (WB, 1999a)) has been consulted extensively particularly on air emission and wastewater discharge standards in assessing air and water quality impacts as well as noise level due to proposed plant construction and operation. Other relevant documents (WB, 2004a, and b) of the World Bank have also been consulted, particularly for assessment of social impacts.

2.8 IFC PERFORMANCE STANDARDS

The Performance Standards (PS) (January 2012) established by IFC stipulates that the Project shall meet certain requirements throughout the life cycle of an investment by IFC or other relevant financial institution such as other DFIs (e.g. DEG, FMO) or commercial banks, which are signatory to the Equator Principles, 2006.

2.8.1 Brief on IFC Performance Standards, 2012

A brief description of the Performance standards is provided in **Table 2.8-1.**

Table 2.8-1 IFC Performance Standards

Performance Standards	Specific Areas
Performance Standard 1	Assessment and Management of Environmental and Social Risks and Impacts
Performance Standard 2	Labour and Working Conditions
Performance Standard 3	Resource Efficiency and Pollution Prevention
Performance Standard 4	Community Health, Safety and Security
Performance Standard 5	Land Acquisition and Involuntary Resettlement
Performance Standard 6	Biodiversity Conservation and Sustainable Management of Living Natural Resources
Performance Standard 7	Indigenous Peoples
Performance Standard 8	Cultural Heritage

IFC Performance Standards, January 2012

These PS and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts. A brief on the requirements as laid down in the performance standards is described in the following subsections.

2.8.2 Major Tenets of IFC Performance Standards

This sub section tries to provide the requirements of the specific PS, so as to set up the context for matching the requirements of these PS during the various stages of the life cycle of the Project.

PS 1: Assessment and Management of Environmental and Social Risks and Impacts

The PS 1 requires Social and Environmental Assessment and Management Systems for managing social and environmental performance throughout the life cycle of this Project and runs through all subsequent PSs. The main elements of PS 1 include:

- A Social and Environmental Assessment to understand the social and environmental impacts and risks;
- A Management Program for mitigating the impacts and minimizing the risks identified in the assessment;
- Establishing and ensuring organizational capacity and requisite trainings to the staff to implement the Management Programme;
- Engagement with the community to ensure free prior informed consultation (FPIC), community grievance redress constructive relationship all through the project life cycle; and
- Adequate monitoring and reporting systems to measure and report the effectiveness of the Management Programs.

The social and environmental performance is a continuous process to be initiated by the management and would involve communication between the organization, its workers and local communities directly affected by the Project. The PS requires that Project proponent initiate regular assessment of the potential social and environmental risks and impacts and consistently tries to mitigate and manage strategy on an ongoing basis.

PS 2: Labour and Working Conditions

The economic growth through employment creation and income generation is recognized and balanced protecting the basic rights of workers. PS 2 is guided by the various conventions of International Labour Organization (ILO) and outlines the minimum requirements of working conditions, protection to the workforce (including issues of child and forced labour) and ensuring occupational health and safety of both its 'employees' as well as 'non employees' working through contractors. The PS requires:

- Establishment of a sound worker-management relationship;
- Encouraging equal opportunity and fair treatment of workers;
- Promoting compliance with national labour and employment laws; and
- Promoting healthy and safe working conditions for workers.

PS 2 requires project proponents to conduct its activities in a manner consistent with the four core labour standards (child labour, forced labour, non discrimination, and freedom of association and collective bargaining). In addition, PS 2 also addresses other areas such as working conditions and terms of employment, retrenchment, and occupational health and safety issues.

Some of these requirements refer to the applicable national law. Whereas national law establishes standards that are less stringent than those in PS 2, or are silent, the project proponent is expected to meet the requirements of PS 2.

PS 3: Resource Efficiency and Pollution Prevention

PS 3 outlines the approach to pollution prevention and abatement in line with internationally disseminated technologies and practices with objectives to:

a) avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from activities; and
b) promote the reduction of emissions that contribute to climate change. PS 3 requires a project to avoid, minimize, or reduce adverse impacts on human health and environment by adopting pollution preventive and control technologies throughout the Project life cycle.

PS 3 outlines a project approach to Pollution Prevention and Abatement (PPA) in line with internationally disseminated technologies and practices. It describes the measures to take into account the potential impact of emissions on the ambient conditions (such as ambient air quality) and seek to avoid or minimize these impacts within the context of the nature and significance of pollutants emitted.

PS 4: Community, Health, Safety and Security

PS 4 concentrates on the responsibility that must be undertaken by the client to avoid or minimize the risks and impacts to the community's health, safety and security that may arise from project activities. PS 4 require a project to evaluate risks and impacts to the health and safety of the affected community during the Project life cycle and establish measures to avoid minimize and reduce risks and impacts from the Project.

PS 4 recognizes that project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development. However, projects can also increase the potential for community exposure to risks and impacts arising from equipment accidents, structural failures, and releases of hazardous materials. The performance standard details out project proponents responsibility to avoid or minimize the possible risks and impacts to community health, safety and security that may arise from project activities.

PS 5: Land Acquisition and Involuntary Resettlement

The objectives of this PS are to:

- Avoid or at least minimize the involuntary resettlement wherever feasible by exploring alternative project designs;
- Mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons' use of land by:
    - Providing compensation for loss of assets at replacement cost; and

  - Ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected.
- Improve or at least restore the livelihoods and standards of living of displaced persons; and
- Improve living conditions among displaced persons through provision of adequate housing with security of tenure at resettlement sites.

PS 5 require a project to consider various processes and systems to avoid /minimize social and economic impacts related to land acquisition and resettlement.

This PS applies to physical or economic displacement resulting from the following types of land transactions:

- Type I: Land rights for a private sector project acquired through expropriation or other compulsory procedures;
- Type II: Land rights for a private sector project acquired through negotiated settlements with property owners or those with legal rights to land, including customary or traditional rights recognized or recognizable under the laws of the country, if expropriation or other compulsory process would have resulted upon the failure of negotiation; and
- This PS does not apply to resettlement resulting from voluntary land transactions (ie market transactions in which the seller is not obliged to sell and the buyer cannot resort to expropriation or other compulsory procedures if negotiations fail). The impacts arising from such transactions shall be dealt with as under PS1, though sometimes, when risks are identified, the project proponent may decide to adhere to PS 5 requirements even in willing buyer-seller cases.

PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

PS 6 aims at protecting and conserving biodiversity, the variety of life in all its forms, including genetic, species and ecosystem diversity and its ability to change and evolve, is fundamental to sustainable development. The components of biodiversity, as defined in the Convention on Biological Diversity, include ecosystems and habitats, species and communities, and genes and genomes, all of which have social, economic, cultural and scientific importance. This PS addresses how clients can avoid or mitigate threats to biodiversity arising from their operations as well as incorporate sustainable management of renewable natural resources.

PS 6 recognizes that protecting and conserving biodiversity- the variety of life in all its forms, including genetic, species and ecosystem diversity- and its ability to change and evolve, is fundamental to sustainable development. It reflects the objectives of the Convention on Biological Diversity to conserve biological diversity and promote use of renewable natural resources in a sustainable manner.

PS 7: Indigenous Peoples

PS 7 acknowledges the possibility of vulnerability of indigenous people owing to their culture, beliefs, institutions and living standards, and that it may further get compromised by one or other project activity throughout the life cycle of the project. The PS underlines

the requirement of avoiding / minimizing adverse impacts on indigenous people in a project area, respecting the local culture and customs, fostering good relationship and ensuring that development benefits are provided to improve their standard of living and livelihoods.

PS 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from dominant groups in national societies, are often among the most marginalized and vulnerable segments of the population. The term "indigenous people" is more clearly defined in the IFC Guidance Note for PS 7.

Objectives of PS 7 underscore the need to avoid adverse project impacts on Indigenous Peoples' communities living in the project's area of influence, or where avoidance is not feasible, to minimize, mitigate or compensate for such impacts through mechanisms that are tailored to their specific cultural characteristics and expressed needs of the Indigenous Peoples, in a manner commensurate with the scale of project risks and impacts.

PS 8: Cultural Heritage

PS 8 aims to protect the irreplaceable cultural heritage and to guide clients on protecting cultural heritage in the course of their business operations. In addition, the requirements of this PS on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.

PS 8 recognizes the importance of cultural heritage with an objective to:

- Protect cultural heritage from the adverse impacts of project activities;
- Support its preservation; and
- Promote the equitable sharing of benefits from the use of cultural heritage in business activities.

The PS requires the project proponent to comply with relevant national law on the protection of cultural heritage, including national law implementing the host country's obligations under the Convention Concerning the Protection of the World Cultural and Natural Heritage and other relevant international law.

2.8.3 IFC Project Categorization

As part of its review of a project's expected social and environmental impacts, IFC uses a system of social and environmental categorization. This categorization is used to reflect the size of impacts understood as a result of the client's social and environmental assessment and to specify IFC's institutional requirements. Similar to ADB, the IFC categories are:

- Category A Projects: Projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented;
- Category B Projects: Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures;
- Category C Projects: Projects with minimal or no adverse social or environmental impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks;
- Category FI Projects: All FI projects excluding those that are Category C projects.

IFC therefore categorizes project primarily according to the significance and nature of impacts. IFC defines the project's area of influence as the primary project site(s) and related facilities that the client (including its contractors) develops or controls; associated facilities that are not funded as part of the project (funding may be provided separately by a client or a third party including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of a project; areas potentially impacted by cumulative impacts from further planned development of a project; and areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that would occur without a project or independently of a project.

Categorization of the Proposed Project

With reference to the IFC's environmental and social screening criteria, it is anticipated that the proposed Gas-fired Power Plant Project will fall under Category A for the following reasons:

- **Unprecedented:** The project is a Greenfield project. The regional/spatial setting of the Project has virtually no precedence of industrial activity in the immediate vicinity. Although Ashugonj Fertilizer Factory (AFF) adjacent to site and its impacts are therefore unprecedented, cumulative and irreversible, and change the landuse of the area significantly in the long run;
- **Cumulative:** A similar capacity plant by BPDB is proposed in the immediate vicinity, although as mentioned above its schedule for development is currently unclear. Cumulative impacts on physical, biological and socio-economic environmental conditions are therefore anticipated at some point in future;
- **Irreversible:** Environmental impacts of the project are anticipated during the construction and operation of the power plant and the laying of the natural gas pipeline. The irreversible impacts will encompass air emissions and air quality, noise and vibration, water supply and wastewater discharge, erosion and runoff, impacts on drainage, impacts on fisheries, health and safety impacts, traffic management, gas pipeline risks and solid wastes;
- **Diverse:**The diverse nature of activities related to the power plant will have impact;
- **Power:**The proposed project will support in providing reliable electricity for domestic use, small and medium size industrial activities and generation of employment opportunities. In addition, it is proposed that surplus power be provided for other parts of the country.

2.8.4 IFC EHS Guidelines

During the design, construction, and operation of the project the borrower/client will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. These standards contain performance levels and measures that are normally acceptable and applicable to projects. For this purpose IFC EHS guidelines are recommended.

The Environmental, Health, and Safety (EHS) General Guidelines (April 30, 2007) will be applicable for this Project. In addition to that, IFC's Sector specific EHS Guidelines for Thermal Power Plants (December 19, 2008) will also apply.

2.9 APPLICABLE EHS STANDARDS

The EHS standards as stipulated in ECR 1997 and amendments of DOE as well as in the IFC EHS guidelines (General and Thermal Power Plant specific) for air quality, surface and ground water quality, ambient noise levels, emissions and effluent discharge have been presented in the environmental baseline section **(Chapter 5)** as well as in impact assessment section **(Chapter 6)** for comparison with the baseline conditions and predicted impacts, respectively.

CHAPTER-3
DESCRIPTION OF THE PROPOSED PROJECT

3.1 TYPE OF THE PROJECT

Construction of 51 MW Gas Fired Power Plant at Ashugonj, Brahmanbaria isanatural gas based power generation plant. The power plant is designated for continuous base load operation. It can also be used in Stand-by mode.The operation principle is according to electrical demand. The control of electrical production bases on parallel with grid operation.

Auxiliary cooling is arranged with air-cooled radiators and auxiliary cooling system is dimensioned for power without heat production.Electric power will be generated by gas generating set. The engine is capable of running at rated output continuously. For other conditions the power will be adjusted.

3.2 LOCATION & APPROACH ROAD OF THE PROJECT

The concerned power plant named Midland Power Co. Ltd. is being established at Ashugonj in Brahmanbaria district. The selected site for Midland Power Co. Ltd. is nearly 5-6 km away from Brahmanbaria district city centre. The proposed site of the project is on the south side of Dhaka-Sylhet highway and very close to the Ashugonj Fertilizer and Chemical Complex Ltd. (AFCCL). Northern side of the project there are Govt. SILO and after that Dhaka-Sylhet highway and Bhairab Meghna Bridge exist. Eastern side of the project there is Govt. establishment (GTCL), approach road to AFCCL and after that vacant land exists. Meghna River is very adjacent to the western side of the project. Bhairab Railway Station is about 1.5-2 KM away towards northwest from the project site. The project site will enjoy the infrastructural facilities such as electricity, water, telecommunication, etc. The access to the project site, project location sketch map and layout plan of the project with its surroundings has been shown in **Fig-3.2-1**&**Fig-3.2-3**. Project site is well connected with the national road linking system. A satellite image describing the project location considering the existing scenario inscribed within 5km radius is shown in **Figure 3.2-2**.

3.2.1 ELECTRICAL INTERCONNECTION FOR POWER EVACUATION

MPCL will establish a substation in their project compound. This substation will be connected from gas engine generator and then the generated electricity will be transmitted from the substation to the PGCB grid through 4.2Km transmission line. MPCL will be responsible to construct this transmission line. Figure-3.2-1 shows the electrical interconnection for power evacuation with green lined diagram. It may be proposed for EMP and ECR with due approval of TOR from DOE.

3.2.2 FUEL TRANSPORTATION

The fuel of the power plant (Natural gas)will be collected from nearby Gas Valve station of GTCL which is 1.05 km away from the RMS of the MPCL compound. MPCL will be responsible for the installation of this pipeline. The black line diagram of Figure-3.2-1 shows

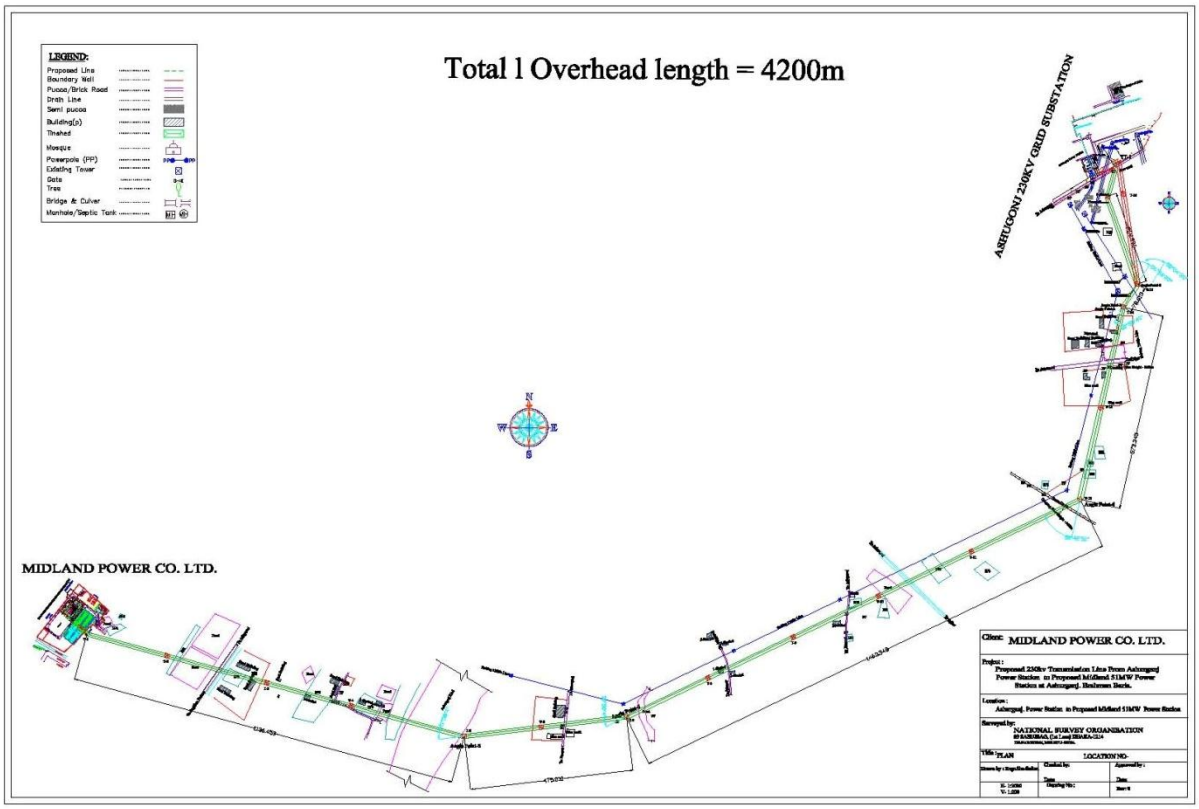
the fuel transportation of the proposed power plant. It may be proposed for EMP and ECR with due approval of TOR from DOE.

3.3 PROJECT INFORMATION IN BRIEF

The basic data of the project are furnished in Table-3.3-1.

Table-3.3-1: Basic data of "Midland Power Co. Ltd."

1.	Name of the Project	: Midland Power Co. Ltd
2.	Type of Industry	: Power Generation Company
3.	Project Proponent	: Mr. Feroz Alam, Managing Director
4.	Contact Address	: YOUTH TOWER, 822/2, Rokeya Sarani, Dhaka-1216.
5.	Project Location	: Ashugoanj, Brahmanbaria.
6.	Total Area of the project	: 3.76 acres
7.	Name of the Raw Materials	: Natural Gas
8.	Quantity required (raw material)	: 12 MMCFD
9.	Final Product	: Electricity
10.	By-product, if any	: None
11.	Plant Capacity	: 51 MWH
12.	Project Cost	: TK. 24533.19 Lac
13.	Engine Manufacturer	: Rolls Royce-Norway
14.	Engines	: Bergen
15.	Fuel Requirement	: 12 MMCFD (Natural Gas)
16.	Fuel Source	: Bakhrabad Gas System pd., Ltd. Feni
17.	Water source	: Deep Tube- Well
18.	Water requirement	: 5000 L/day
19.	Waste water generation	: 2000 L/day
20.	Gaseous emission	: 31484 ft^3 / min
21.	Gaseous emission procedure	: Exhaust Manifold (20m high exhaust stack)
22.	Date of Commencement	: January 2012
23.	Date of Completion	: September 2012
24.	Total Manpower	: 70 Persons



Electrical Interconnection for Power Evacuation

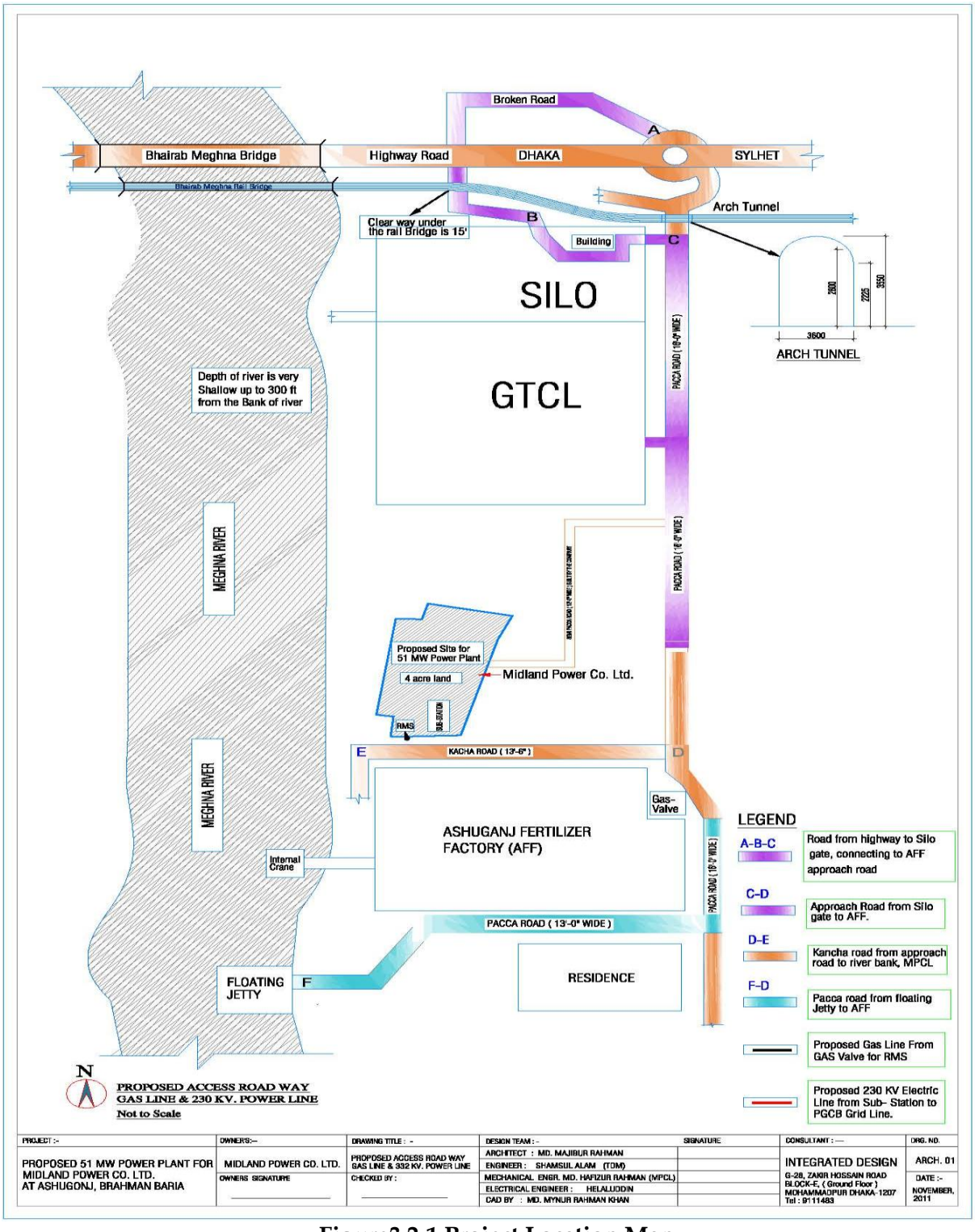


Figure3.2-1 Project Location Map

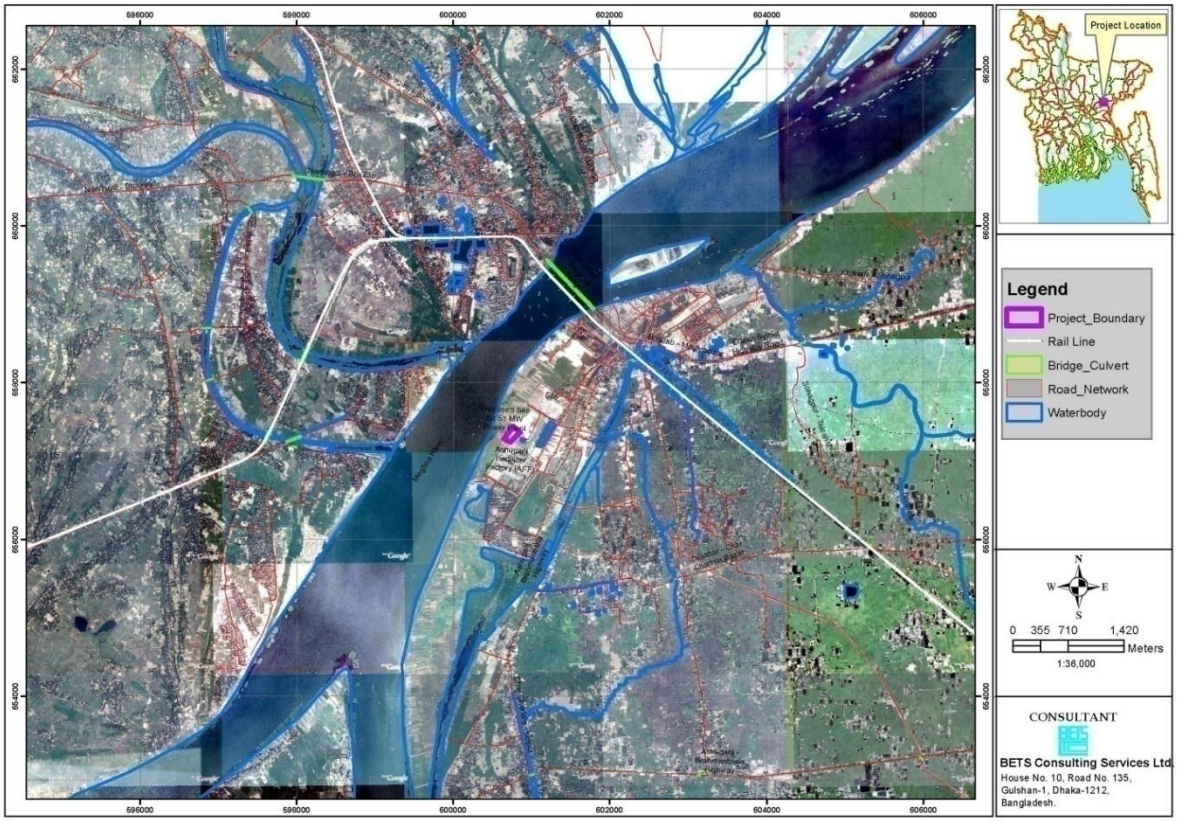


Figure 3.2-2 Project Location in Satellite Image

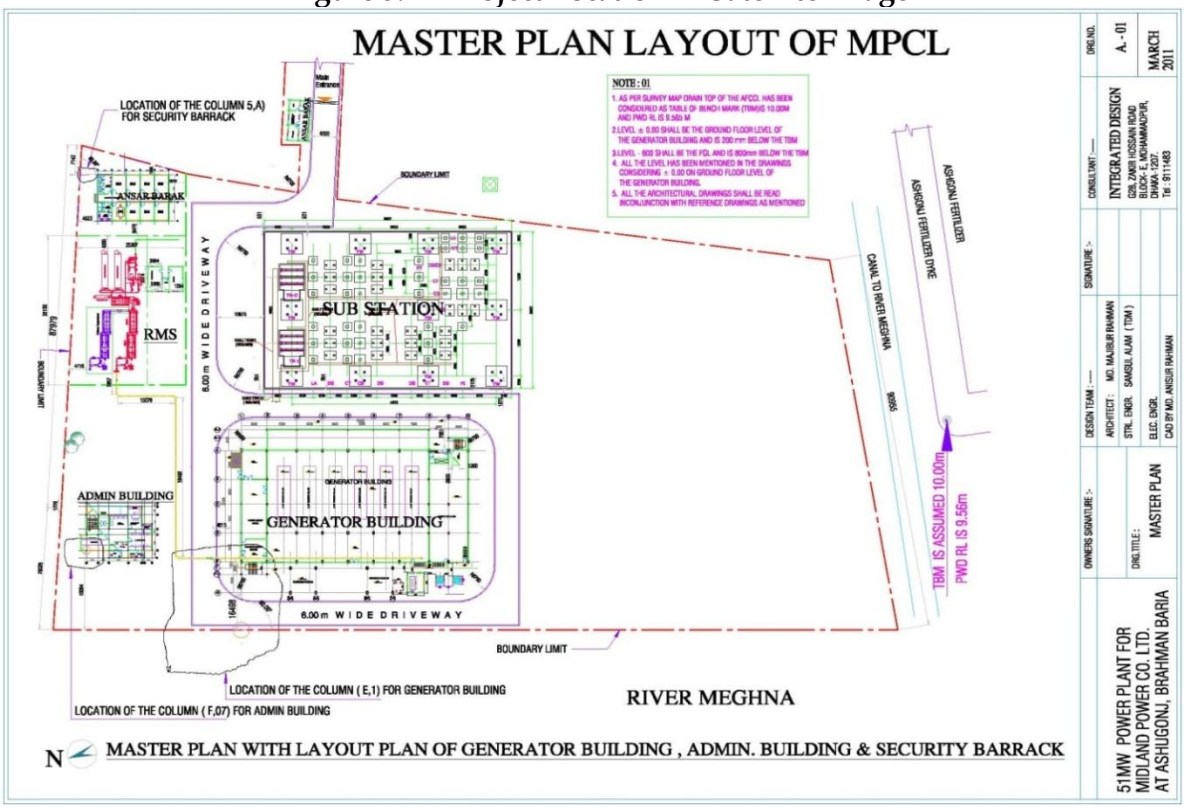


Figure 3.2-3 Layout Plan of the Project Area

3.4 PRESENT STATUS OF THE PROJECT

The construction work for developing infrastructure for the project started in January, 2012. The site development work for construction of major items for development during construction phase of factory building, office building, guard house, water pump house, etc and construction of drainage and sewer lines also started as well.The power plantis in operation from 7 December 2013. Environmental Clearance Certificate (ECC) from the Department of Environment (DOE) was issued for this project in 31March 2014. The issued ECC is annexed in **Annex-II** of this report. This ESIA report is prepared for the World Bank considering the no project scenario and therefore important environmental and social issues of Construction & Operation Phases of the project are carefully taken care of for assessment.

3.5 RESOURCES AND UTILITIES

a) Gas

The project at full capacity shall require approximately 12 MMCFD for its Gas Generator, etc. The project will have gas connection from Bakhrabad Gas System Ltd. For which necessary arrangements for getting the gas connection has been done. The main gas delivery line and riser point of 'Bakhrabad Gas System Ltd.' exists very near from the project premise.

b) Water

The plant will not consume water for its operation as the gas engine has a dry low NO_x control and all cooling operations will be performed by air. Water consumption will only be in the form of domestic water consumption by the plant's personnel. The water will be supplied from Deep Tube well to be drilled on and around the site. It has been estimated that nearly 5,000 liter/day water will be required for domestic purposes. Water will be stored in underground reservoir and lifted to overhead tank by pump and motor.

c) Labour force required

During Construction Phase

The major construction works include construction of factory building, office building, water pump house, and construction of, wares house, etc. The construction works of the project is expected its completion within 09 months period. During factory erection and setting up of machinery a good number (about 200) of skilled; semi-skilled and daily wage labors will get job opportunity in the project. In addition to that this project will create employment opportunity to a number of persons indirectly by giving business to them.

During Operation Phase

This project will create direct job opportunity for about 70 people in various official capacities.

3.6 POWER GENERATION METHOD

Electrical supply and distribution is as follows-

- Gas Engine is connected directly to generator by a flexible coupling
- Generator is cabled to medium voltage switchgear
- Medium voltage current is led to low voltage switchgear station service station
- transformer
- Direct current system is for medium voltage switchgear operations and for instrumentation.

Station will be delivered with an auxiliary cooling arrangement by dry cooler. The start-up and loading time of the engine depends on the preheating level of the engine. When properly preheated, the engine can be loaded to full power within minutes.
If the Gas Engine is in cold condition, it can be started after the pre-lubricating oil pump has reached the required pressure. It shall normally not be loaded faster than what mentioned in the operating manual. Faster loading is possible in case of emergency.

3.7 PLANT OPERATION

The operation of the generating set and the auxiliaries needed is carried out from the turbine control computer in a separate control room. The operation method is automatic with automatic synchronizing. Also the whole plant is controlled and monitored from this screen. The power plant control and supervision system is designed for unattended operation with a daily control and check-up routines.

Control and supervision system is based on PLC and computer units. System allows full control and supervision of all significant parameters in the plant, sends necessary alarm signals and takes care of the plant history recordings. Remote monitoring from the clients other control facility or automation system can be integrated into the system.

Protection of the plant is designed against hazardous faults like loss of lubricating oil pressure. From the alarm central the operators can see the most important temperatures and pressures as well as alarms before shutdowns.

The power station and the control system have been designed to operate parallel with the grid. Plant can also be operated in island mode.

3.8 PROJECT COST AND FUNDING

The total cost for site development, infrastructure development, and machinery procurement and installation costs including trial run cost for the entire industrial project has been estimated to be Tk 24533.19 lac. The yearly environmental monitoring cost of construction and operation phase of the project would be around Tk. 27 lac and around Tk. 43 lac respectively. Cost for the environmental management system and safety & occupational health of the staff during the operation phase would be Tk. 10 lac per annum. The fund for the project is organized by the proponent from equity participation and borrowed from commercial bank i.e. Standard Chartered Bank.

CHAPTER 4:
ANALYSIS OF ALTERNATIVES

4.1 GENERAL

The purpose of the analysis of alternatives as part of the ESIA process is to select best among all possible project options. The assessments and recommendations made by the EIA team are presented below.

4.2 SITE SELECTION

The critical and attentive issues for selection of power plant site are taken care of is listed below:

- Avoiding the following twelve (12) Ecologically Critical Areas: Human Settlements, Forest Sanctuaries, National Parks, Game Reserves, Mangroves, Forest Areas, Wetlands, Wildlife Habitats, Archaeological Sites, Ancient Monument Sites, Biodiversity Areas and Similar Other Areas.
- Preference of Non-productive Land: The non-productive land as an alternative just near the proposed agriculture land is preferable for environmental soundness.

The power plant land is a privately owned land and has no dispute with the locality. More on the land is out of the DOE identified twelve ecologically critically areas.

The site is well located considering the following:

- Easy access
- Close proximity to organized industrial zone
- Close proximity to the already existing national electric transmission lines
- Close proximity to the already existing natural gas transmission lines

4.3 TECHNOLOGY OPTIONS

Gas Engine power plants are self-contained, light weight and they do not require bulk water. They can be quickly installed at a lower cost than other types of power plants. Gas Engine units are high speed, low vibration quick start machines suitable for peaking power plants. These units require less space, have lower installation and maintenance cost and have simple lubrication and ignition system. Specific fuel consumption does not increase with time in Gas Engine Plants as rapidly as other IC engine based power plants. Also, poor quality of fuel can be readily used in Gas Engines. Their disadvantages are poor part load efficiency, special metal requirements, special cooling methods and short life. Gas Engine power plants are the most suitable plants that can be installed at selected load centers with fewer auxiliaries. Gas Engines can be brought on load quickly and surely.

Table 4.3-1 Summary of alternative site assessment

Sl. No.	Issues	Justification for the Selected Site
1	Land Availability	Proposed site is the private land of MPCL
2	Land Acquisition	No land acquisition is required

Sl. No.	Issues	Justification for the Selected Site
3	Land Development	Minor improvements required
4	Logistics Support (Technical and nontechnical)	No logistic support available. New logistic network is required to be developed.
5	Proximity to Load Center	Fairly close the main load center
6	Mode of Communication	• Good connectivity by roadway • Excellent water transport connectivity. Situated on the bank of the Meghna River. Waterway connectivity is essential for transporting heavy machineries. • Close to the Bhairab Meghna Rail Bridge.
7	Transmission Line	• Existing transmission lines can be utilized
8	Gas Line	• Closer to the gas Valve Station i.e. 1.05Km only and can be developed with marginal investment
9	Environmental Impact	Given modern technologies **(i.e. use of Dry Low NOx technology in this project is likely to reduce NOx emission significantly)** for control of noise, vibration and air pollution, environmental impact is expected to marginally increase. **Annex-XV** provided the Manufacturer's Specification of Engines with Emission Levels. NOx level indicates in the Specification is 250 mg/Nm3which is higher than that of WB requirement of 200 mg/Nm3. This level is the max level mentioned in the specification but the monitored level is always around 100 mg/Nm3 which is automatically monitored and recorded.
10	Time for implementation	New power generation facilities can be established and made operational within a short time

Summary on Comparative Technology Use:

As per project requirement commercial department collected offers for gen-sets and its associated plant equipment from the following gen-set manufacturer:

1. Rolls-Royce Marine AS, Norway
2. Wartsila Finland OY
3. GE Jenbacher GmbH & Co. OG, Austria
4. MWM GmbH, Germany.

After evaluation it had been perceived that the Rolls Royce engine is the most effective for the project. The average revenue earning/cost savings per kWh found highest among others, that is 0.3113 tk/kWh after adjustment of all expenses.

After negotiation with the Equipment manufactures considering the price, delivery period, reputation, after sales service and world Renowned Brand by the Executive Committee finally selected Rolls-Royce as a Main Equipment Supplier for this project. Technical Comparison with Investment Analysis of MPCL is annexed in **Annexure-XVIII**.

4.4 NO PROJECT SCENARIO

Bangladesh is facing a major electrical power shortage for the last one decade. The shortfall aggravated during the last 2-3 three years and the total power scenario is very complex one.

The supply demand situation in this sector will drastically hamper the development in all sectors of life including those in agricultural, industrial, commercial and domestic sectors. Particularly, the agricultural sector and the industrial sector productivity stoppage may lead to catastrophic disaster in the country in future. There is no alternative than to add more power generating units to the existing power system of Bangladesh within a shortest possible time frame. This is due not only to the increase in demand, but also due to aging of the existing power generating units most of which will near their life cycle very shortly. Both, base load and peaking plants are necessary to be added to the system, so that the whole system can run economically and efficiently. Technically a gas fired power plant is necessary to have more energy efficient power generation systems with higher output. Considering the nature of the peaking demand the proposed gas fired power plant seems to be the most suitable option.

CHAPTER 5:
ENVIRONMENTAL AND SOCIAL BASELINE DATA

5.1 INTRODUCTION

5.1.1 STUDY OVERVIEW

This section discusses the existing conditions within the project study area, covering both the natural and social environments. The analysis was completed through the use of a combination of secondary data sources in addition to extensive on-ground reconnaissance and baseline studies. The assessment is divided into three broad categories:

- Physical Environment;
- Biological Environment; and
- Socio-economic Environment

5.1.2 Site Overview

The Midland power plant is loacated on the left bank of Meghna River at Char Chartala union in Ashuganj upazila of Brahmanbaria district and approximately 2.40 km southern side of the Dhaka - Sylhet highway. Ashuganj fertilizer factory is located in the southern side and Gas Transmission Company limited is in the northern side of the power plant. The rural settlement is presented adjacent to the plant boundary. The 5 km study area map is shown in **Figure 5.1-1.**

5.1.3 Objectives and Methodology

The primary objective of the environmental and social baseline condition study is to provide an environmental and social baseline against which potential impacts from the operation of power plant can be compared.
The methodology adopted for collecting the baseline data was as follows:

- Study area of 5 km radial zone from the centre of the power plant location was selected for the baseline studies.
- The environmental and social field monitoring and survey was carried out during the period of September 2014 to October 2014.
- Primary data collection was through environmental monitoring and field survey for water, air, noise and ecology.
- Social baseline of the study area was captured through social surveys involving field consultations, interviews, meeting with stakeholders, discussions with government departments and secondary data review etc.
- Secondary data was collected from government reports, academic institutes, websites, published literature, interactions with government department and stakeholders etc.

Figure 5.1-1: 5 km Study Area Map

5.2 PHYSICAL ENVIRONMENT

5.2.1 CLIMATE

5.2.1.1 GENERAL CHARACTERISTICS

Several climatic zones occur within Bangladesh, with the study area falling within the south central zone as illustrated in **Figure 5.2-1**. The climate of Bangladesh is heavily influenced by the Asiatic monsoon pattern that creates three distinct seasons within the study area:

1. Pre-monsoon hot season (from March to May);
2. Rainy monsoon season (from June to October); and
3. Cool dry winter season (from November to February).

Mean daily maximum temperature rarely exceeds 32°C, and mean daily minimum temperature is approximately 10°C. Average humidity is relatively high, often exceeding 80%, and most rainfall occurs in summer. Fog is very common in winter (Rashid, 1977). High temperatures and thunderstorms characterize the pre-monsoon, hot season. April is the hottest month in the country, with mean temperatures ranging from 27°C in the east and south, to 31°C in the west-central part of the country. After April, increasing cloud cover reduces the temperature. Wind direction is variable during this pre-monsoon season, especially in the early stages of the season. Rainfall during this period, mostly caused by thunderstorms, can account for 10 to 25% of the annual total (Rashid, 1977).

The summer monsoon season is typified by Southerly or South-westerly winds, very high humidity and heavy rainfall, as well as long periods of consecutive days of rainfall. These conditions are caused by tropical depression weather systems entering the country from the Bay of Bengal. About 80% of the annual precipitation occurs during the five-month monsoon season from May to September (Rashid, 1977).

Low temperatures, cool air blowing from the west or northwest, clear skies and low levels of rainfall characterize the dry season. The average temperature in January varies from 17°C in the northwest and north-eastern parts of the country to 20°C to 21°C in the coastal areas. Minimum temperatures in the extreme northwest in late December and early January reach between 3°C to 4°C.
Long-term average climatic data collected at the nearby Comilla weather station (2004 to 2013) reflect the monsoonal effects on climate in this region (Bangladesh Meteorological Department, Dhaka 2014):

- Mean maximum temperature (35.5^0C)
- Mean daily minimum temperature (6^0C)
- Mean annual relative humidity 81%
- Mean annual rainfall (2016 mm)

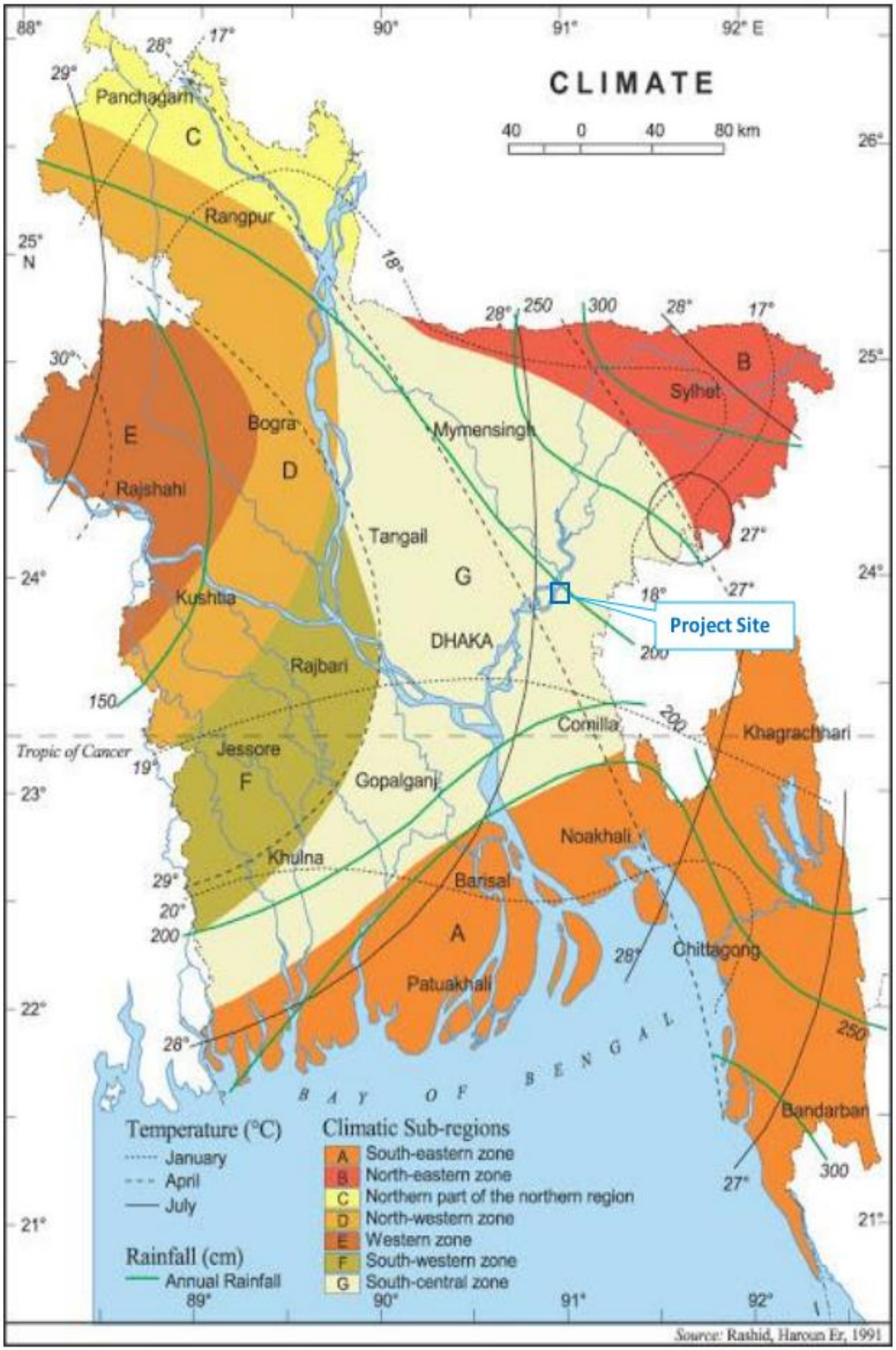


Figure 5.2-2: Climatic Zones of Bangladesh

5.2.1.2 RAINFALL AND HUMIDITY

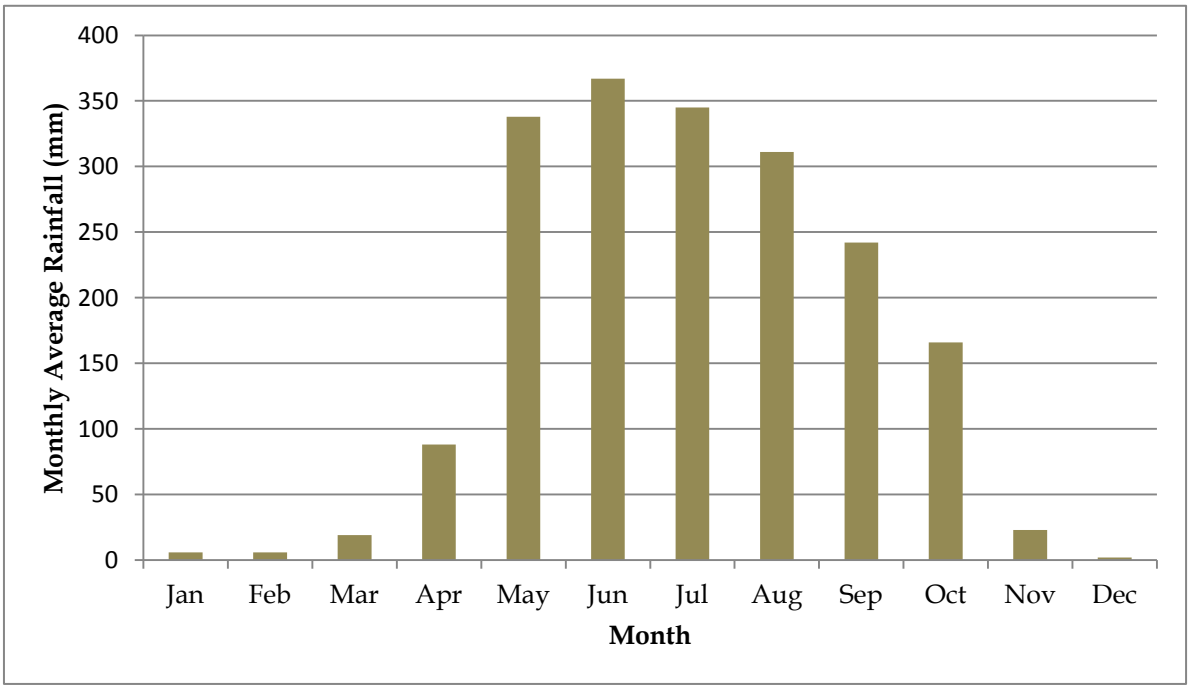
The monthly and yearly rainfall recorded at the Comilla weather station is shown in **Error! Not a valid bookmark self-reference.** and **Error! Reference source not found.**2)

The records show that average monthly rainfall is highest from April through to September. The highest annual rainfall (2,497 mm) recorded within the last 10 years was in the year of 2007, while the lowest annual rainfall (1,578 mm) was recorded in 2010.

Table 5.2-1: Total Monthly and Annual Rainfall (mm), Comilla Weather Station

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2004	0	4	6	175	186	654	311	183	686	218	1	0	2424
2005	6	2	249	157	193	259	403	410	395	349	0	1	2424
2006	0	0	0	117	607	402	151	226	300	94	1	0	1898
2007	0	20	21	179	153	548	654	221	339	280	82	0	2497
2008	30	11	26	34	282	330	457	375	247	265	0	0	2057
2009	0	0	3	48	295	235	573	427	145	98	0	0	1824
2010	0	13	30	23	343	417	94	125	241	277	0	15	1578
2011	0	0	28	76	351	346	273	501	233	76	0	0	1884
2012	16	1	13	195	209	442	282	373	178	115	102	3	1929
2013	0	3	30	28	467	214	276	243	255	124	0	3	1643
Average	**6**	**6**	**19**	**88**	**338**	**367**	**345**	**311**	**242**	**166**	**23**	**2**	**2016**

Source: Bangladesh Meteorological Department, Dhaka.



Source: Bangladesh Meteorological Department, Dhaka.

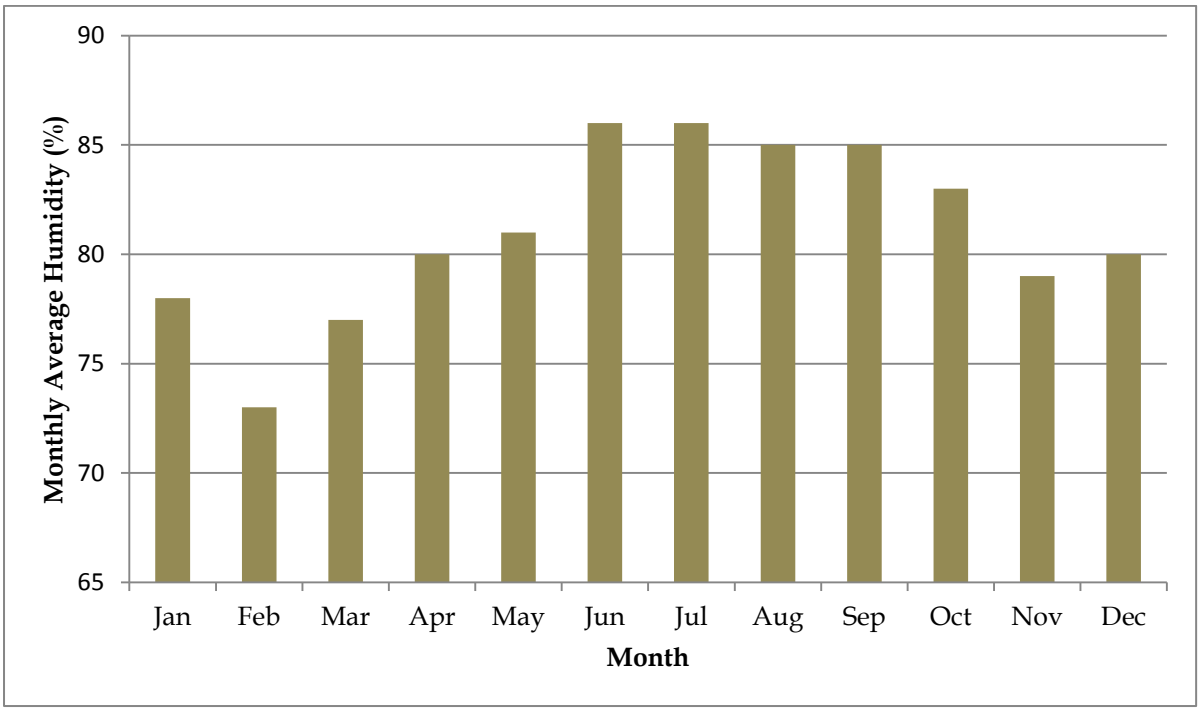
Figure 5.2-2: Average Monthly Rainfall (2004-2013), Comilla Weather Station

Relative humidity remains fairly constant from January to December, though on average it is higher in April to October as shown in **Error! Not a valid bookmark self-reference.** and Figure3. This observed change in humidity correspond with the pre-monsoon and dry seasons within the study area.

Table 5.2-2: Average Monthly Relative Humidity (%), Comilla Weather Station

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	83	74	79	83	78	85	87	84	87	79	78	78
2005	77	76	82	79	80	84	85	87	86	84	80	77
2006	79	79	73	78	80	85	85	83	85	83	81	79
2007	77	77	72	82	82	86	88	85	86	82	82	80
2008	79	73	81	78	79	86	86	86	83	83	78	83
2009	79	74	76	79	80	83	86	86	83	82	77	80
2010	78	71	77	81	81	87	84	84	86	83	79	77
2011	76	69	75	78	83	86	85	86	85	81	77	81
2012	78	71	76	82	80	85	86	84	86	83	79	84
2013	74	69	76	79	86	82	84	86	85	85	79	81
Average	**78**	**73**	**77**	**80**	**81**	**85**	**86**	**85**	**85**	**83**	**79**	**80**

Source: Bangladesh Meteorological Department, Dhaka.



Source: Bangladesh Meteorological Department, Dhaka.

Figure5.2-3: Average Monthly Humidity (2004-2013), Comilla Weather Station

5.2.1.3 Temperature

The monthly average minimum and maximum temperatures recorded at the Comilla weather station are presented below in **Error! Not a valid bookmark self-reference.** and Table 5.2-4respectively. The lowest average temperature recorded in the past 10 years was in January 2013 (6.0°C). The highest average temperature reached 35.5°C in June 2012. Throughout the year the highest temperatures are generally in March through October, and the lowest temperatures are from December to February (Source: Bangladesh Meteorological Department, Dhaka.

Figure5.2-4).

Table 5.2-3: Average Monthly Minimum Temperature (°C), Comilla Weather Station

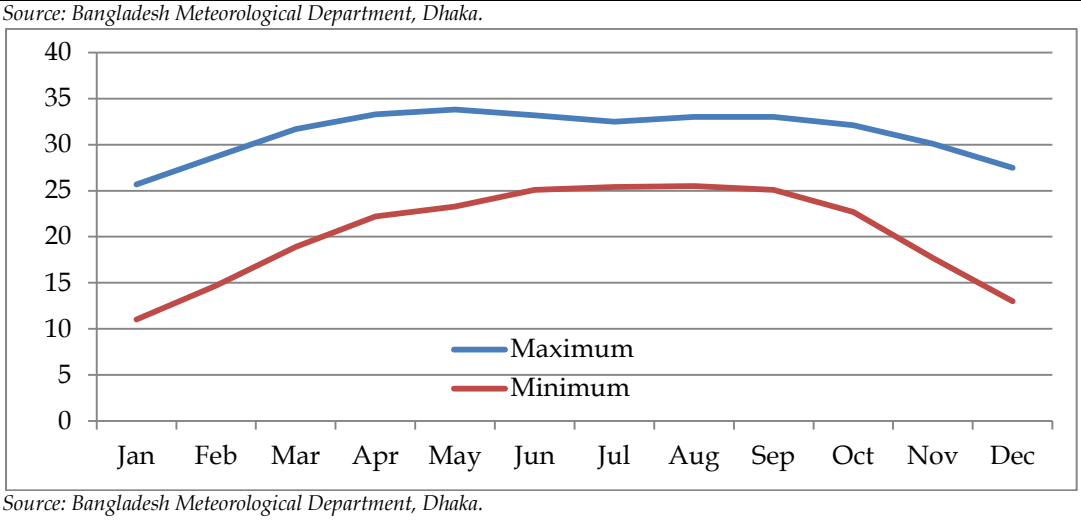
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	12.9	14.8	20.9	22.4	25.1	25.0	25.5	25.4	25.1	23.1	17.2	14.5
2005	12.4	16.4	21.1	22.7	23.5	26.1	25.5	25.5	25.4	24.2	18.1	14.0
2006	12.2	18.5	20.1	23.0	24.4	25.6	25.8	25.6	25.2	24.2	19.1	13.3
2007	11.1	16.0	18.1	22.7	24.9	25.3	25.4	26.1	25.5	23.3	20.0	14.4
2008	13.2	14.1	20.5	22.9	23.9	25.2	25.6	25.5	25.3	23.2	18.4	15.9
2009	13.6	15.6	20.4	24.2	24.3	25.9	25.5	25.9	25.6	23.0	19.0	13.3
2010	11.0	14.7	22.0	25.2	24.7	26.1	26.3	26.3	25.6	24.7	20.0	13.8
2011	8.4	12.6	14.0	20.0	21.7	23.4	24.2	24.0	24.6	21.3	16.3	10.7
2012	9.4	10.6	16.6	18.8	20.6	23.0	25.0	25.2	24.8	19.6	13.6	9.4
2013	6.0	13.4	15.5	20.0	19.5	25.8	25.2	25.1	24.2	20.0	15.2	10.7
Average	**11.0**	**14.7**	**18.9**	**22.2**	**23.3**	**25.1**	**25.4**	**25.5**	**25.1**	**22.7**	**17.7**	**13.0**

Source: Bangladesh Meteorological Department, Dhaka.

Table 5.2-4: Average Monthly Maximum Temperature (°C), Comilla Weather Station

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	24.0	27.8	30.8	31.6	34.0	32.0	31.6	32.6	30.9	30.9	29.5	27.3
2005	24.8	28.6	30.5	33.5	33.1	33.4	31.8	31.5	32.5	31.2	29.3	27.6
2006	25.6	30.2	32.0	33.2	33.1	32.6	32.0	32.9	32.0	32.1	29.1	27.0
2007	24.4	26.9	30.2	32.0	33.6	31.9	30.7	32.2	31.7	31.4	29.1	25.9
2008	24.8	25.9	30.6	33.5	33.8	31.6	31.0	31.7	32.7	30.9	29.8	26.5
2009	26.0	28.9	31.7	33.8	34.0	33.4	31.8	32.5	33.2	32.2	30.3	26.1
2010	24.5	28.1	32.0	33.3	33.5	31.9	32.7	33.4	32.8	32.3	30.2	26.4
2011	27.5	29.3	32.5	33.6	34.5	35.0	34.8	35.1	35.0	33.4	31.5	30.5
2012	27.5	30.5	33.2	34.6	35.0	35.5	34.0	33.6	34.6	32.8	31.4	27.0
2013	28.0	30.8	33.4	34.1	33.5	35.0	35.0	34.2	35.0	33.8	30.8	30.2
Average	**25.7**	**28.7**	**31.7**	**33.3**	**33.8**	**33.2**	**32.5**	**33.0**	**33.0**	**32.1**	**30.1**	**27.5**

Source: Bangladesh Meteorological Department, Dhaka.



Source: Bangladesh Meteorological Department, Dhaka.

Figure 5.2-4: Average Minimum and Maximum Temperatures (2004-2013), Comilla Weather Station

5.2.1.4 Wind Speed and Direction

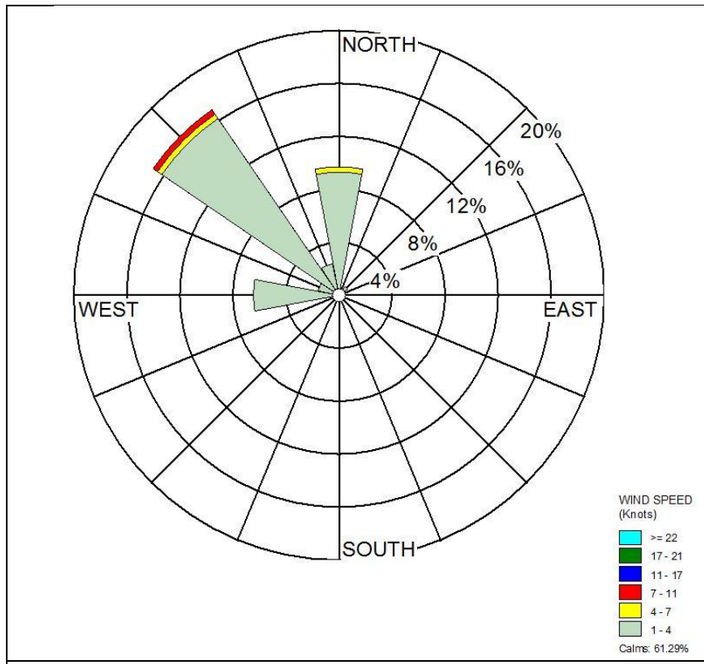
Data about wind speed and direction for the period from 2004 to 2013 as collected from Meteorological Department are attached hereto **Table** 5.2-14.2-5.

The data indicates that the maximum wind speed recorded as 25 knots in the month of October, 2007. The prevailing wind direction is South and South-east in most part of the year.

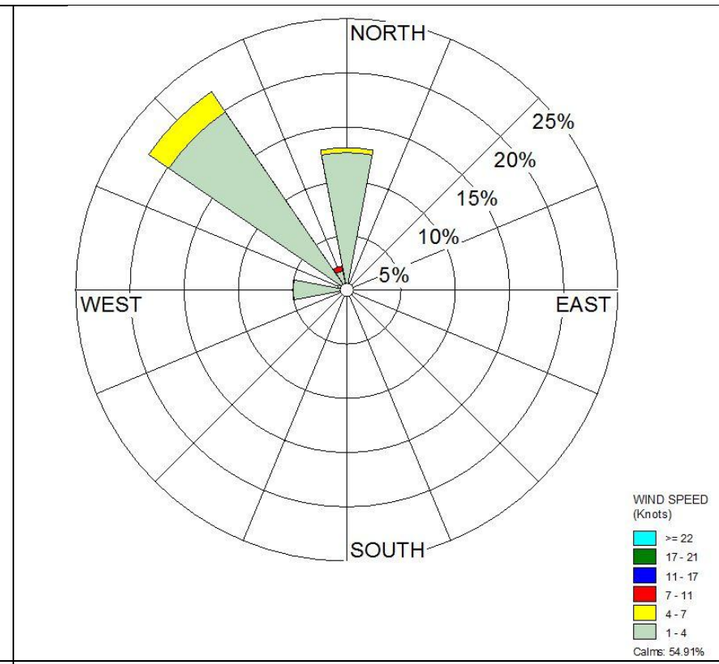
Monthly and seasonal wind roses based on the meteorological data collected from BMD for Comilla observatory are presented in **Figure**5.2-5. Annual wind roses are shown in **Figure**5.2-6.

Table 5.2-1: Monthly & Yearly Maximum Wind Speed in Konts & Direction in Degree at Comilla

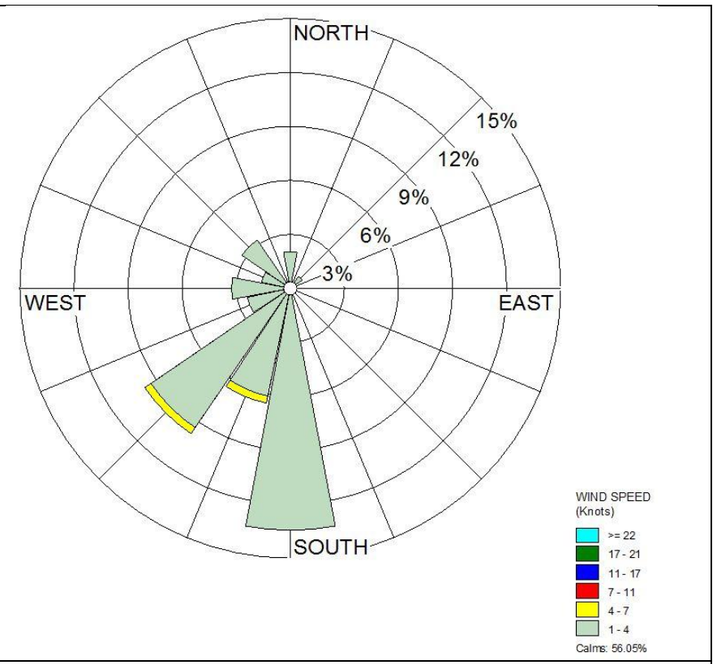
Year	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec		
	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm	Sp	Dr	Tm
2004	8	31	6	12	18	6	20	18	6	20	18	12	18	18	6	16	22	12	18	18	6	14	18	12	12	13	12	20	18	18	10	36	6	6	36	6
2005	15	31	9	15	18	9	15	5	9	15	22	18	15	5	9	15	18	3	14	18	9	14	18	12	12	18	15	10	18	12	8	36	9	9	31	9
2006	10	34	9	16	18	6	14	31	9	15	18	6	16	18	18	17	18	21	14	18	9	8	18	9	8	18	6	5	21	12	5	36	12	4	31	6
2007	6	29	9	7	18	6	8	31	6	15	21	15	18	27	15	10	18	9	10	18	15	9	18	12	8	23	6	15	7	18	25	18	0	5	36	6
2008	6	36	15	20	9	12	16	23	18	11	5	12	12	18	9	13	18	9	12	18	9	11	16	9	8	18	12	21	18	3	4	36	9	4	36	6
2009	5	23	9	6	31	9	8	23	15	13	18	6	13	18	9	8	27	6	11	23	18	5	18	15	7	18	6	5	18	9	4	36	9	3	36	9
2010	4	36	3	4	36	9	10	18	6	17	18	9	14	27	15	9	31	21	6	18	12	8	18	9	5	18	6	6	18	12	3	36	3	4	36	9
2011	10	18	9	6	18	9	14	18	9	7	31	15	5	18	9	6	18	9	6	18	12	6	18	9	8	18	9	4	20	18	3	36	6	3	36	9
2012	4	36	6	4	36	6	7	18	6	8	20	9	13	18	6	8	18	12	8	18	9	5	18	18	5	18	18	5	18	6	4	36	12	4	36	15
2013	7	31	9	8	33	9	6	22	15	15	31	18	13	16	9	12	18	6	9	18	9	9	13	9	8	18	6	9	18	6	4	36	9	4	31	9



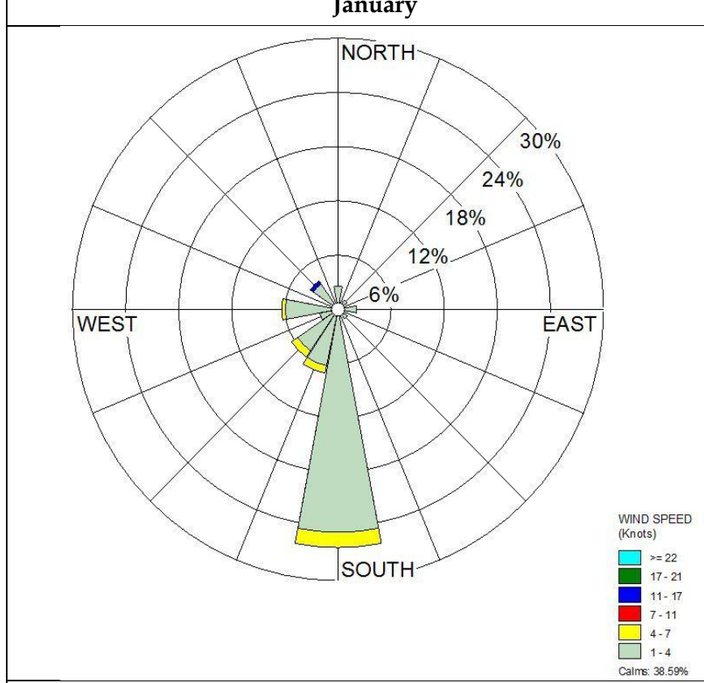
January



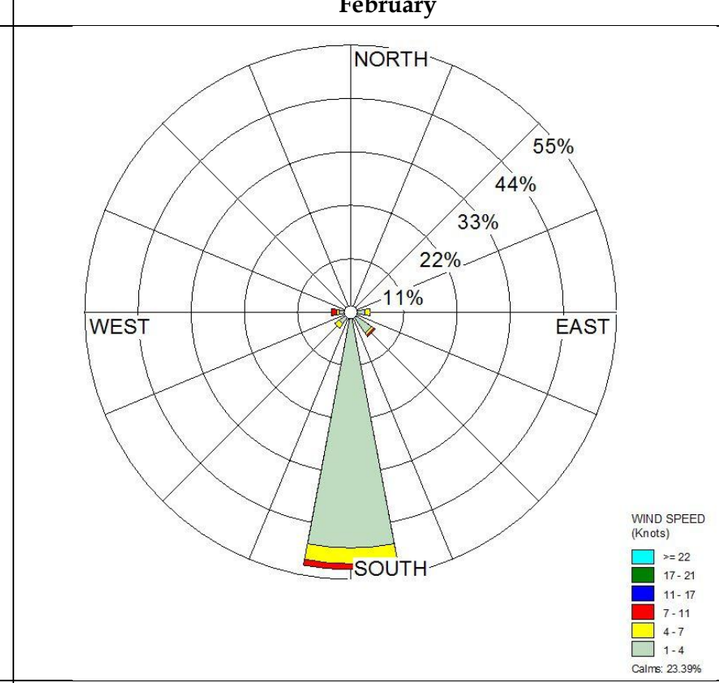
February



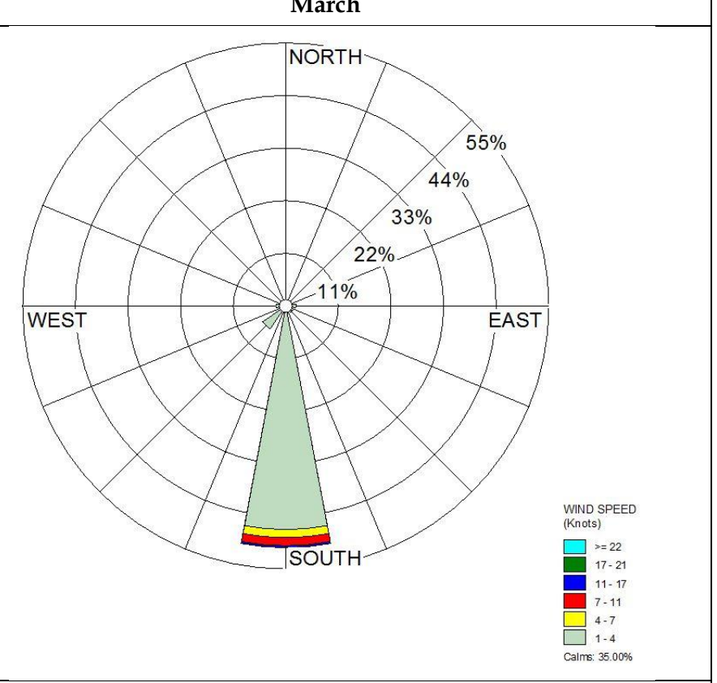
March



April

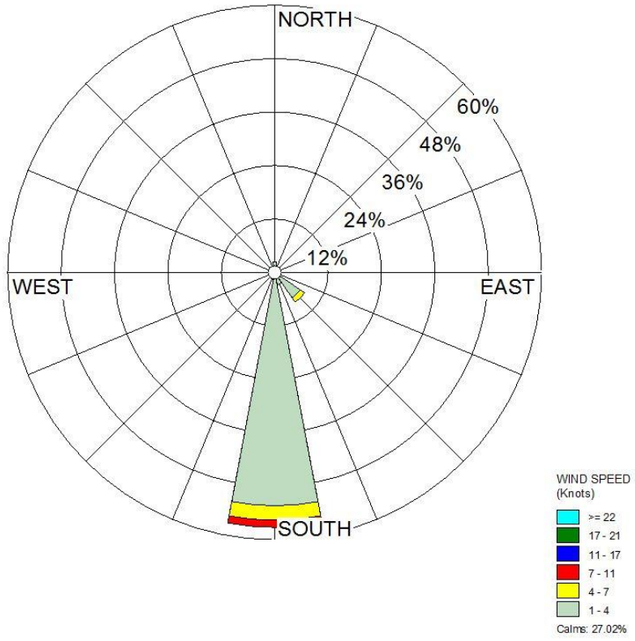


May

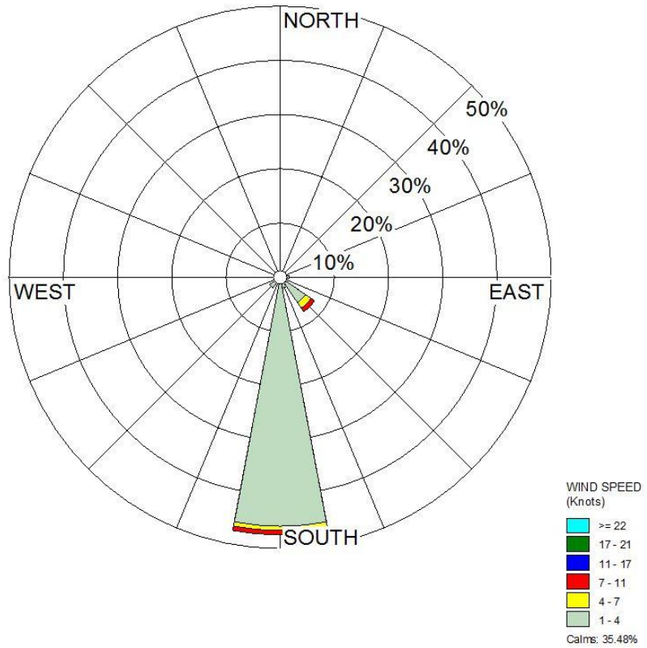


June

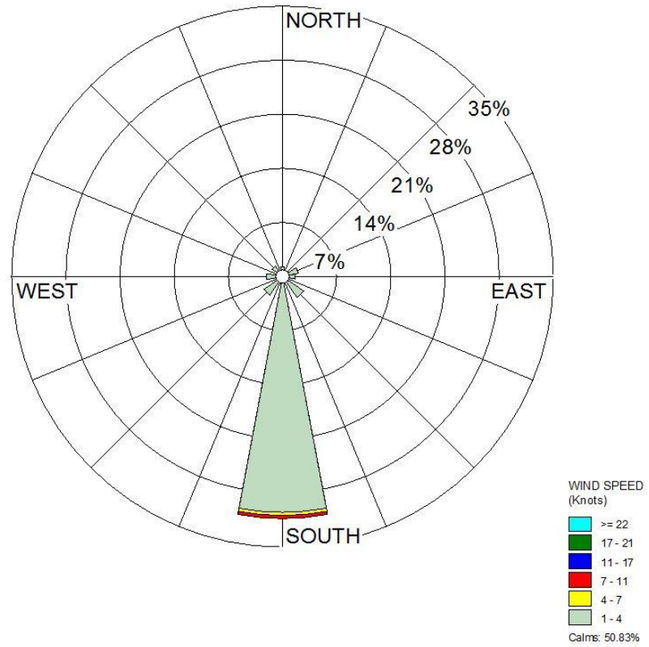
Figure 4.2-5: Monthly Wind Rose Diagram (2013), Comilla Weather Station



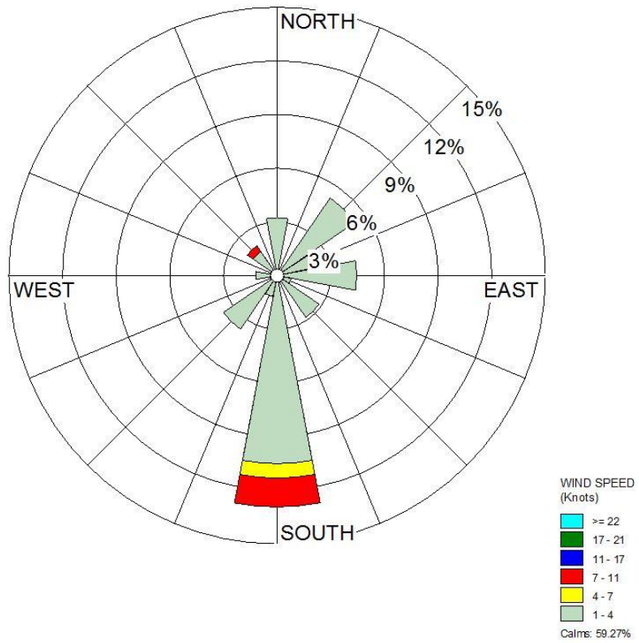
July



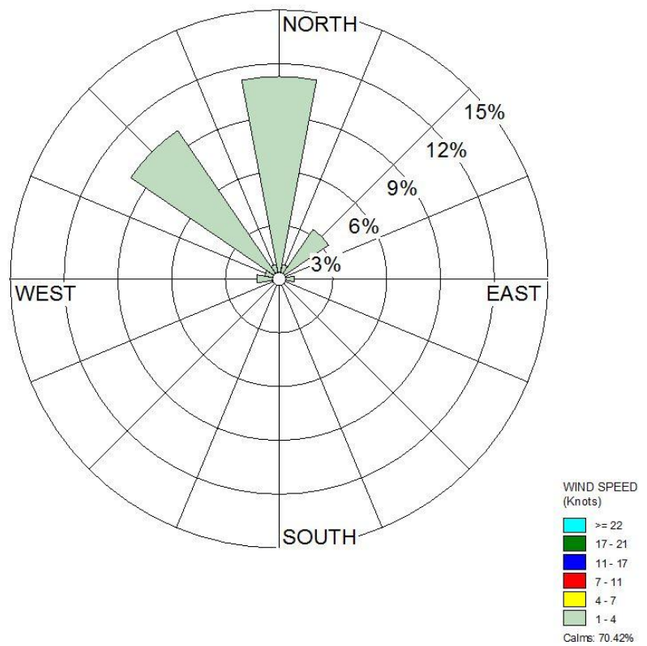
August



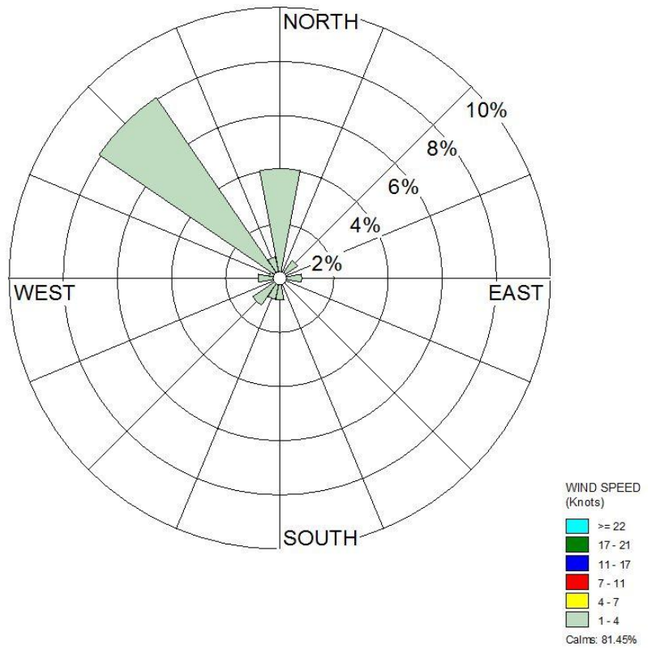
September



October

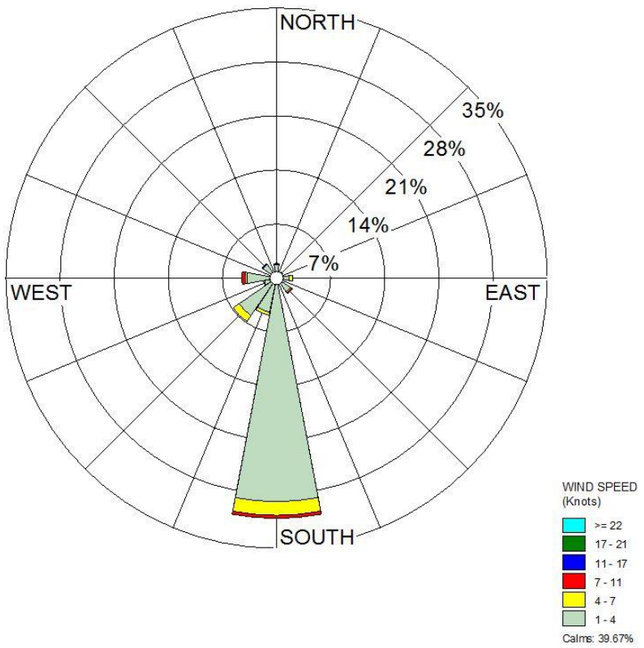


November

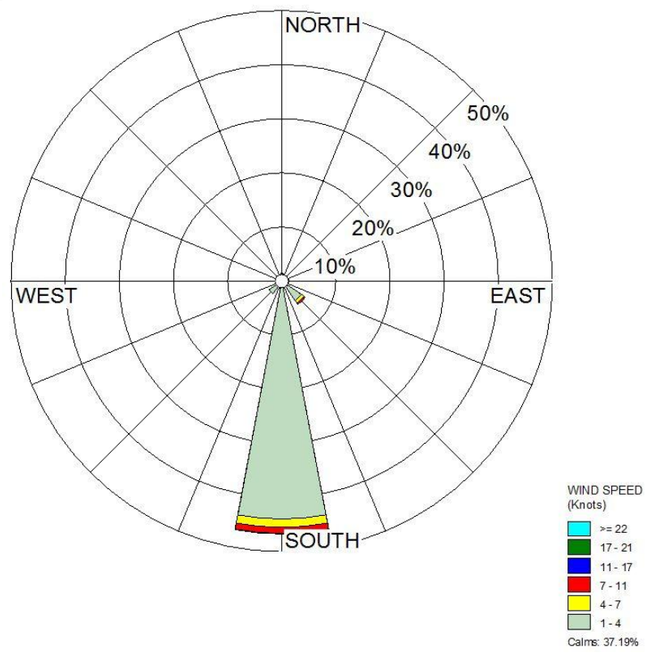


December

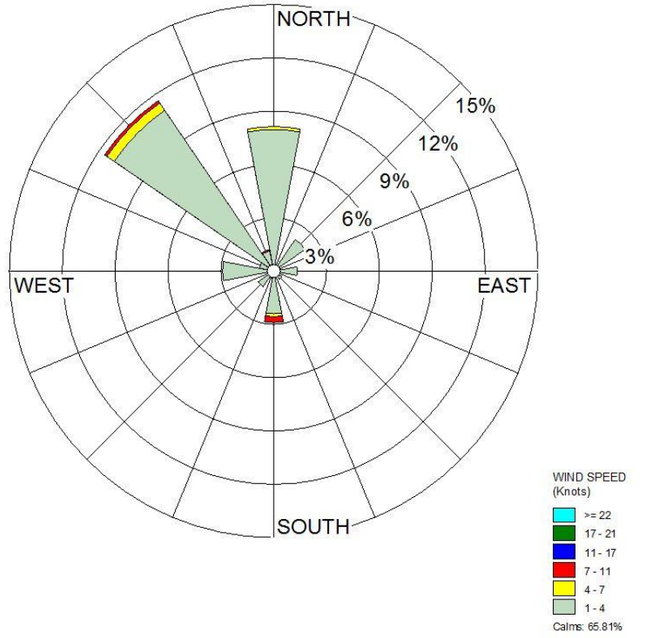
Figure 5.2-5: Monthly Windrose Diagram (2013), Comilla Weather Station (Continued)



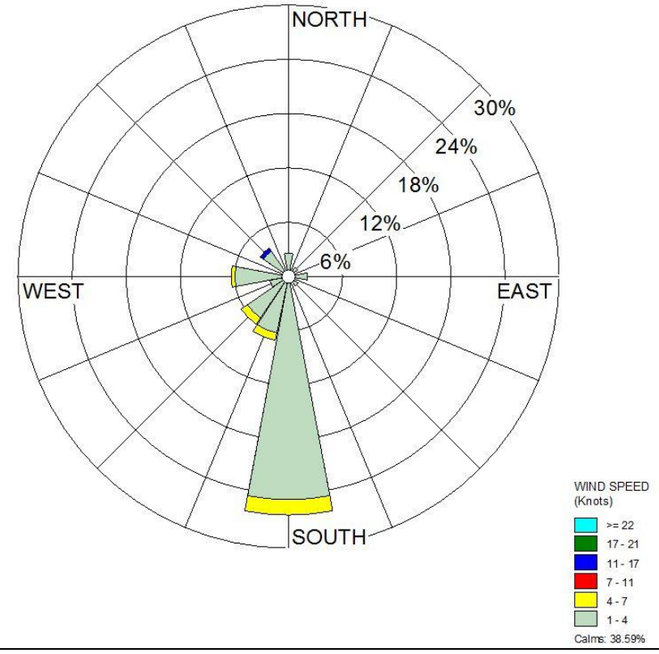
Pre-Monsoon (March-May)



Monsoon (June-September)



Winter (October-February)



Annual

Figure5.2-6: Seasonal and Annual Wind Rose Diagram (2013), Comilla Weather Station

5.2.2 LAND USE

The power plant is located in the industrial belt along the river Meghna. The area on the north-west side of the Midland power plant is mainly used as river landing site for paddy business, stone, sand bricks and breaking yard. In the Southern side is Ashuganj fertilizer factory and staff quarter.
The land use pattern in the area is of mixed type having industrial, commercial and residential uses. Erratic development of housing and industries, imprudent alignment of roads and commercial places and some pockets of good agricultural land are common features of the existing topography surrounding the project area.

5.2.3 GEOLOGY AND SOILS

Geology of Bangladesh is generally dominated by poorly consolidated sediments deposit over the past 10,000 to 15,000 years (Holocene age). The geology of the study area consists of Quaternary deltaic sediments, which have been strongly influenced by tectonic movements on deep-seated faults. The area lies on a tectonic block, which has been uplifted relative to the surrounding areas. The soil profile of the study area consists of about 12m thick clay deposit followed by sand, clay and progressively coarser sand as depth increases.

In terms of crop production, the soils of Bangladesh can be categorized into three main classes; floodplain, terrace and hill soils. Soils are mainly grey loamy on the ridges and gray to dark gray clayey in the basins. Gray sands to loamy sands with compact silty topsoil's occupy areas of the old Brahmaputra Char floodplain or alluvial soils. In adjoining southern part soil mainly comprises sandy barns and sandy clay barns and tends to be gray to dark gray in poorly-drained basins and brown on higher and better drained land.

5.2.4 NATURAL HAZARDS

5.2.4.1 INTRODUCTION

Bangladesh can be regarded as being susceptible to natural calamities. This is due to its unique combination of physiographic, morphological and other natural features, which have lead to direct loss of life and physical property on a massive scale. Natural calamities experienced include floods, cyclones and storm surges, and earthquakes.

5.2.4.2 FLOODING

Every year near about one-fifth of Bangladesh undergoes flood during the monsoon season. A flood season in Bangladesh may start as early as May and can continue until November.
Floods of Bangladesh can be divided into three categories: (i) monsoon flood - seasonal, increases slowly and decreases slowly, inundate vast areas and causes huge loss to the life and property; (ii) flash flood-from sudden torrential flows, following a brief intense rainstorm or the bursting of a natural or manmade dam or levee; and (iii) tidal flood - short duration, height is generally 3-6m, prevents inland flood drainage.

It has been observed that, the existing power plant area has never been inundated by flood water.

5.2.4.3CYCLONE AND STORM SURGES

Devastating cyclones hit the coastal areas of Bangladesh almost every year usually accompanied by high-speed winds, sometimes reaching 250 km/hr or more and 3-10 m high waves, causing extensive damage to life, property and livestock. Because of the funnel shaped coast, Bangladesh repeatedly becomes the landing ground of cyclones formed in the Bay of Bengal. The existing power plant site is far from the coastal belt, the likely impact of cyclones is relatively small.

5.2.4.4 SEISMICITY

Bangladesh is situated in one of the most tectonically active regions in the world. Here three major tectonic plates (the Indian Plate, the Tibet Sub-Plate, and the Burmese Sub- Plate) collide and thrust over each other. Earthquakes occur frequently in the wider region.

Bangladesh can be divided into three Seismic Zones, as described by the ranges of the seismic coefficient. Zone I is the most severe area for earthquake intensity and frequency and Zone III is the least severe (BNBC, 1993). The study area falls in Zone II (0.15) i.e. medium intensity seismic zone. The location of the power plant, relative to the seismic zones is provided in Figure 5.2-7.

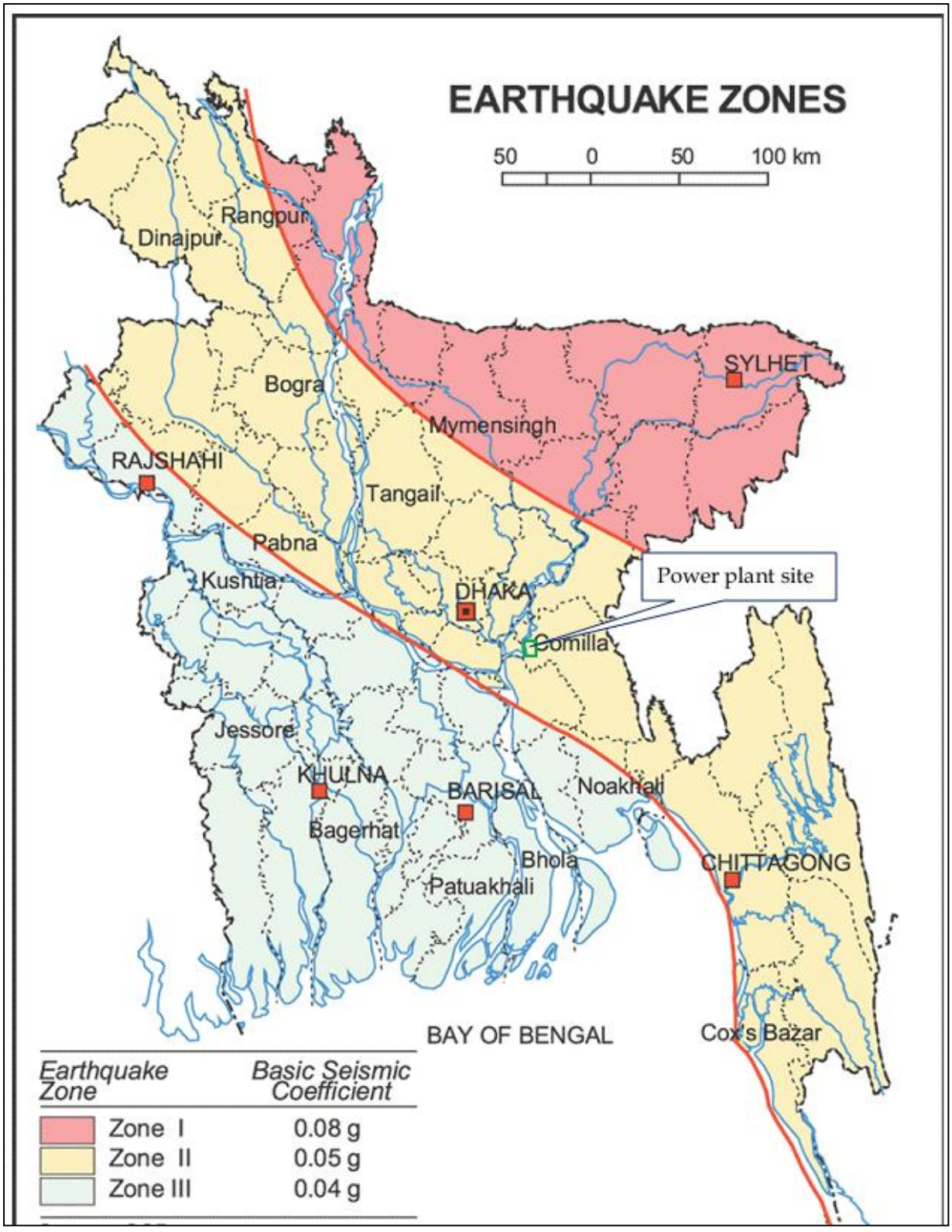


Figure 5.2-7: Seismic Zones of Bangladesh (BNBC, 1993)

5.2.5 WATER RESOURCES

Bangladesh and the western portion of the Indian State of Bengal are located within the 'Bengal Basin'. According to Rahman et al (2003), this basin includes the world's largest river delta, which is 140,000 square kilometers (the Ganges-Padma, Jumna-Brahmaputra- Tista and

Meghna rivers and numerous tributary complexes) and the world's largest submarine fan complex (the Bengal Fan). These river systems carry a combined annual sediment load of 1.5 to 2.4 billion metric tons..

Bangladesh has an average annual surface flow of approximately 1,073 million acre feet (MAF), of which about 870 MAF (93%) are received from India as inflow and the remaining 203 MAF (7%) as rainfall. This water is enough to cover the entire country to a depth of 9.14m. About 132 MAF (65% of rainfall and 12% of total) is lost to evaporation each year (114.30 cm), the remainder flows out to the Bay of Bengal.

Water sampling and analysis was undertaken to understand the overall baseline water quality characteristics of the surface and groundwater in the study area. Samples were taken from representative selected water body and groundwater sources representing different parts of the study area.

The surface water sampling was collected from the Meghna River which is adjacent to the power plant. Groundwater sampling locations were selected to obtain a representative water sample from various zones within the study area. The samples were collected from existing ground water sources. A total of 3 samples, One (1) surface water and two (2) ground water samples were collected. Detail of the sampling location is provided in **Table 5.2-6**and depicted in **Figure 5.2-8**.

Table 5.2-6: Details of Surface and Ground Water Sampling Locations

Sl.	Sampling location	Sampling Code	Geographic location
1.	Meghna River	SW1	24° 1'46.20"N 90°59'8.11"E
2.	Power Plant Area	GW1	24° 1'41.70"N 90°59'17.56"E
3.	Char Chartala Village	GW2	24° 1'38.66"N 90°59'21.76"E

The samples were analyzed for parameters covering physico-chemical characteristics.

Water samples were collected in a 250 ml sterilized clean PET bottle for complete physio-chemical tests.

The samples were analyzed as per standard procedure/method given in Standard Method for Examination of Water and Wastewater Edition 20, published by APHA. Details of the analysis method and protocol are presented in Table 5.2-7.

Figure 5.2-8: Surface and Ground Water Sampling Locations

Table 5.2-7: Methods for Water Analysis

Sl.	Parameter	Test method (APHA)
1.	Temperature (˚C)	Digital thermometer
2.	TDS (mg/l)	Digital TDS meter
3.	EC (µmhos/cm)	Digital EC meter
4.	DO (mg/l)	Digital DO meter
5.	pH	Digital pH meter
6.	Salinity (ppt)	Digital Salinity meter
7.	Total Hardness (as $CaCO_3$) (mg/l)	2340.C
8.	Chloride (Cl^-) (mg/l)	4110.B
9.	Iron (Fe) (mg/l)	3113.B
10.	Calcium	3113.B

5.2.5.1 SURFACE WATER RESOURCES

The nearby surface water source in the existing power plant is the Meghna River. Upstream of the site, the Upper Meghna meets the Old Brahmaputra River at Bhairab Bazar and downstream, it joins the Padma River near Chandpur. This is a meandering river with braided characteristics. It flows along the western part of the Brahmanbaria District boundary and hassignificant influence on the drainage of the Brahmanbaria District. There is a notable change in the flow characteristic of the Meghna River between wet and dry seasons and with lower flow levels in the river. Tidal influence becomes more pronounced in the dry season. During the monsoon, the Meghna River dominates flood extent in the District. It is apparent that Meghna River is the primary source of prolonged monsoon flooding in Brahmanbaria District.

5.2.5.2 SURFACE WATER QUALITY

The surface water Quality was compared with the Bangladesh ECR standard for best practice based classification criteria. **Table 5.2-8**shows the analysis results. Some of the water analysis parameters are discussed below in detail:

pH

pH of the Meghna River is within the permissible limits of 6.5 to 8.5.

Dissolved Oxygen (DO)

The DO of the sample of Meghna River is 6.7 mg/l and thus meets the surface water classification for different usages.

Biological Oxygen Demand (BOD)

The BOD level is 3.0 mg/l for the Meghna River and thus is well below the permissible limits. Comparison of the data with the surface water quality standards of government of Bangladesh reveal the fact that water of the water bodies are fit for supply after conventional treatment, Water usable by fisheries, Industrial process and cooling industries and Water usable for irrigation.

Table 5.2-8: Surface Water Quality Analysis

Characteristics	Unit	Sampling Location	Bangladesh Standard*					
		SW1	Source of drinking water for supply only after disinfecting	Water usable for recreational activity	Source of drinking water for supply after conventional treatment	Water usable by fisheries	Water usable by various process and cooling industries	Water usable for irrigation
BOD_5	mg/l	3.0	2 or less	3 or less	6 of less	6 of less	10 or less	10 or less
Calcium	mg/l	3.8	-	-	-	-	-	-
COD	mg/l	8.0	-	-	-	-	-	-
Chloride	mg/l	3.5						
EC	µmhos/*cm*	128	-	-	-	-	-	-
DO	mg/l	6.7	6 or above	5 of more	6 or more	5 or more	5 or more	5 or more
Iron	mg/l	0.1	-	-	-	-	-	-
pH	-	6.7	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
Phosphate		0.7						
Salinity	ppt	Nil	-	-	-	-	-	-
Temperature	°C	28.4	-	-	-	-	-	-
TDS	mg/l	78	-	-	-	-	-	-
Total Hardness	mg/l	19.3	-	-	-	-	-	-
Turbidity	NTU	60	-	-	-	-	-	-

(Source: Laboratory Analysis, Department of Soil, water and Environment, University of Dhaka and EQMS laboratory, SamplingDate: 28/9/14)

** Bangladesh Environment Conservation Rules, 1997- Schedule 3 (Standards for inland surface water)*

5.2.5.3 GROUND WATER

Groundwater aquifers in Bangladesh are constantly recharged by major river systems and by infiltration of rainwater. Groundwater is usually available within 5 m below ground surface (mbgs). This level fluctuates seasonally but approaches close to the surface in most parts ofthe country from July to September. At Ashuganj, the groundwater level is about 6 mbgs surface during the dry season, with levels returning to their normal position before the end of the monsoon season. This fall in ground levels is an entirely natural process that arises because of the hydrological link with the river. The groundwater present in the project area is at three distinct levels:

- An upper silty clay cover of less than 20 m thicknesses, along the borders of the NCR. The maximum thickness ranges from 50 to 100 m.
- A middle composite aquifer of fine to very fine sands, varying in thickness from 30 m to 60 m along the border of the NCR. In the centre of the region, the aquifer is less than 10 m thick. Although it is a good aquifer, its irrigation development potential is poor, because its sands are too fine for slotted well screens and for providing high discharge rate. However, it is used as a source of supply for HTWs and MOSTIS.
- The lowest and main aquifer consists of medium, medium-to-fine or medium-to-coarse sand with layers of clay and silt extending to 30-60m. The coarser-grained structure of this aquifer is suitable for large-scale groundwater development with screened wells. Most tube wells within the main aquifer are less than 150 m deep.

The results of two groundwater samples are shown in **Table 5.2-9.**

Table 5.2-9: Ground Water Quality Analysis Result

Sl.	Parameters	Sampling code		Bangladesh Standard
		GW1	GW2	
1.	Arsenic (As) (mg/l)	<0.05	<0.05	0.05 mg/l
2.	Chloride (Cl^-) (mg/l)	172.6	160.4	150-600 mg/l
3.	Conductivity (µmhos/cm)	140	132	-
4.	Fluride (F) (mg/l)	0.20	0.18	1 mg/l
5.	Fecal Coliform (mg/l)	0	0	-
6.	Iron (Fe) (mg/l)	0.40	0.70	0.3-1.0 mg/l
7.	Lead (Pb) (mg/l)	<0.05	<0.05	0.05 mg/l
8.	pH	6.8	7.0	6.5-8.5
9.	Temperature (°C)	26.6°C	26.3 °C	20-30 °C
10.	Total Coliform (mg/l)	0	0	-
11.	Total Dissolved Solids (mg/l)	340	320	1000 mg/l

(Source: Laboratory Analysis, Department of Soil, water and Environment, University of Dhaka and EQMS laboratory)

5.2.6 AIR QUALITY

5.2.6.1 NATIONAL CONTEXT

Within Bangladesh there are two major sources of air pollution: industrial emissions and vehicular emissions. Industrial sources include power generation, fertilizer factories, mills (sugar, paper, jute and textile), brick kilns, tanneries, chemical and pharmaceutical industries and the burning of solid waste. Emissions from these various sources contribute to the formation of the smog that regularly shrouds the major cities (Rahman *et al,* 2005).

Pollutants emitted from industrial sources include hydrogen sulfide, ammonia, and chlorine; all of which can result in health complaints such as skin irritation, headaches and nausea. Sustained exposure to these pollutants can result in other severe health effects such as severe respiratory health issues and birth defects (Rahman *et al,* 2005). In Bangladesh – where some 89% of the population use solid fuel – air-quality related deaths were estimated to be over 56,000 in 2007 alone (WHO, 2007). With increasing rates of urbanization, it is anticipated that vehicular ownership and usage will also increase, leading to a continued decline in air quality. DoE has identified two-stroke engines as a major polluter, and now discourages their use within Dhaka (Rahman *et al,* 2005).

Within the rural areas of Bangladesh, the main sources of air pollution are brick kilns and domestic heating and cooking – with wood, coal, diesel and bio-fuel (often manure) used as sources of energy (UNEP, 2002). It is therefore likely in rural areas that the principal air contaminants are particulate matter and volatile organic compounds (VOCs). Rural areas often also experience problems, particularly in the dry season, with dust generation due to construction, transport and agricultural activities such as tilling, threshing and plowing.

5.2.6.2 METHODOLOGY FOR AIR QUALITY MONITORING

The existing ambient air quality of the study area was monitored at three locations (September 2014- October 2014) and at the plant gate (January 2015-February-2015) during the monitoring period. The monitoring parameters included Particulate Matter (SPM PM_{10} and $PM_{2.5}$), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NOx), and Carbon Monoxide (CO). All the parameters were monitored on 24-hourly basis except Carbon Monoxide (CO) during the duration of the study.
The particulate and gaseous samples collected during the monitoring have been analyzed as per the procedures specified in Table 5.2-10. The geographical locations of the ambient air quality monitoring locations has been presented in Table 5.2-11 and depicted in Figure 5.2-9.

Table 5.2-10: Methodology for Analysis of Ambient Air Quality

Sl.	Parameter	Analysis procedure
1.	SPM	Gravimetric method
2.	PM10	**AirMetric MiniVol sampler**
3.	PM2.5	**AirMetric MiniVol sampler**
4.	SO_2	Colorimetric method at 560nm using spectrophotometer (West-Gaeke method)
5.	NOx	Colorimetric method at 540 nm using spectrophotometer (Jacob and Hochheiser method)

6.	CO	Digital CO meter

Table 5.2-11: Ambient Air Quality Sampling Location

Sl.	Sampling Station	Station Code	Geographic Location
1	Inside the Midland power plant boundary	AQ1	24° 1'41.23"N 90°59'18.11"E
2	Midland Staff Quarter, Char Chartala	AQ2	24° 1'23.35"N 90°59'33.35"E
3	In front of food Sillo gate, Char Chartala	AQ3	24° 2'15.08"N 91° 0'1.47"E
4	At the Plant Gate	-	24° 1'39.66′ N 90° 59'19.5′ E

Figure 5.2-9: Ambient Air Quality Monitoring Locations

5.2.6.3 AMBIENT AIR QUALITY IN THE STUDY AREA

The monitored ambient air quality is summarized in Table 5.2- and results are annexed in ANNEX III.

Table 5.2-12: Ambient Air Quality in the Study Area

Location	Observed	`Ambient Air Pollutants Concentration ($\mu g/m^3$)		
		SO_2	**NOx**	**CO**
AQ1	Maximum	27.45	42.61	340
	Minimum	18.23	26.68	175
	Average	22.21	34.58	255.83
AQ2	Maximum	13.87	25.48	120
	Minimum	9.45	16.31	80
	Average	11.59	20.58	98.33
AQ3	Maximum	11.34	20.51	90
	Minimum	8.02	10.26	40
	Average	9.67	15.55	65
Bangladesh Standard**	**24-Hourly**	**365**	**-**	**-**
	8-Hourly	**-**	**-**	**10,000**
	Annual	**80**	**100**	**-**
WHO	**24-Hourly**	**20**	**-**	**10,000**
	Annual	**-**	**40**	**-**

***The Bangladesh National Ambient Air Quality Standards have been taken from the Environmental Conservation Rules, 1997 which was amended on 19th July 2005 vide S.R.O. No. 220-Law/2005.*

****Who Ambient Air Quality Guideline Values (2005 and 2000), which are also being referred in the World Bank and IFC's General Guidelines (2007)*

Table-5.2-13 Ambient PM_{10}, $PM_{2.5}$ Concentrations as per NAAQS as determined using extrapolation procedure

Pollutant	Averaging Time	Who Guidelines	Proposed Bangladesh Standards	Measured Concentration
PM_{10}	24 hour	---	150 $\mu g/m^3$	191± 48 $\mu g/m^3$
	Annual	---	50 $\mu g/m^3$	105± 56 $\mu g/m^3$
$PM_{2.5}$	24 hour	---	65 $\mu g/m^3$	146 ± 36 $\mu g/m^3$
	Annual	---	15 $\mu g/m^3$	54 ± 32 $\mu g/m^3$

N.B.: It should be noted here that the PM data are sampled and tested by the Reputed Atomic Energy, Dhaka (AED). Dr. Bilkis Ara Begum, Chief Scientific Officer, Chemistry Division, Atomic Energy Centre, Dhaka has tested and analyzed the data with due diligence. The analysis data are annexed in Annexure-XIX.

5.2.6.4 ANALYSIS AND DISCUSSION OF RESULTS

$PM_{2.5}$ & PM_{10}

Table 5.2-13 represents the ambient PM_{10}, $PM_{2.5}$, concentrations as per NAAQS as determined using extrapolation procedure.

- The PM_{10} and $PM_{2.5}$ concentrations are higher than the yearly average Bangladesh National Ambient Air Quality Standards and also for 24 hour standards except for the wet season.

The contribution of the plant to the cumulative level of air pollutants in the airshed is presumed to be low based on the size and number of other plants in the area.

SO_2

The 24-hourly SO_2 concentration was recorded in the range of 8.02 – 27.45 µg/m^3. Average concentration of SO_2 are reported slightly higher due to the industrial setup. During the monitoring period, the maximum SO_2 concentration is reported at power plant site as 27.45 µg/m^3. SO_2 concentrations at all the monitoring locations were reported well below 365 µg/m^3, which is a 24-hourly National Ambient Air Quality Standard (NAAQS) for SO_2 in Bangladesh. The results were also compared with the WHO guideline values for SO_2 and it is noted that the average SO_2 concentrations at AQ2 and AQ3 are less than the stipulated guideline value (20 µg/m^3), whereas average concentrations at AQ1 is within the interim target-2 (50 µg/m^3).

NO_x

The 24-hourly NOx concentration was recorded in the range of 10.26 – 42.61 µg/m^3. Average concentration of SO_2 are reported slightly higher due to the industrial setup. During the monitoring period, the maximum NOx concentration is reported at power plant site as 42.61 µg/m^3.There are no stipulated standards for 24-hourly Nox concentration in Bangladesh and also there is no WHO guideline value for the same. The annual Bangladesh standard and WHO guideline value for NOx are 100 µg/m^3 and 40 µg/m^3 and present average concentrations at all the locations are well below these values.

CO

The 8-hourly CO concentration was recorded in the range of 40.0 – 340.0 µg/m^3. Average concentrations of CO are reported low at all the monitoring locations while comparing with the Bangladesh Standards as well as WHO guideline (10 mg/m^3).

5.2.7 NOISE LEVEL

Excessive noise is a potential issue for both human and biological receivers and can cause a range of negative issues, from mild annoyance and moderately elevated levels of agitation to

significant disturbance of behavioral patterns and, in severe cases, temporary or permanent hearing loss. According to the World Health Organization Guidelines for Community Noise (1999), daily sound pressure levels of 50 decibels (dB) or above can create discomfort amongst humans, while ongoing exposure to sound pressure levels over 85 dB is usually considered the critical level for temporary hearing damage. Table 5.2-14 shows the Schedule 4 of the ECR sets the acceptable noise level criteria for various land uses in Bangladesh and World Bank general EHS guideline standard for noise level.

Table 5.2-14: Standards for Noise (EQS)

Sl.	Area Category	Bangladesh Guidelines (dBA)		World Bank general EHS Guidelines	
		Day[1]	Night[1]	Day[2]	Night[2]
1.	Silent Zone	50	40	-	-
2.	Residential Zone	55	45	55	45
3.	Mixed Area	60	50	-	-
4.	Commercial Area	70	60	70	70
5.	Industrial Area	75	70	70	70

Source: Sound Pollution (Control) Rules-2006, Bangladesh, EHS Guidelines for General Environmental Guidelines, April 2007, WBG

1. GoB ―day‖ is 06:00-21:00; GoB ―Night‖ is 21:00-06:00
2. WBG ―day‖ is 07:00- 22:00, WBG ―Night‖ is 22:00-07:00

5.2.7.1 AMBIENT NOISE LEVEL IN THE PROJECT STUDY AREA

Noise levels were recorded at Nineteen locations in the study area during the monitoring period. Noise levels were recorded in the form of sound pressure levels with the help of a digital sound level meter. Noise level were recorded for two hours at day and night time in the closest settlement area indicated as NL17, NL18 and NL19 monitoring locations and rest of the locations were recorded for 20 minutes both day and night times. The details of noise monitoring locations are given in **Table 5.2-15**15and depicted in **Figure 5.2-10**. The purpose of ambient noise level measurement was to determine sound intensity at the monitoring locations. The sound level is recorded in form of A-weighted equivalent continuous sound pressure level (Leq) values with the use of A-weighting noise measuring instrument.

Table 5.2-15: Details of Ambient Noise Monitoring Locations

Sl.	Code	Location	Geographic Location	Location Setting
1.	NL1	South-west corner of the plant boundary	24° 1'37.79"N 90°59'13.38"E	Industrial
2.	NL2	North-west corner of the plant boundary	24° 1'42.68"N 90°59'17.54"E	Industrial
3.	NL3	North-east corner of the plant boundary	24° 1'40.34"N 90°59'20.57"E	Industrial
4.	NL4	South-east corner of the plant boundary	24° 1'36.35"N 90°59'15.92"E	Industrial

Sl.	Code	Location	Geographic Location	Location Setting
5.	NL5	North side of the plant boundary	24° 1'41.91"N 90°59'18.49"E	Industrial
6.	NL6	North side of the plant boundary	24° 1'41.46"N 90°59'19.09"E	Industrial
7.	NL7	North side of the plant boundary	24° 1'41.00"N 90°59'19.67"E	Industrial
8.	NL8	East side of the plant boundary	24° 1'39.43"N 90°59'19.82"E	Industrial
9.	NL9	East side of the plant boundary	24° 1'38.94"N 90°59'18.86"E	Industrial
10.	NL10	East side of the plant boundary	24° 1'37.37"N 90°59'17.07"E	Industrial
11.	NL11	South side of the plant boundary	24° 1'36.73"N 90°59'15.15"E	Industrial
12.	NL12	South side of the plant boundary	24° 1'37.14"N 90°59'14.25"E	Industrial
13.	NL13	Adjacent to the engine room (Western side)	24° 1'39.96"N 90°59'15.79"E	Industrial
14.	NL14	In front of the engine room (east side)	24° 1'39.62"N 90°59'17.16"E	Industrial
15.	NL15	Infront of the engine room (east side)	24° 1'40.47"N 90°59'17.67"E	Industrial
16.	NL16	Halima Begum's House, Char Chartala	24° 1'35.05"N 90°59'27.42"E	Industrial
17.	NL17	Habibur Rahman House, Char Chartala	24° 1'39.42"N 90°59'21.69"E	Industrial
18.	NL18	Akter Mia's House, Char Chartala	24° 1'37.66"N 90°59'21.03"E	Industrial
19.	NL19	Khorshed Mia's House, Char Chartala	24° 1'36.70"N 90°59'16.84"E	Industrial

Figure 5.2-10: Noise Level Monitoring Locations

Detail noise levels are presented in **Table 5.2-**16.

Table 5.2-16: Noise level in and around the Proposed Project Site

Location	Normalized Noise Data (dB)		Applicable Standard * (dB(A))	
	Day	Night	Day	Night
NL1	63.0±3.0	60.0±2.82	75	70
NL2	69.0±3.2	65.8±3.09	75	70
NL3	51.2±2.4	50.3±2.37	75	70
NL4	61.3±2.9	58.0±2.73	75	70
NL5	63.6±3.0	62.0±2.91	75	70
NL6	61.8±2.9	59.0±2.77	75	70
NL7	53.2±2.5	52.6±2.47	75	70
NL8	55.6±2.6	53.3±2.50	75	70
NL9	64.9±3.1	63.7±2.99	75	70
NL10	59.0±2.8	58.6±2.75	75	70
NL11	60.5±2.8	60.1±2.82	75	70
NL12	60.9±2.9	60.4±2.84	75	70
NL13	66.3±3.1	64.9±3.05	75	70
NL14	67.0±3.1	66.3±3.12	75	70
NL15	65.2±3.1	62.7±2.95	75	70
NL16	56.3±2.6	53.4±2.51	75	70
NL17	59.6±2.8	58.6±2.75	75	70
NL18	57.9±2.7	56.9±2.68	75	70
NL19	62.5±2.9	61.9±2.91	75	70

Source: Field Survey by EQMS (September, 2014)

**Environmental Conservation Rules, 1997 (Schedule 4) (subsequent amendment in 2006)*

Table 5.2-16 summarizes the measured ambient noise levels at each monitoring location. The project area falls into Industrial zone according to Bangladesh Environmental Quality Standard ECR'97 categorization. Noise levels of all locations were within the standard limit of ECR'97 (subsequent amendment in 2006). Normalization of Noise level is annexed in Annexure-XX.

5.3 BIOLOGICAL ENVIRONMENT

5.3.1 OVERVIEW

The countries of South and Southeast Asia are considered by the IUCN as regions of high species diversity. A large number of native plants, including 3,000-4,000 species of woody

flora, have been recorded from Bangladesh. The country lies at the meeting point (tecotonal region) of several floristic provinces, including the Manipur-Khasia, Bengal and North Burman provinces within the Indo-Malayan realm (IUCN, 2002).

The entire floodplain of Bangladesh was once well forested, but most of the native forests have disappeared in recent decades due to mounting pressure from human populations. The floodplain land has long been subject to cultivation, the most dominant land use within the study area. Thus only scattered patches of native trees, wetlands and associated fauna habitat remain in isolated locations within the terrestrial environment (IUCN, 2002). In many parts of the country, the abundance of plantations and groves of trees around villages creates an aspect of discontinuous forest (Wahab, 2008).

The river systems within the study area are used as local transport routes and are also important for fishing and fish farming. The freshwater watercourses also provide an important nursery ground for native fish. In addition, a number of fish ponds and freshwater wetlands occur within the study area. These areas provide diverse habitats for many freshwater aquatic flora and fauna.

The natural forests of Bangladesh have been subject to rapid depletion in recent years. Forests have been declining at a rate of 2.1% annually from the early 1980s. It was estimated in 1999 that only about 6% of the total area of the country merits the term 'forested' (Salam, et. al. 1999). Traditionally "sal" and mixed evergreen forests used to cover vast areas in the centre and east of Bangladesh. Most of the forests, which are considered of low productivity, have been replaced for tree monoculture plantations using eucalyptus and rubber among other species. Most of this forest land has been denuded, degraded, and occupied by forestry companies or displaced people (IUCN, 2002).
Figure 5.3-1and Figure 5.3-2 shows the location of the existing power plant in relation to the country's forest and protected areas. The maps illustrates that no protected habitats or reserve forests occur within 50 km of the plant.

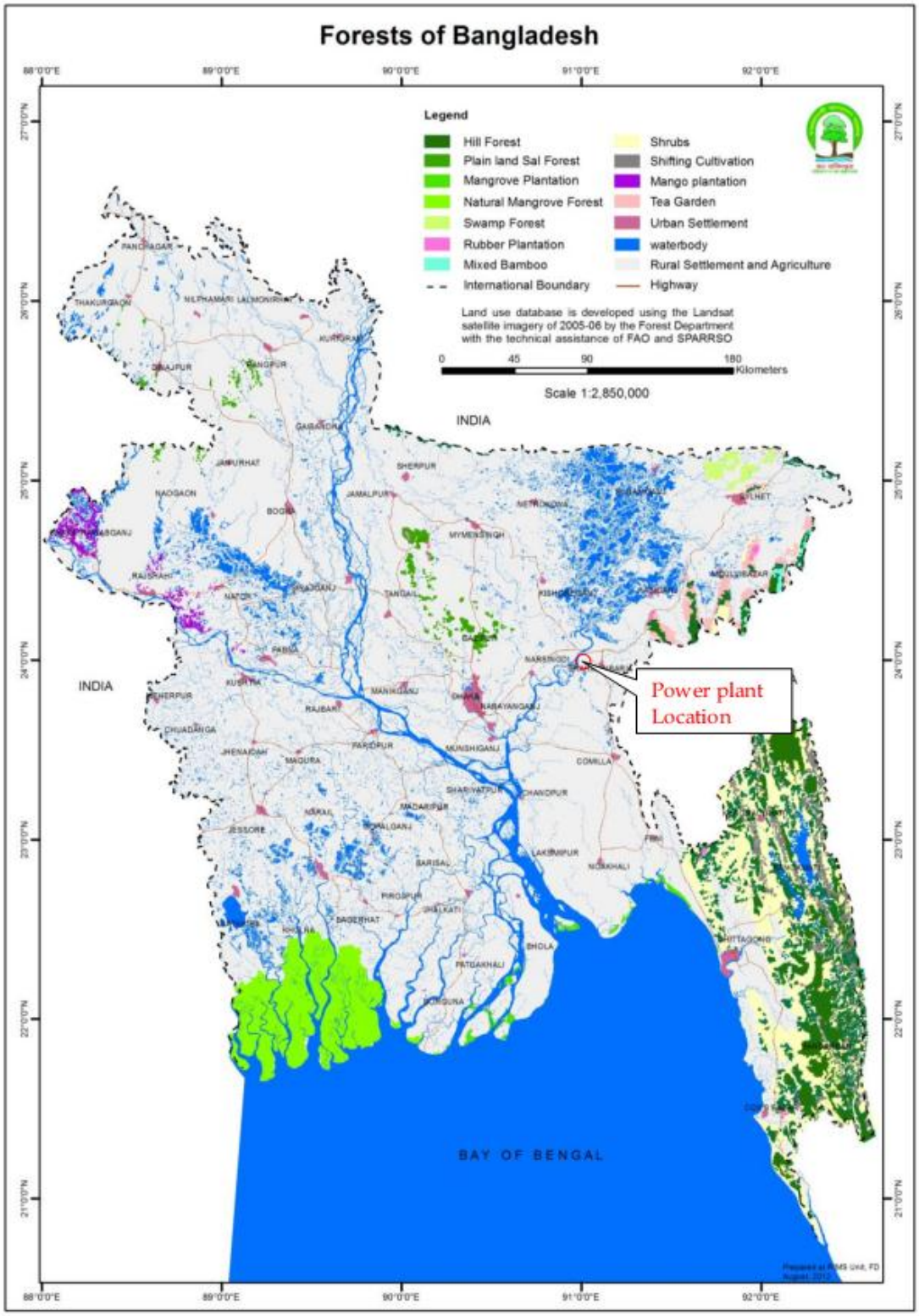


Figure 5.3-1: Forest Areas of Bangladesh

Figure 5.3-2: Protected Areas of Bangladesh

5.3.2 BIO-ECOLOGICAL ZONE

Twenty-five bio-ecological zones have been delineated within Bangladesh by the IUCN. Six parameters were used to determine the areas including: physiography, soil, rainfall and temperature, floral distribution, faunal distribution and flood depth (IUCN 2002). The project site occurs in the Meghna Floodplain bio-ecological zone (4e) as shown in **Figure 5.3-3**.

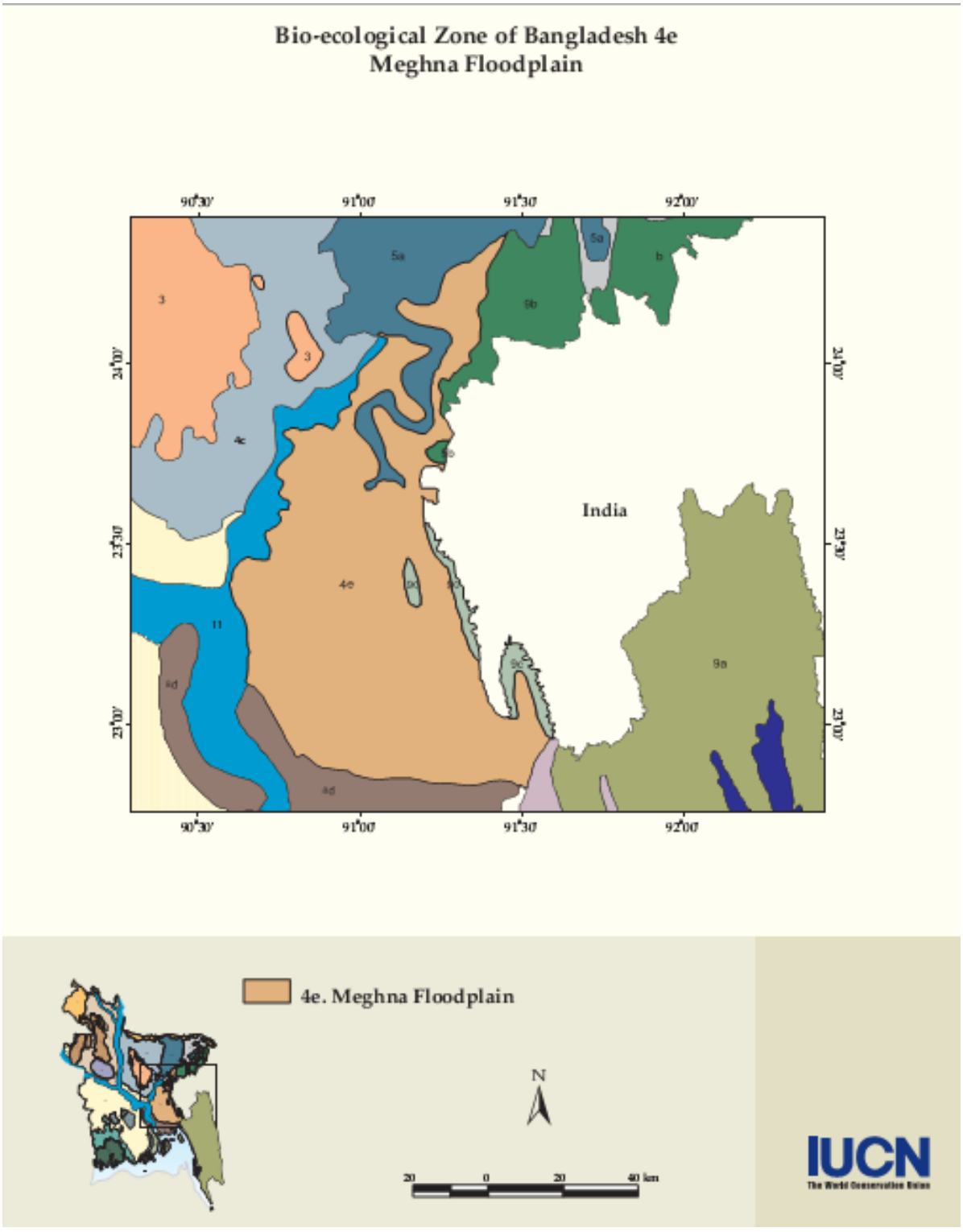


Figure 5.3-3: Bio-ecological zone of the study area

Meghna Floodplain Bio-ecological zone

A major part of the Meghna floodplain was created by the deposition of sediments brought in by the old Brahmaputra river, before it changed its course to the west of the Madhupur sal tract some 200 years ago. The rest of the sediments were laid down principally by the Meghna river itself and by some minor rivers draining down from the Tipperah hills. This floodplain occupies a low-lying landscape of chars and many broad meandering channels. This zone is mostly affected by seasonal flooding while riverbank erosion is considered the major environmental hazard (Brammer, 1996).

The luxuriant growth of palms is the dominant characteristic feature of the vegetation type of this zone. The Betel nut (*Areca catechu*) is increasingly visible as the dominant tree species towards the western section of this zone, and grows almost in the form of forests along the Meghna above Lakshmipur. It is invariably accompanied by the Mandar (*Erythrina indica*), a thorny tree species, that serves to shade the young betel nuts. The Coconut (Cocos *nucifera*) is also very commonly found in the western part of this zone and on the chars. The Toddy palm (*Borassus flabellifer*) and Date palm (*Phoenix sylvestris*) are also to be seen in most parts. The Mahogany (*Swietenia mahagoni*) and Teak (*Tectona grandis*) planted at the roadsides have, on the other hand, matured well. This zone also produces several varieties of cane, a good deal of bamboo and thatching grass (Khan, 1977).

It is evident from old accounts that a few hundred years ago, this zone had, like many other places in Bangladesh, more forest cover than it has today; consequently, faunal diversity was also richer than it is today. Webster (1911) mentioned that the different species of deer, tiger and buffalo, which were well represented in the past, became scarce during the last few decades. Prominent mammalian species, which were found in this zone, are several species of bats, different species of monkeys, pangolins, etc. Moreover, several species of raptorial birds were found in this zone which included: the Red-headed vulture (*Sarcogyps calvus*), White-rumped vulture (*Gyps bengalensis*), Crested serpent eagle (*Spilornis cheela*), Short-toed snake eagle (*Circaetus gallicus*), etc. All these species are now either extinct or threatened (Khan, 1977).

The bio-ecological zone has been separated into two broad ecosystem types that occur within the study area. These are:

- Terrestrial; which represents the flora and fauna that occurs in land based areas that remain relatively unaffected by inundation associated with the monsoon; and
- Aquatic; which includes the flora and fauna associated with water bodies in the study area, including Meghna River, situated adjacent to the Power Plant.

5.3.3 ADOPTED METHODOLOGY

This section deals with the methodology for biodiversity assessment of Flora (tree, shrubs, and herbs) and Fauna (birds, reptiles, amphibians, mammals) as well as the surrounding ecosystems. Most of the field work within the Project study area addressed these groups although each group was dealt with different approaches and requirements. A four person multidisciplinary team was organized to deal with these various aspects. The status of the

flora and fauna of the study area (both terrestrial and aquatic environments) was determined by:

- Reconnaissance survey of project area and surrounding area
- Interviews and discussion with local informants
- Review of IUCN-Bangladesh Red Data Book relevant to the area, and
- Through different secondary sources.

5.3.4 FLORAL COMPONENT

Reconnaissance field surveys were made to assess the various vegetation types/ecosystems present within the project impact zone. Once established, the target areas were extensively surveyed and a species assessment was made. To facilitate the identification of the maximum number of species, several visits were made. The study area (both directly and indirectly impacted area) occupies both terrestrial as well as aquatic ecosystems.

5.3.4.1 TERRESTRIAL FLORA

There is no designated forest in the project site and this area is dominated by industrial and commercial establishments. Terrestrial plant species is not so diverse. No endangered or threatened were found in the study area. Only common plant species were found in the study area with herbaceous vegetation.

As a result of past and continued land use within the study area, there are three main terrestrial ecological communities within the study area. They are:

- Agricultural Land;
- Homestead Plantation;
- Road side vegetation

Agricultural Land

The study area contain low crop field. The agricultural area provide important hunting and feeding grounds for birds and other wildlife. Species such as the rat (*Mus booduga*) and rat *(Rattus rattus)*. Thus, predatory birds such as Black kite (*Milvus migrans*) and House Crow (*Corvus splendens*) are commonly found foraging in the agricultural areas around the study area.

Agricultural vegetation has the lowest diversity of all ecosystem types within the study area. Several weed species occur within this area including *Alternanthera sessilis*, *Amaranthus spinosus*, *Cynodon dactylon*, *Polygonum sp*., and *Oxalis corniculata*.

Thirteen crop field species were found within the study area these are shown in the **ANNEX IV.**

Homestead Plantation

Homestead vegetation within the study area is generally in moderate condition. Most of the houses around in the study area are surrounded by locally cultivated plants. Common homestead vegetation includes Aam (*Magnifera indica*), Kanthal (*Artocarpus heterophyllus*),

Supari (*Areca catechu*), Mehogani (*Swietenia mahagoni*), Kola (*Musa sp.*) and Jam (*Syzygium cumini*). Among the shrubs Datranga (*Melastoma malabathricum*) and Vat (*Clerodendrum viscosum*) are the most common species. Such vegetation plays an important role in meeting food, fodder, medicine, fuel and other requirements for local people. Homesteads vegetation also provides good shelter for many wildlife species for nesting, roosting and feeding.

Thirty Two homestead species were identified in the study area. Fruit, timber, fuel wood and medicine producing plants were identified. Homestead flora consists of both native and exotic species, a detailed list of these species has been provided in **Annex IV.**

Roadside Vegetation

Approximately 12-15 families of the plant species are present in the study area. These are: Gramineae, Leguminosae, Moraceae, Myrtaceae, Cyperaceae, Euphorbiaceae, Rutaceae, Solanaceae, Labiatae, Rubiaceae, Malvaceae, Compositae, etc. The most common roadside plantation trees are Koroi (*Albizia procera*), Sisso (*Dalbergia sissoo*), Mahogany (*Sweitonia mahagoni*), Katanote (*Amaranthus spinosus*), Dhutura (*Datura meteloides*), Apang (*Achyranthus aspera*), Chorekanta (*Chrysopogon aciculatus*), Jagadumur (*Ficus glomoreta*), Swetadrun (*Leacus lavendulifolia*), Tulsi (*Ocimum sanctum*), Titbegun (*Solanum indicum*), Benna (*Veteveria zizanioides*), Bot (*Ficus benghalensis*) etc. Koroi (*Albizia procera*), Sisso (*Dalbergia sissoo*), Mahogany (*Sweitonia mahagoni*) are the dominant road side plant species in the study area.

5.3.4.2 Aquatic Flora

Wetland is a one of the feature in the study area. (Wetlands govern necessary nutrients and other elements for whole ecosystems as it is an important type.
There are two types of wetland in the study area.

- Permanent wetland and
- Seasonal wetlands.

Rivers, canals, perennial water bodies and fishponds are the permanent wetland. Seasonal wetland is mainly floodplains which inundates in the monsoon. Most of the study area supports seasonal wetland. Wetland are abounded by different types aquatic flora such as free floating, rooted floating, submerged, sedges and meadows and marginal plants. Free floating plants are commonly observed throughout the study area. A detail species list of wetlands species provided in **Annex IV.**

5.3.5 FAUNAL COMPONENT

There is no forest area in the study area only road side and homestead plantation support the avian species for their nesting. Cultivation and plantation areas support a diverse range of common fauna species; however, the quality of such habitat is influenced by a variety of agricultural practices, including cultivation processes and the use of agro-chemicals. Within the study area, cultivated areas, with their associated vegetation types and homestead bushy area, represent the majority of habitat available for terrestrial fauna species.

Village forests or homestead plantations in this area supplies food, fodder, medicine, fuel and timber for local villagers. Village and homestead vegetation is the single most important plant community in terms of diversity. Settlement, embankment and roadside vegetation plays a very important role in providing shelter for many wildlife species.

5.3.5.1 Terrestrial Fauna

Birds (Avifauna)

Habitat Condition of the study Area: The study area is mixed land with barren land, homestead plantation, road side plantation. These vegetation are supporting the bird species for their nesting in the study area. Some common birds were seen during the field visit.

Species Diversity: A total of about 14 bird species were observed within the study area. A detail about the terrestrial bird species checklist is available in **ANNEX V**.

Important Bird Areas (IBAs) in Bangladesh

According to the Bird Life International the Important Bird Areas (IBAs) of Bangladesh are listed in **Table 5.3-**1. The study area is not fall in any important bird area.

Table 5.3-1: List of the Important Bird Areas (IBAs) of Bangladesh

Country/ Territory	International name	IBA Code	Criteria
Bangladesh	Aila Beel	BD003	A1, A4i, A4iii
Bangladesh	Ganges-Brahmaputra-Meghna delta	BD011	A1, A4i, A4iii
Bangladesh	Hail Haor	BD006	A1, A4i, A4iii
Bangladesh	Hakaluki Haor	BD004	A1, A4i, A4iii
Bangladesh	Hazarikhil Wildlife Sanctuary	BD013	A3
Bangladesh	Himchari National Park	BD018	A3
Bangladesh	Jamuna-Brahmaputra river	BD009	A1, A4i
Bangladesh	Lawachara / West Bhanugach Reserved Forest	BD005	A1, A3
Bangladesh	Madhupur National Park	BD001	A3
Bangladesh	Muhuri Dam	BD012	A4i
Bangladesh	Pablakhali Wildlife Sanctuary	BD014	A1, A3
Bangladesh	Patenga Beach	BD016	A1, A4i
Bangladesh	Rajkandi Reserved Forest	BD007	A3
Bangladesh	Rampahar-Sitapahar Wildlife Sanctuary	BD015	A3
Bangladesh	Rema-Kalenga Wildlife Sanctuary	BD008	A3
Bangladesh	Sangu Matamuhari	BD017	A3
Bangladesh	Sunderbans (East, South, West Wildlife Sanctuaries)	BD010	A1, A4iii
Bangladesh	Tanguar Haor and Panabeel	BD002	A1, A4i, A4iii
Bangladesh	Teknaf Game Reserve	BD019	A1, A3

(Source- Bird Life international, 2004)

Amphibians & Reptiles

The geographical location of Bangladesh is such that there is a high possibility of occurrence of animals and plants. It supports a wide range of floral and faunal community throughout the country.

There is no densely protected forest area within in the study area. Due to lack of natural habitat in the study area, the reptiles in this area not diverse but few species are found in the study area including Common Vine snake *(Ahaetulla nasutus),* Smooth water snake (*Enhydris*) Indian Rat Snake *(Ptyas mucosus)* were foundin the study area. Aquatic and semi-terrestrial snakes were found within the water or next to the water bodies around the Project site.

A variety of lizards and skinks were observed during the survey. Among the lizards identified was the Common garden lizard *(Calotes versicolor*). Lizards were observed in bushes and the lower canopies of trees in various vegetated areas around the study area. Other common geckos including Brook's House Gecko (*Hemidactylus brookii*), the Common House Gecko (*Hemidactylus frenatus*) were seen within homesteads.

Common skink (*Eutrophis macularia*) was found in several of the terrestrial habitats around the study area. Their niche habitat is low-lying vegetation, leaf litter, grassy areas, bushes, stream banks, under logs and burrows. The burrow-dweller Bengal monitor (*Varanus bengalensis)* was seen basking in the study area.

Mammals

No wild mammal species were observed during the site survey. Common mammals that were found within the study area are Mole Rat (*Bandicota bengalensis*), Indian gerbil (Tatera indica), Bandicot Rat (*Bandicota indica*), House Shrew (*Suncus murinus*), Field Mouse (*Mus booduga*), House Mouse (*Mus musculus*), House Rat (*Rattus rattus*), Small Indian Mongoose (*Herpestes autopunctatus*) and Indian fox *(lepis migrocollis*).

5.3.5.2 Aquatic Fauna

The main aquatic fauna in this area are different types of fishes. A few ponds that remain almost dry in the summer season in this area are used for natural cultivation of seasonal fresh water fishing. The fresh water fishes are carp (Rui, Katal, Mrigel, Ghania, Kalibaus etc.). The stretch of the river Meghna provides a habitat for a wide variety of fishes and shellfish species, which include carp, catfish (Boal, Pangas, Shilong, Bacha etc.) and live fish (Koi, Singh, Magur etc.). Tortoise, Frogs, Water Snakes etc. are other aquatic found in the Beels around the project area. **Table 5.3.-2** presents available fish species in the Meghna river and in the Beel areas.

A large number of aquatic fauna was observed in the study area. Many are totally dependent on wetlands (beels, river, ponds) and species are partially dependent on wetlands. There are little available aquatic habitats for faunal species. Wetlands are

intensively exploited and the habitat is highly disturbed. Despite this, some species have adapted to the altered environment, and others have even flourished.

Among the amphibians the skipper frog (Rana cyanophyctis) is common-being found in most of the wetland habitats and has been the most successful in adapting to the altered environment. The common roof turtle (*Kachuga tecta*) and the flat-shelled spotted turtle (*Lissemys punctata*) are the most common of the reptiles. These freshwater turtle species face problems of migration during summer when water levels are inadequate.

The common aquatic snakes include the checkered keelbaek (*Xenochrophis piscator*) and the smooth water snake (*Enhydris enhydris*). The common lizards found within the study area comprise the common skink (*Mabuya carinata*) and the garden lizard (*Calotes versicolor*).

Among other species that once were common but now are only occasionally seen are the monitor lizards (*Varanus bengalensis and V. flavescens*). These species prefer a habitat with or near water.

Common water birds were seen in the study area including Indian Pond Heron (*Ardeola grayii*), Common kingfisher (*Alcedo atthis*), Little Egret (*Egretta garzetta*), Indian Cormorant (*Phalacrocorax fuscicollis*) etc. Aquatic and water-dependent birds have been severely affected by habitat alteration. Wetland degradation has left virtually no sheltered place for waterfowl to roost or nest. Herons, egrets, bitterns and ducks have been intensely affected by habitat alteration.

The freshwater dolphin (*Platanista gangetica*) are seen rarely in the Meghna during the monsoon season.

Table 5.3.-2: Common Fish Species in Meghna River and Surrounding Water Bodies

Sl.	Local name	Common name	Scientific name
1.	Bata	Bata labeo	*Labeo bata*
2.	Rui	Rohu	*Labeo rohita*
3.	Mola	Pale carplet	*Amblypharyngodon mola*
4.	Chital	Humped featherback	*Chitala chitala*
5.	Bagair	Gangetic goonch	*Bagarius bagarius*
6.	Koi	Climbing perch	*Anabas testudineus*
7.	Catla	Catla	*Catla catla*
8.	Taki	Spotted snakehead	*Channa punctata*
9.	Shol	Striped snakehead	*Channa striata*
10.	Gutia	Guntea loach	*Lepidocephalus guntea*
11.	Mirka	Mrigal	*Cirrhinus cirrhosus*
12.	Magur	Walking catfish	*Clarias batrachus*
13.	Ghaura	Garua Bachcha	*Clupisoma garua*
14.	Kachki	Ganges river sprat	*Corica soborna*
15.	Tara baim	Striped spinyeel	*Macrognathus aculeatus*
16.	Sal baim	Tire-track spinyeel	*Mastacembleus armatus*
17.	Bele	Tank goby	*Glossogobius giuris*
18.	Chapila	Indian river shad	*Gudusia chapra*
19.	Golsa-tengra	Menoda catfish	*Hemibagrus menoda*
20.	Shing	Stinging catfish	*Heteropneustestes fossilis*

21.	Ek Thuita	Congaturi halfbeak	*Hyporhamphus limbatus*
22.	Tengra	Day's mystus	*Mystus bleekeri*
23.	Punti	Spot-fin swamp barb	*Puntius sophore*
24.	Khalla	Corsula mullet	*Rhinomugil corsula*
25.	Ayre	Long-whiskered catfish	*Sperata aor*
26.	Ilish	Hilsa	*Tenualosa ilisha*
27.	Boal	Wallago	*Wallago attu*

5.4 SOCIO-ECONOMIC ENVIRONMENT

The socio-economic baseline environment of the study area was captured to have a picture of the current situation to allow comparison with that of any potential impact associated with the proposed project. The study included an assessment of the baseline condition of the local stakeholders including the local community, governmental organizations, and community development agencies such as NGO/Self Help Groups etc amongst other as well as taking into account their perceptions on the impacts and benefits from this existing power plant.

5.4.1 APPROACH AND METHODOLOGY

The approach and methodology adopted for the socio-economic baseline assessment relied on readily available secondary information and primary information collected through consultations with a range of stakeholders for the project as well as sample socio-economic survey of households within the study area of influence . The key activities that were carried out for primary and secondary data collection are summarized as follows:

- **Desk-Based Review** of available project documentation and profile of the project site;
- **Reconnaissance to the Site** to visually observe the social setting in and around 2 km of the area;
- **Secondary Information** is used from the Bureau of Statistic data for 2 km study area.
- **Consultations with the Various Stakeholders** ranging from governmental institutions, local administration (municipality & village administration) , local community, land losers, project proponent and NGOs amongst others
- **Socio-Economic Survey** of the key settlements within close proximity of the existing power plant. The survey was conducted for 52 households and data was collected based on a pre-developed questionnaire to ascertain general socio-economic indicators of the area;

5.4.2 DEMARCATION OF THE PROJECT AREA FOR SOCIO-ECONOMIC STUDY

From the social perspective, considering that the 2 km radius might entail a very large for primary socio-economic landscape, which may not be entirely relevant from the point of studying the social impact for this power plant, the administrative boundaries of the unions, villages and settlements that lie in the immediate vicinity of the plant site and adjacent rural

settlement have been taken for primary socio-economic survey of the study area. The adjacent settlement is Char Chartala village under Char Chartala union.

5.4.3 SITE VISIT AND RECONNAISSANCE

The site visit was conducted by a team comprising of two social specialists from EQMS. The entire site visit was conducted in September, 2014. The socio economic survey as well as the stakeholder consultations was concluded during this period.

5.4.4 STAKEHOLDER CONSULTATIONS

The team consulted with a diverse range of stakeholders associated with the project. These included governmental agencies and departments, local administration, NGO, as well as the community. Furthermore, in order to assess the community and household level impacts, a socio-economic survey for a sample household size of 52 within the close settlement of the existing power plant was undertaken. This survey helped establish the baseline conditions of the community living in the vicinity of the project footprint and their opinions, expectation and apprehensions about the existing power plant. The analyses of this data and the inferences drawn have been provided in the following sections.

5.4.5 DOCUMENTATION COLLECTION AND REVIEW

During the field assessment and stakeholder meetings, documents of relevance to this study were collected and data from the same was utilized in developing this social baseline. The following is a list of documents that were collected and reviewed during this site assessment.

- Bangladesh population Census for 2011 for Brahmanbaria, kishoganj and Narshigdi District
- Agricultural Census Data 2013, Char Chartala union of Ashuganj Upazila, Brahmanbaria
- Fisheries data of Ashuganj Upazila.

5.4.6 SOCIO-ECONOMIC BASELINE PROFILE

5.4.6.1 ADMINISTRATIVE PROFILE OF BRAHMABARIA

Brahmanbaria is a district in east-central of Bangladesh and it is a part of the Chittagong division. Total area of Sylhet District is 1,927.1 km^2 and total population is 2,840,498. Population density of Sylhet district is 1500 per km^2. The Midland Power plant is located at Char Chartala union of Ashuganj upazila under Brahmanbaria district. The plant is located approximately 23.8 km far from district headquarter and 2.4 km from Dhaka-Sylhet national highway.

5.4.6.2 DEMOGRAPHY OF PROJECT AREA

In accordance to the Census of Bangladesh (2011), the total population of the project study area is 229739. In Char Chartala (where the project site is located), Ashuganj, Araishidha, Bhairab Paurashava, Musapur the total population is 25789, 35110, 20727, 118992, 29121 respectively and average population density is the project study area is 3084 persons per sq km. In comparison, the density of population of complete Ashuganj upazila is approximately 2673 persons per sq km. Ashuganj Upazila consists of 8 Unions, 30 Mauzas and 41 villages. **Table 5.4-1**provides a snapshot of the key demographic indicators of the key unions within the project study area for 2 km study area.

Table 5.4-1: Demographic Profile of the Project Study Area

Upazila	Union	Total Population	Total Household	Average Household Size	Sex Ratio	Literacy (%)
Ashuganj	Char Chartala**	25789	5033	5.1	105	55
	Ashuganj	35110	6816	5.1	99	49.4
	Araisidha	20727	3715	5.5	93	54.2
Bhairab	Bhairab Paurashava	118992	24057	4.9	103	53.6
Roypura	Musapur	29121	5807	5	95	47.9
Project Study Area		**229739**	**45428**	**5.1**	**99**	**52.0**
Ashuganj Upazila		**180654**	**33552**	**5.4**	**96**	**51.2**
Bhairab Upazila		**298309**	**58940**	**5**	**97**	**42.7**
Roypura Upazila		**535796**	**110520**	**4.8**	**94**	**40.5**

*Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)** Project site is located in this union*

5.4.6.3 GENDER RATIO

The average household size in the project study area, Ashuganj, Bhairab and Roypur upazila are 5.1, 5.4, 5.0 and 4.8. The Gender ratio in the project study area is 99 as against 96, 97 and 94 for Ashuganj, Bhairab and Roypur upazila respectively. The lowest gender ratio recorded within the study area is in Char Cahrtala union at 105 whereas the highest is in Araisidha at 113.

5.4.6.4 EDUCATION & LITERACY

According to the Census of Bangladesh (2011), the literacy rate in the project study area is only 52.0%. In comparison, literacy rates in Ashuganj, Bhairab and Roypura Upazilas are also moderate with only 51.2%, 42.7% and 40.5% of the population classified as literate respectively. The literacy rate was found to be lower in the rural areas as compared to the urban settlements where it was observed to be comparatively greater. The low literacy can be attributed to low availability of educational infrastructure in the district, lack of accessibility, as well as use of traditional and archaic means of education practices.

5.4.6.5 SOCIAL CLASSIFICATION

As per the 2011 census, the population of the project study area primarily consists of Muslims constituting almost 97.8% of the total population. The remaining 2.8% is primarily constituted by Hindus with Christians, Buddhists and others comprising an insignificant percentage. In the project area, the population primarily consists of Muslims with majority of the same from the Sunnisect. The following **Table 5.4-2**indicates the various religious profile of the project study area.

Table 5.4-2: Religion Profile of the Project Study Area

Upazila	Union	Total Population	Muslim		Hindu		Christian		Buddhist		Others	
			Pop.	%	Pop.	%	Pop.	%	Pop.	%	Pop.	%
Ashuganj	Char Chartala	25789	25370	98.4	403	1.6	10	0.039	6	0.023	0	0
	Ashuganj	35110	32415	92.3	2689	7.7	6	0.017	0	0	0	0
	Araisidha	20727	20431	98.6	296	1.4	0	0	0	0	0	0
Bhairab	Bhairab Paurashava	118992	110875	93.2	8082	6.8	30	0.025	4	0.003	1	0.0008
Roypura	Musapur	29121	28494	97.8	627	2.2	0	0	0	0	0	0
Project Study Area		**229739**	**217585**	**94.7**	**12097**	**5.3**	**46**	**0.020**	**10**	**0.004**	**1**	**0.0004**
Ashuganj Upazila		**180654**	**172249**	**95.3**	**8336**	**4.6**	**18**	**0.010**	**12**	**0.007**	**39**	**0.0216**
Bhairab Upazila		**298309**	**286457**	**96.0**	**11815**	**4.0**	**32**	**0.011**	**4**	**0.001**	**1**	**0.0003**
Roypura Upazila		**535796**	**515579**	**96.2**	**20199**	**3.8**	**10**	**0.002**	**2**	**0.000**	**6**	**0.0011**

*Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)** Project site is located in this union*

5.4.6.6 VULNERABILITY CLASSIFICATION

Vulnerability in the project study area has been defined in the context of socioeconomic status of both individual groups as well as household groups. These include women; old, physically handicapped and destitute people at the individual level and houses headed by women, the physically handicapped, and those below the poverty line. Amongst various categories of vulnerable identified for the project, physically challenged, women and old aged are at the highest risk.

5.4.6.7 Employment Profile

In accordance to the Census of Bangladesh (2011), service is the dominant source of employment and household income in the study area. The situation is similar at Ashuganj, Bhairab upazila whereas in Roypura upazila of Narsindi district agriculture is the dominant source of income. In the project study area with a few percentage of the population involved in agricultural practices including direct farming, sharecropping, agricultural labourers etc.

With respect to employment profile specifically for the project study area, the following **Table 5.4-3**provides the key occupation practices.

Table 5.4-3: Employment Status by field of Activity in the Project Study Area

District	Upazila	Total Population		Field of Activity											
				Agriculture				Industry				Service			
				Male		Female		Male		Female		Male		Female	
		Male	Female	Pop.	%	Pop.	%	Pop.	%	Pop.	%	Pop.	%	Pop.	%
Ashuganj	Char Chartala**	13192	12597	520	3.94	202	1.60	150	1.14	9	0.07	1346	10.20	299	2.37
	Ashuganj	35110	17435	792	2.26	17	0.10	1166	3.32	455	2.61	1246	3.55	346	1.98
	Araisidha	9987	10740	591	5.92	6	0.06	299	2.99	141	1.31	908	9.09	39	0.36
Bhairab	Bhairab Paurashava	60284	58708	1429	2.37	87	0.15	1859	3.08	315	0.54	6830	11.33	1063	1.81
Raipura	Musapur	14197	14924	967	6.81	37	0.25	327	2.30	107	0.72	1471	10.36	103	0.69
Project Study Area		**132770**	**114404**	**4299**	**3.24**	**349**	**0.31**	**3801**	**2.86**	**1027**	**0.90**	**11801**	**8.89**	**1850**	**1.62**
Ashuganj Upazila		**88340**	**92314**	**5704**	**6.46**	**291**	**0.32**	**2852**	**3.23**	**1163**	**1.26**	**7193**	**8.14**	**1304**	**1.41**
Bhairab Upazila		**146929**	**151380**	**11184**	**7.61**	**452**	**0.30**	**5515**	**3.75**	**484**	**0.32**	**12860**	**8.75**	**1588**	**1.05**
Roypura Upazila		**258993**	**276803**	**39191**	**15.13**	**914**	**0.33**	**4456**	**1.72**	**461**	**0.17**	**17154**	**6.62**	**1753**	**0.63**

*Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)** Project site is located in this union*

5.4.6.8 LOCAL ECONOMY

Agriculture

Brahmanbaria's economy is primarily agrarian economy as well industrial with significant revenue to its GDP coming from agriculture, industrial and agro based industries. **Table 5.4-4**provides a snapshot of agricultural production of some of the key crops in Char Chartala union of Ashuganj Upazil.

Table 5.4-4: Production of Key Crops in Char Chartala union of Ashuganj Upazila as per 2012-13 statistics

Sl.	Crop name	2012-13	
		Cultivated land (Hectare)	Production (Ton/hector)
1.	Boro	200	3.75
2.	Tomato	10	10
3.	Brinjal	8	12
4.	Sweet Potato	80	6
5.	Mustard	40	1.2
6.	Nut	10	2
7.	Chili	5	1.5

Source: Agricultural Department, Ashuganj Upazila

It can be observed from the above table that Rice, and Vegetables contribute to the majority of the total crop output. Rice especially is cultivated both for self-consumption as well as export to other places in Bangladesh.

Local Economy: Fisheries & Aquaculture

Fishing is a common livelihood practice around the project study area. In Ashuganj upazila remarkable percentage people involve in fisheries activities in the Meghna River. According to the Upazila fisheries officer, there is 1823 registered and approximately 1000 non registered fisherman live in the Ashuganj upazila whereas 586 fisherman in lalpur union.

Livestock & Poultry

Rearing of livestock and poultry is also an alternative occupation in Ashuganj. It is mostly a sub-practice carried out in conjunction with farming activities and one of the key sectors that includes participation from women and children. The types of livestock reared include Cow, cattle, buffalo, goats, sheep, fowl, and ducks amongst others. The livestock is reared primarily for milk and meat for self-consumption as well as retail and export.

5.4.6.9 ACCESS TO INFRASTRUCTURE

Electricity

Electricity is a key issue within the project study area and also an overall concern in Brahmanbaria district with about 71.3% of the district electrified whereas the project study

area cover 75.5%. The following **Table 5.4-5**indicates the availability of electricity connection and source of drinking water facility of the project study area.

Source of Drinking Water

The primary source of drinking water throughout the district and Ashuganj upazila is deep tube well. As per the 2011 census, in Ashuganj, Bhairab & Roypura upazila respectively 90.5, 94.7 and 97.2 of the populations were dependant on tube well for meeting their water requirements. As per the census, it was estimated that 98.2% of the population in study area have access to safe drinking water while the remaining are exposed to other water sources.

Table 5.4-5: Sources of Drinking Water and Electricity Facility of the Project Area

Upazila	Union	Total Households	Source of Drinking Water (%)			Electricity Connection (%)
			Tap	Tube-well	Other	
Ashuganj	Char Chartala**	5033	33.4	64.7	1.8	98.4
	Ashuganj	6816	12.9	85.2	1.9	92.8
	Arisidha	3715	1.1	98.4	0.5	96
Bhairab	Bhairab Paurashava	24075	7.5	91.8	0.7	97
Raipura	Musapur	5807	0.3	98.8	0.9	83.3
Project Study Area		**45446**	**11.0**	**87.8**	**1.2**	**93.5**
Ashuganj Upazila		**33552**	**8**	**90.5**	**1.5**	**91.2**
Bhairab Upazila		**58940**	**3.2**	**94.7**	**2.1**	**86**
Roypura Upazila		**110520**	**0.2**	**97.2**	**2.6**	**56.4**

*Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)** Project site is located in this union*

Sanitation

With respect to the sanitation facilities in the project study area, about 37.2% of the total dwellings have sanitary (water sealed) and 46.7% (non water sealed) latrines. Almost 13.0% percent have non sanitary latrines or Kuchcha toilets and remaining 7.4% is dependent on open defecation. The key factors impeding better sanitation practices are primarily poverty, lack of drainage systems and traditional practices used for generations. The following **Table 5.4-6** shows the toilet facility in the project area.

Table 5.4-6: Sanitation Facility of the Project Study Area

Upazila	Union	Total Households	Type of Toilet Facility (%)			
			Sanitary (water-sealed)	Sanitary (non water-sealed)	Non-sanitary	None
Ashuganj	Char Chartala**	5033	29.5	64.8	3.9	1.8
	Ashuganj	6816	48.9	40.6	8.5	1.9
	Arisidha	3715	48.2	46.5	4.7	**0.6**
Bhairab	Bhairab Paurashava	24075	38.7	37.9	19.7	3.8
Raipura	Musapur	5807	20.8	43.8	28	7.4
Project Study Area		**45446**	**37.2**	**46.7**	**13.0**	**3.1**
Ashuganj Upazila		**33552**	**35.1**	**55.2**	**7.8**	**1.9**
Bhairab Upazila		**58940**	**20.4**	**34.6**	**37.4**	**7.6**

Upazila	Union	Total Households	Type of Toilet Facility (%)			
			Sanitary (water-sealed)	Sanitary (non water-sealed)	Non-sanitary	None
Roypura Upazila		**110520**	**20.4**	**38.2**	**30.1**	**11.3**

*Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)** Project site is located in this union*

5.4.6.10 CULTURAL HERITAGE

The project study area as such, does not encompass any key cultural heritage or resource of national or regional value. The only cultural resources within the area are local mosques and graveyards.

5.4.7 FINDINGS OF SOCIO-ECONOMIC SURVEY

The baseline assessment also comprised a socio-economic survey which was conducted in the closest rural settlement of the existing Midland power plant and data collected from randomly selected 52 household in order to gain first hand information about the key household level socio-economic indicators.

The socio-economic data was collected on the following main indicators:

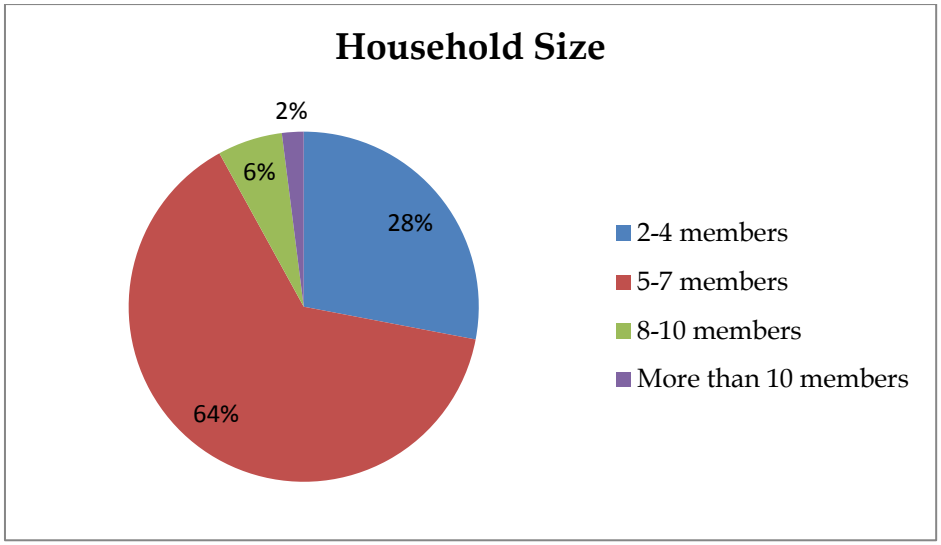
- Demographic Trends
- Access to Public Amenities and Infrastructure
- Access to Utilities and Resources
- Asset ownership
- HH Expenditure & Loan and Debt
- Participation of Women
- Overall awareness and opinion about the project

The following sections provide results from the analysis of the data collected as per the above indicators.

5.4.7.1 DEMOGRAPHIC TRENDS

Household Size

According to the survey data, the majority of the households in the study area have more than 5 members. A significant percentage (64%) has 5-7 members followed by (28%) households having 2-4 members. Only about 6% of the total sample constituted of households having below 8-10 members and 2% have more than 10 members. **Figure 5.4-1**shows the household size of the study area.



Source: Socio-economic Survey by EQMS (September, 2014)

Figure 5.4-1: Average Household Size in the study area

Population

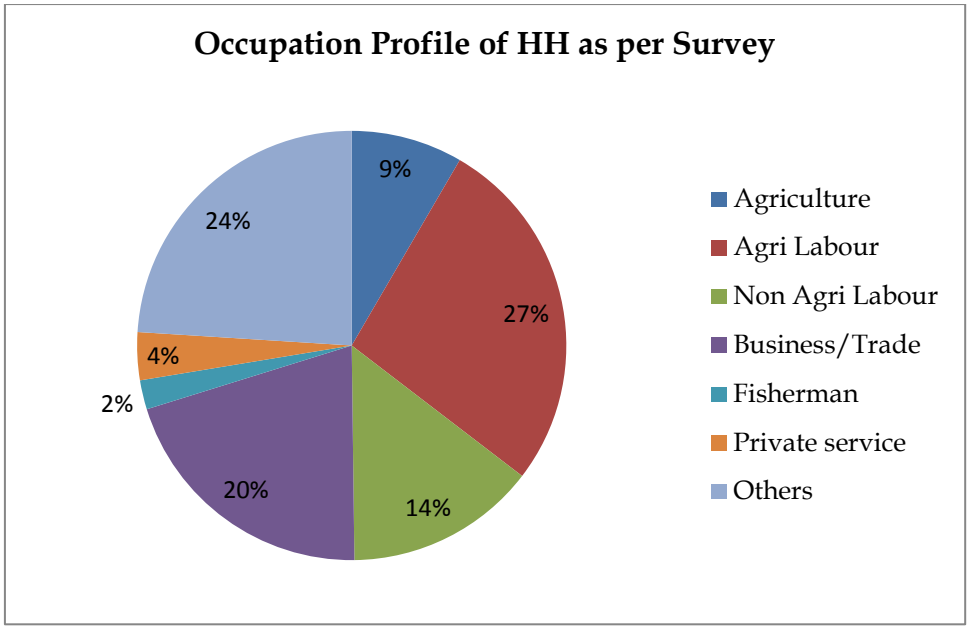
There are 284 peoples living in 52 households in the area giving an average of 5.5 persons per household.

Population age and sex distribution

According to the survey data, the majority of the households in the project area have average population age 25 years. There are 43% women and 57% men.

5.4.7.2 OCCUPATIONAL PROFILE

As per the survey data it can be observed that almost 27% of the respondents are involved in agricultural labour followed by business (20%), Non Agricultural labour (14%) Agricultural activity (9%), Private Service (4%) and Fisherman (2%) in the study area. 24% are doing other activities including rickshaw-puller, construction worker, driver etc. It can also be observed that majority of the women respondents are housewives or involved in household activities. **Figure 5.4-2**showing the occupational profile of the study area.

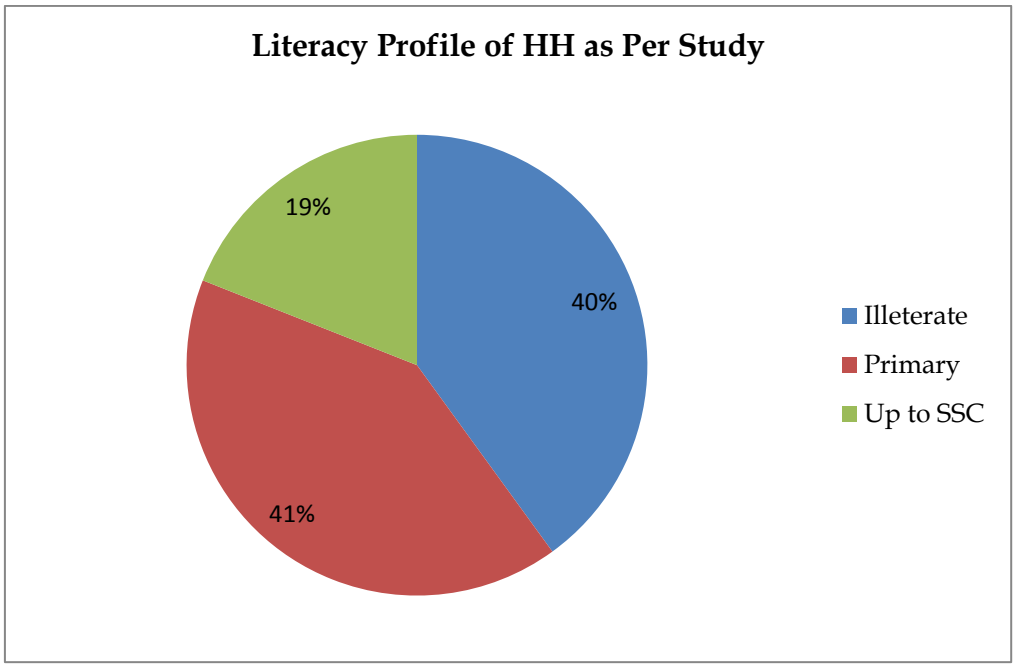


Source: Socio-economic Survey by EQMS (September, 2014)

Figure 5.4-2: Occupation Profile of the Project Area

5.4.7.3 EDUCATION & LITERACY

In terms of education and literacy amongst the sample, majority of the respondents were found to be primary level almost 41% and a significant proportion has illiterate almost 40%. Also secondary 19% of the total sample. **Figure** 5.4-3shows the education and literacy of the study area.



Source: Socio-economic Survey by EQMS (September, 2014)

Figure 5.4-3: Education and Literacy of the Study Area

5.4.7.4 ACCESS TO UTILITIES & RESOURCES

Property of household

In the Surveyed area, category of land ownership namely Private and Government property are available and recognized. In the present survey, data or household land ownership by category and by type of land were collected to sketch the land ownership scenario for the Villages. The whole land ownership scenario in Surveyed area has been sketched by drawing two different scenarios with Scenario-I land owner, scenario-II is household renter. Conservative estimation considering private Property is 85%,Government Property 15%. Almost these property households have been conveying Ownership about 71% property owners, 8% giving house hold rent, 15% squatter and 6% sharecropper.

Sanitation Facilities

It can be observed from the below Figure that some of the households or approximately 58% in the project study area pit latrine and 42% sanitation latrine facilities. Moreover, proper sanitation facilities almost 70% mostly observed in the middle and upper middle class sections of the society.

Source of Fuel for Cooking

Households in the study area use fuel for cooking purposes from different sources including Firewood, crop residue, Kerosene, Cylinder gas, Biogas etc. Almost 32% Source of Fuel has bought from market and 68% collected from nearby sources.

Access to resources

Among the surveyed HH within the project study area, certain questions were asked with respect to access to key resources such as water sources, grazing land, hospital and markets. All surveyed households reported to have immediate access to resources way within a distance as reported in the following **Table 5.4-7**.

Table 5.4-7: Access to Resources in Study Area

Access to Resources	Less than 1 km	1-3 km	>3 km	Total HH
Main Market	-	52	-	52
Medicine/Hospital	-	52	-	52
Masjid/Temple	52	-	-	52
Grazing land	52			52
Surface water sources	52			52

5.4.7.5 ASSET OWNERSHIP

Land Ownership

The survey has revealed that about 85% own homestead and 8% own agricultural irrigated land.

House Type

Majority of the houses in the sample area surveyed are Kuccha and made of locally resourced materials such as mud, straws, Asbestos and burnt bricks. In the study area there are 34% are earthen floor with tin wall and tin roof, 60% are Brick floor with tin wall and tin roof and rest of are built in concrete.

Household Income

The main sources of income of the surveyed area are agriculture and livestock, agriculture labour, fisheries, non-agriculture labour, industry, business, hawker, transport, construction, service, rent remittance, and others. The income-earner in the HH on average 26% earns below 5000Tk per month. Almost 44% earns 6000-10000 Tk per months. 22% earns 11000-15000 Tk per month. Only 8% households earns 15000Tk above which have been helping their solvency.

Domestic Animals

The percentage of households possessing domestic animals is observed to be moderate in the study area with more than 75% not owning any form of domestic animals. However within the remaining 25% most of the HH owned or reared cows, goats, hens and ducks.

5.4.7.6 HOUSEHOLD EXPENDITURE

It can be observed from the survey that the majority of the expenditure is attributed to food and consumable resources with almost half of the monthly income being allocated for the same. Other significant expenditures include clothing, education and healthcare, transportation and Fuel.

5.4.7.7 OVERALL PERCEPTION ABOUT THE EXISTING POWER PLANT

Majority of the respondents have a positive perception about the power plant. They express their opinion that the power plant is a national asset and support to meet our electricity demand. Only who lives in adjacent to the power plant provide their opinion regarding the noise level and odor problem those mostly comes from other industry located near to the settlement and they inform that noise level from the power plant is tolerable. Positive expectations of the surveyed household are primarily with respect to overall development in the area, improved road facilities and employment opportunity for the local people.

CHAPTER6: ANTICIPATED ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

6.1 INTRODUCTION

This section analyses the potential environmental and social impacts due to the Project. The Project activities will occur in two distinct stages of the Project life cycle:
(a) Construction of the Plant (Construction Phase) and
(b) Operation and maintenance of the Plant (Operation Phase).

However, some of the social impacts are linked to the pre-construction phase of the project. The Project does not envisage any major environmental impact in the pre-construction phase. However, there are social impacts associated with the planning and pre construction phase due to land acquisition (with no physical displacement involved). The same have been discussed in **Section 6.1.10** along with other social impacts.

Note: Environmental and social impacts during decommissioning of the Plant have not been considered in the impact assessment, as these will depend on the options available at the time of expiry of the power purchase agreement between MPCL and BPDB. If the Power Purchase Agreement, Land Lease Agreement, Gas Supply Agreement and the other relevant agreements are not extended or renewed and an alternative economical fuel is available, the power plant may be retrofitted to support alternative power generation. This option would be possible, provided that the required retrofits and new emission rates meet the applicable standards and guidelines. If retrofitting is not a feasible option, and the operational life of the Power Plant expires, the power plant will be decommissioned according to the requirements of the authorities at that time.

6.2 CONSTRUCTION PHASE

The major activities during the construction phase of the 51 MW gas fired power plant may be broadly classified into the following: (i) mobilization of equipment, materials and personnel; (ii) site preparation; and (iii) civil construction and electromechanical installation/erection.

Some of these project activities would likely to have some adverse impacts on certain environmental parameters, while some other would have beneficial effects. In this study, the effects of the project activities on physico-chemical, ecological and socio-economic (i.e., human interest related)parameters have been assessed separately.

6.2.1 ECOLOGICAL IMPACTS

Construction of gas fired power plant would have some potential impacts (direct and indirect) on the existing ecological environment. Activities such as land clearing and alteration, movement of people and vehicle, material placement, excavation, accident, etc.

have direct or indirect impacts on the existing ecological environment. During construction phase, small scale impacts could be identified by studying or monitoring the associated flora and fauna. Large scale impact, if any, could be identified after completion of the proposed project through careful long-term study and monitoring. In this study, at first possible general impacts of project activities on 3F (flora, fauna and fish) have been assessed, which has been followed by more specific evaluation of ecological impacts and risk assessment.

6.2.1.1 IMPACT ON FLORA

Construction of power plant has potential impacts (direct and indirect) on the existing aquatic and terrestrial flora. Within the project sites, magnitude/intensity of these impacts may vary from place to place, and some could easily be identified, while others require long-term study/monitoring. However, general impacts on project works on flora are briefly described below.

Aquatic Flora

The proposed Gas Fired Power Plant project site has aquatic habitat which supports few common aquatic floral species and none of them are threatened in Bangladesh. All aquatic floral species are grown in the wild within the proposed project site. Due to proposed project activities, all aquatic flora inside the proposed project would be adversely affected. People, vehicle and material movement over the aquatic floral habitat may cause damage or may uproot from the ground.

Terrestrial Flora

The proposed project site has terrestrial habitat which supports diversified terrestrial floral species, and none of them are threatened in Bangladesh. During site preparation, some naturally grown floral species (herb and shrub) would have to be cleared; but cutting or clearing of trees would not be required, as there are not "trees" within the project site. These herbs and shrubs within the project site are used by certain adaptive wildlife as habitat for certain time, and therefore, removal of these would have some potential impact. Terrestrial undergrowth has great contribution to the existing ecosystem, and clearing or removal of the undergrowth would also have some adverse impacts.

6.2.1.2 IMPACT ON FAUNA INCLUDING FISH

Construction of the power plant could have some adverse impacts (direct and indirect) on the existing aquatic and terrestrial fauna due to their highly sensitive and reactive behavior for disturbance that may occur at or near their habitat. Faunal species that are sensitive to direct (human activity and traffic) or indirect disturbance (noise) would be impacted most. Habitat disturbance would reduce habitat availability and effectiveness for a certain period for mammals, reptiles, amphibians, birds and their predators. There are also some possibilities of direct mortality and displacement of amphibians, reptiles, birds and mammals from the use of vehicle or machineries over terrestrial or aquatic faunal habitats. Quantification of these losses is difficult; however, the impact is expected to be low and

short-term in nature. Actions near fish habitats may also have some potential impact on fish fauna e.g., mortality, contamination of water, etc. However, fish habitat (i.e., the river) is not likely to be affected significantly during the construction phase of the project.

Amphibians

Few common amphibian species are available at or near the proposed project site and none of them are nationally threatened. Amphibians are more sensitive to the environmental changes due to their permeable skin and other biological features. Amphibians use both aquatic and terrestrial habitat for their survival and changes of those habitats have a great impacts for their survival. The proposed project activities could have some impacts on existing amphibians such as (i) undergrowth or vegetation may be cleared for construction works, (ii) project vehicle and materials may enter into the shallow / deep freshwater bodies or saturated ground, (iii) increased contamination of water due to various actions related to project, etc. These impacts may cause temporary or permanent disturbance of amphibian habitat. Impacts on amphibian population could be evaluated by monitoring the changes of species composition and richness and their relative abundance.

Reptiles

Few common reptilian species are available at or near the proposed project site and none of them are nationally threatened. One reptile was identified in the study area but not from within the project site. Reptiles are sensitive animal and sometimes used as indicative species for bio-environmental assessment. Burrowing reptiles are bio-sensitive and respond quickly to any man-made or natural activities/calamities. If the project activities are conducted during pre or post breeding season of the burrowing reptiles, the entire community could be affected seriously or their life cycle could be jeopardized.

Birds

Some avian species are available at or near the proposed project site and none of them are nationally threatened. Most birds have adaptive capability by which they can survive in altered environment. Potential impacts are disturbance due to project related actions and excessive human presence during bird's foraging, resting and nesting time that might result in reproductive disturbance/failure. Removal of floral (tree, herb and shrub) species for proposed project would affect some bird habitat from where they collect food (insects), take rest and also build nests. Potential impacts for those bird species are (i) habitat destruction, (ii) temporary displacement due to increased human disturbance and vehicle movement, and (iii) nest abandonment and/or reproductive failure caused by project related disturbance.

Mammals

Few common mammalian species are available at or near the proposed project site and none of them are nationally threatened. One aquatic mammal was identified as threatened from the study area, but not from the proposed project site. Some mammalian species may be

disturbed and displaced from portions of the project sites for some hours, days or months due to the project activities. They are likely to return to their habitat soon after the disturbance has ceased. Project activities, e.g., movement of vehicle and people could displace potential prey species for some mammal within the project area. However, the effects are expected to be temporary, incidental and minimal.

Fish

The stretch of the river Meghna provides a habitat for a wide variety of fishes and shellfish species and none of them are nationally threatened. A few ponds that remain almost dry in the summer season in this area are used for natural cultivation of seasonal fresh water fishing. Therefore, potential impact seems to be restricted only in the river of the proposed project site. These fishes may encounter some potential impacts from the proposed project activities such as mortality, soil /sand deposit to fish habitat, water drawn from shallow fish habitat etc. Monitoring of native fish species composition change and their richness/relative abundance could be an indicative tool to evaluate project impacts.

6.2.1.3 EVALUATION OF ECOLOGICAL IMPACT

Significant potential impacts would require alternative and/or additional mitigation measuresabove and beyond those already incorporated in the base design for the project / activity. Thesignificance of an impact is determined by:

- Ecological consequence of the activity
- Likelihood of occurrence of the activity and
- Calculating the product of these two parameters.

Consequence and likelihood of ecological impacts resulting from planned activities arediscussed below.Changes in the planned activities for the proposed project would affect boththe impact assessment and also the planned mitigation activities.

Consequence

Table 6.2-1 presents the consequence assessment criteria for ecological impact assessment. The level of consequence for each identified impact is determined by examining a number of factors relating to the activity. Each category has a number of parameters as follows:

- Ecological perception of the activity
- Ability of natural environment (ecological fabric and structure) to absorb the impact(i.e. adapt to change) based on its natural dynamics and resiliencies and/or
- Whether or not the activity results in a breach of legislation, regulation or standards to which the project must comply and/or a breach in operator policy.

It should be noted that in assessing an impact, the assigned level of consequence might be different for different consequence criteria. Where this has been found to be the case for this project's proposed activities, a rule has been established that the highest ranking criteria establish the overall consequence ranking for the impact in question.

Table 6.2-1 Categories and definition of consequence levels for ecological impacts

Category	Ranking	Definition
Critical	5	• Very serious environmental effects with impairment of ecosystem function. • Long-term, widespread effects on significant environment (e.g. unique habitat, national park) • Habitat restitution time >100 years and requiring extreme substantial intervention.
Major	4	• Serious environmental effects with some impairment of ecosystem function (e.g. displacement of species). • Relative widespread medium–long term impacts. • Habitat restitution time >10 years and requiring substantial intervention. • Potential for continuous non-compliance with environmental regulations and/or company policy.
Moderate	3	• Moderate effects on biological environment but not affecting ecosystem function. • Moderate short-medium term widespread impacts • Habitat restitution time 1-5 years (possible limited and local areas up to 10years) with potential for full recovery and limited or no intervention required. • Potential for short to medium term noncompliance with environmental regulations and/or company policy.
Minor	2	• Minor effects on biological environment. • Minor short-medium term damage to small area of limited significant • Full recovery in < 1 year without intervention required. • Any potential non-compliance with environmental regulations and/or company policy would be minor and short-term.
Low	1	• No lasting effect. • Low-level impacts on biological environment. • Limited damage to minimal area of low significant. • Compliance with environmental regulations and/or company policy at all times. • Possible beneficial effect or ecosystem improvement.
None	0	• No impact on ecosystem damage. • No compliance required for environmental regulations and/or company policy at all times. • Possible beneficial effect or ecosystem improvement.
Limited Positive	+	• Some beneficial improvement to ecosystem. • Benefits to specific flora and / or fauna.
Modest Positive	++	• Moderate beneficial improvement to ecosystem. • Medium benefits to specific flora and / or fauna.
Significant Positive	+++	• Major beneficial improvement to ecosystem. • Large scale benefits to specific flora and / fauna.

Likelihood

The following Table 6.2-2 presents criteria for level of likelihood of the occurrence of an activity. The level of likelihood for each identified impact is determined by estimating the probability of the activity occurring.

Table 6.2-2 Likelihood of occurrence and rankings natural impacts

Impact Likelihood	Ranking	Definition Impact	Frequency
Almost Certain (80–100%)	5	The activity will occur under normal operating conditions.	Very Frequent (High frequency of occurrence–occur morethan one per month)
Very Likely (60 - 80%)	4	The activity is very likely to occur under normal operational conditions.	Frequent (Regular frequency. Event likely to occur at least once per year)
Likely	3	The activity is likely to occur at	Occasional

Impact Likelihood	Ranking	Definition Impact	Frequency
(40 - 60%)		some time under normal operating conditions.	(Occurs once every 1 – 10 years)
Unlikely (20 - 40%	2	The activity is unlikely to but may occur at some time under normal operating conditions.	Few (Unlikely to occur during life of operations – occurs once every 10–100 years)
Very Unlikely (0 - 20%)	1	The activity is very unlikely to occur under normal operating conditions but may occur in exceptional circumstances.	Rare (Highly unlikely to occur during life of the operation. Occurs less than once every 100 years).

Impact Significance

The significance of ecological impact is determined by calculating the consequence and likelihood of occurrence of the activity, expressed as follows:

Significance = Consequence × Likelihood

The above two tables illustrate all possible consequence and likelihood for the different consequences and likelihood categories. The possible significance rankings are presented in the following Table 6.2-3.

Table 6.2-3 Ecological impact significance rankings

Ranking (Consequence × Likelihood)	Significance
>16	**Critical**
9-16	**High**
6-8	**Medium**
2-5	**Low**
<2	**Negligible**

Table 6.2-4 illustrates the risk assessment matrix for the power plant project. Based on the above risk assessment matrix, Table6.2-5 shows the ecological impact of the proposed power plant project. Table 6.2-5 indicates that most ecological impacts are rated as low. No long-term adverse impacts to the floral and faunal species or their ecosystem are expected.

Table6.2-4 Risk assessment matrix

Likelihood/ Frequency	Consequence Severity				
	Low	Minor	Moderate	Major	Critical
Almost certain	High	High	Extreme	Extreme	Extreme
Very Likely	Moderate	High	High	Extreme	Extreme
Likely	Low	Moderate	High	Extreme	Extreme
Unlikely	Low	Low	Moderate	High	Extreme
Very Unlikely	Low	Low	Moderate	High	High

6.2.2 PHYSICO-CHEMICAL IMPACTS

The important physico-chemical environmental parameters that are likely to be affected by the project activities during construction phase include water and soil quality, air quality, and noise level. The potential impacts of the project activities on these physico-chemical environmental parameters are described in this Section.

6.2.2.1 IMPACT ON WATER QUALITY AND GENERAL ENVIRONMENT

Waste and wastewater generated during the construction phase of the project include construction debris and wastes, and some other solid wastes (e.g., from labor sheds), human wastes from people working at the project site (e.g., from labor sheds), and some liquid waste from construction processes. These waste/ wastewater could lead to pollution of water and general environment, if not properly disposed.

Wastewater

Wastewater, in the form of human wastes, will be generated mainly in the temporary labor sheds. This could be a major source of pollution (including water pollution) if not properly disposed. Use of un-sanitary latrines and improper disposal of human waste would create environmental pollution and adversely affect health and well being of the people at the construction site by increasing the risk of disease transmission. Proper disposal of waste water should therefore be ensured as suggested in Section 6.5. There is also risk of disease transmission from workers from outside who would come to work within the MPP complex.

Solid waste

Construction debris and wastes to be generated during the construction phase would include scrap iron, steel, wooden frames, piping, and other solid wastes. Most of it will be generated toward the end of the construction phase during carrying out of the finishing works, while the site will be cleared of waste materials. The volume of such construction wastes is likely to be significant. Indiscriminate storage and disposal of these construction debris and wastes could create local water logging and ponding by blocking drainage lines and would be aesthetically displeasing. Proper disposal of these wastes, as described in Section 6.5, is therefore necessary.

Table 6.2-5 Summary of potential ecological impact assessment

Potential Impacts Source / Project Activities	Impact	Ecological Receptor Type	Description	Likelihood	Consequence	Risk Rating
Site Preparation /clearing for base camp and MPP and associated activities	Floral destruction	Flora	• Direct, Negative • Long term, Local • Irreversible	Likely	Minor	Moderate
	Loss / alteration of faunal habitat	Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
	Increased access for exposed faunal harassment or killing (e.g. snake, rat)	Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
Construction of base camp	Disturbance of soil dwelling fauna (e.g. bee eater, rat)	Fauna	• Direct, Negative • Short term, Local • Reversible	Likely	Minor	Low
MPP construction	Generation of high intensity welding flash and noise	Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
	Contamination of surface soil with used lubricant, if any	Flora and Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
Fencing	Movement disturbance of terrestrial fauna (amphibian, reptile & mammal)	Fauna	• Direct, Negative • Short term, Local • Reversible	Likely	Minor	Low
Material storage or placement	Habitat destruction of terrestrial flora (herb, shrub) and borrowing faunal habitat and Movement disturbance of terrestrial fauna (amphibian, reptile & mammal)	Flora and Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
Vehicle movement	Impairment of terrestrial flora (herb & shrub), terrestrial fauna (amphibian, reptile & mammal)	Flora and Fauna	• Direct, Negative • Short term, Local • Reversible	Likely	Minor	Low
Equipment installation	Habitat destruction of terrestrial flora (herb, shrub) and movement disturbance of terrestrial fauna (amphibian, reptile & mammal)	Flora and Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
Soil excavation	Habitat destruction of terrestrial / aquatic flora (herb, shrub) and Movement disturbance /habitat destruction of terrestrial (burrow) fauna	Flora and Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low

Potential Impacts Source / Project Activities	Impact	Ecological Receptor Type	Description	Likelihood	Consequence	Risk Rating
	(amphibian, reptile, bird & mammal)					
Noise disturbance	Disturbance of terrestrial faunal livelihood [movement, foraging, breeding) (amphibian, reptile, bird & mammal)	Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
Water quality	Water contamination due to project related activities (e.g. waste discharge)	Fauna and Fish	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
Exhaust from generators	Movement disturbance of terrestrial fauna (e.g. aves)	Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
Spills (oil / Chemical) on land or water	Habitat destruction of flora and fauna	Flora and Fauna	• Direct, Negative • Short term, Local • Reversible	Very Unlikely	Minor	Low
Waste generation: (Solids/liquid/gaseous) (e.g. cement bags, exhaust from cranes/ heavy equipment, domestic waste)	Impairment of the health of terrestrial flora and fauna	Flora and Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
	Nuisance noise, dust, emissions, lighting etc	Flora and Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
	Increased level of disease vectors (mosquitoes, rats, flies, etc)	Flora and Fauna	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
	Water and soil contamination due to sewage discharge (e.g. increase in water borne diseases)	Fauna and Fish	• Direct, Negative • Short term, Local • Reversible	Unlikely	Minor	Low
Decommissioning • Repair of damaged roads • Removal of structures • Restoration of site etc	Nuisance (e.g. noise, emission, vibration etc) from heavy machinery.	Fauna	• Direct, Negative • Short term, Local • Reversible	Likely	Minor	Low

Solid waste of domestic nature that would be generated in the temporary labour sheds at the construction site is not likely to be significant in volume. But indiscriminate disposal of such solid waste would create environmental pollution and unhealthy situation at the project site. These solid wastes should also be disposed of properly as outlined in **Section 6.5.**

Drainage

Since the construction phase involves significant earthwork, there are chances of stagnation and ponding of storm water if care is not taken for proper drainage of storm water.

Impacts Related to Construction of Gas Pipeline

It should be noted that a gas pipeline of 1.05km will be constructed along the available existing road from the Gas Valve Station of GTCL to the RMS of MPCL compound forsupply of gas to the proposed power plant. It has very minimal adverse impact in the project considering the disturbance of the movement of the normal vehicles, sound generation for pipeline connection, and dust generation for the trenching of the road.

6.2.2.2 AIR QUALITY IMPACTS

During the construction phase of the proposed power plant project, the important sources of emissions would include those from the operations of construction equipment and machineries, vehicles carrying construction materials to the site and taking construction debris out of the site. If construction equipment, such as stone (aggregate) crushers is used at the site, this may result in significant emission of particulate matter during its operation. Since construction of the proposed power plant project would most likely involve significant earthworks, increase in particulate matter in the air from wind-blown dust is also a concern to the project site. Mitigation measures as outlined in **Section 6.5** should be adopted to minimize the possible adverse impacts of project activities on air quality.

6.2.2.3 IMPACT ON NOISE LEVEL

During construction stage major source of noise is expected to stem from transport vehicles which include barges and trucks. Also noise is expected to be produced from plant construction activities. The construction phase may be broadly classified into two different groups:

i. General Site and Plant Construction,
ii. Water and Effluent Treatment Plant construction, and
iii. Access Road Construction.

To assess the noise generated by different activities it is essential to identify the equipment to be used at various stages of the construction work. Therefore, an inventory of the probable equipment to be used and their reference noise generation data are of utmost importance.

General Site and Plant Construction

Construction of the 51 MW gas fired power plant will involve numerous activities. The major construction activities are:

1. General plant construction on the north-western part of the complex;
2. Loading and unloading of construction materials and equipment along with the power generation equipment;
3. Pile driving at the site;
4. Construction of the access road to the north of the processing facility; and
5. Earthwork trucks transporting cuttings along the access road for power plant construction.

Inventory of equipment to be used in general site and plant construction

Some major works such as pile driving, transportation of the equipment and machineries from the dock to the site, installation of the plant, civil works, etc. may induce noise related problems. Construction equipment at the facility is expected to include;

1. Conventional earth-moving equipment, such as excavators, heavy trucks, off–road trucks, roller–trucks,
2. Concrete mixers and cranes.

This equipment will be used to grade and prepare the ground for construction of power plant. Pile drivers are also expected to be used intermittently during the construction operation. Vibration caused by the pile driver may also be a problem during the construction phase.

Access Road Construction:

At present, access to the proposed site is through a paved road which ends about 75m short of the proposed site boundary. Therefore, an access road needs to be constructed to ensure easy and safe access to the proposed plant. Major activities expected to take place for the construction of the access road include, excavation, earth filling, compaction and pavement casting.

Inventory of equipment to be used during access road construction

To accomplish the construction works mentioned above following equipment are expected to be used; i) Heavy truck; ii) Off-route truck; iii) Excavator; iv) Roller; v) Grader; and v) Concrete mixer.

The heavy trucks will be employed in carrying construction materials. The off-route trucks will be used to carry away earth cuttings using excavator. The roller will be used for ground preparation and the concrete mixer will be for preparation of concrete mix.

Noise Impact – Construction Phase

As mentioned earlier, noise may cause mild to severe impact on human nervous system if exposed to sustained high level noise exposure. The physical and psychological impacts

depending on level of exposure may be annoyance, speech interference, sleep deprivation, performance degradation and hearing loss. Accordingly, the Bangladesh Standard for noise level is 75 dBA at daytime and 70 dBA at night (DoE, 1997).

6.2.3 SOCIO-ECONOMIC IMPACTS

In many development projects, the most significant loss of income results from loss of land (due to land acquisition) and income. However, for the proposed power plant project, no land would have to be acquired as the land owner himself is planning to construct the power plant and hence there will be no loss of private land or property. There will be no displacement of population and no resettlement will be required. Also, the proposed project site is not used for any income generating activity, and therefore, there will be no direct loss of income associated with proposed project.
However, a number of project activities will have some adverse impacts on certain socioeconomic parameters (e.g., traffic and communication, public health), while other will have beneficial impacts (e.g., employment). The impacts of the project activities during construction phase on important socio-economic parameters are summarized below.

6.2.3.1 TRANSPORT

During construction phase, some additional traffic will be generated for bringing in construction material and equipment. This traffic will pass through heavily traveled Dhaka-Ashugonj road. Road traffic flow to and from the project site is likely to increase during the construction phase due to increased movement of vehicles carrying construction materials, equipment and machinery, and personnel. However, possible adverse impact of increased traffic flow is likely to be limited, especially if mitigation measures, as outlined in Section 6.5, are adopted. The negative impact of the increased traffic flow would be mostly concentrated mainly within the Midland Power Plant Complex and affecting people in residential areas located close to the project site.

6.2.3.2 NAVIGATION

Large barges are likely to be used to carry the power plant equipment to the plant site via the Meghna River. It is a busy navigation route. So there will be some crowding of in the navigation channel. However, such crowding is expected to be minor in nature and easily manageable.

6.2.3.3 PUBLIC HEALTH

The construction activities of the power plant are likely to have some impact on human health and well being due to increased noise pollution and vibration, and local air pollution within and around the project site. Construction activities will generate dust (see Section 6.2.2).Noise pollution and vibration will be generated from additional traffic and operation of construction equipment. The residential building located close to the project site will be affected by such noise pollution and vibration. Adetailed assessment of noise pollution and its impact is presented in Section6.2.2. Solid wastes generated by the construction activities

and labors may create environmental pollution and thus affect public health, if not properly disposed (see Section 6.2.1).

Accident during construction phase is also an important issue. Proper measures including regular maintenance of equipment and use of protective gear are needed to reduce the risk of such accidents during the construction phase.

6.2.3.4 EMPLOYMENT

Some job opportunities will be created for labors as well as skilled manpower (including engineers) for construction of the proposed project. Installation of power plant will require relatively small number of skilled personnel and laborers; as such installation is highly automated.

6.3 ENVIRONMENTAL IMPACT OPERATIONAL PHASE

6.3.1 OVERVIEW OF IMPACTS

During operation of the 51 MW gas fired power plant, certain environmental parameters will experience some adverse impacts while some others will enjoy beneficial effects. In this study, the effects of the project activities on ecological, physico-chemical, andsocio-economic parameters have been assessed. As noted earlier, since the project site islocated in a developed industrial area that does not appear to be very sensitive, ecologically. The impact of project activities on most ecological parameters (e.g., wetlands, homestead vegetation, forest cover, bushes and trees, wild life, species diversity) are mostly insignificant. Since there will be no thermal discharge (or other forms of discharge from the power plant) in the Meghna river, the operation of the power plant will not affect the water quality or the aquatic ecosystem of the river. However, thermal emission from the power plant may have some adverse impact on homestead vegetation in the surrounding areas.

The effects of project activities a number of physico-chemical environmental parameters have been assessed. These parameters include noise level, water quality, and air quality. The potential impacts of the project activities on these physico-chemical environmental parameters are described in this Section.

The impact of the power plant project at its operation phase on socio-economic parameters will be mostly beneficial. Increased power supply will promote well-being of the people suffering from lack of power supply or serious load shedding; it is also likely to have positive impact on industrial activities and employment. The impacts of project activities on socioeconomic parameters are also described in this Section.

6.3.2 NOISE IMPACTS DURING OPERATIONAL PHASE

As mentioned in **Chapter 5** prolonged exposure to high level of noise may cause significant damage to human hearing organ and may cause neurological damage. OSHA noise exposure limits for the work environment provides a guideline for the time of noise

exposure at the work environment which may be adopted to prepare an environmental management plan(Table 6.3-1).

Table 6.3-1 OSHA noise exposure limits for the work environment

Noise (dBA)	Permissible Exposure (Hours and minutes)
85	16 hrs
87	12hrs 6 min
90	8 hrs
93	5 hrs 18 min
96	3 hrs 30 min
99	2 hrs 18 min
102	1 hr 30 min
105	1 hr
108	40 min
111	26 min
114	17 min
115	15 min
118	10 min
121	6.6 min
124	4 min
127	3 min
130	1 min

Note: Exposure above or below the 90dB limit have been "time weighted" to give what OSHA believes are equivalent risks to a 90 dB eight-hour exposure. Source: Marsh, 1991, p. 322.

Therefore, noise assessment during the operational phase of different units of a power plant is essential to adopt adequate management and mitigation measures. With the engine noise specification a noise modeling is prepared for this project. The noise model and engine specification are annexed in **Annex-XIV** and **Annex-XV** respectively. Add paragraph on the data

Impact during General Site and Plant Operation

The project area falls into Industrial zone according to Bangladesh Environmental Quality Standard ECR'97 categorization. Noise levels of all locations were within the standard limit of ECR'97 (subsequent amendment in 2006).

6.3.3 WATER QUALITY ASSESSMENT

The Gas Engine component of the power plant does not generate any thermal effluent which needs to be discharged in the environment. This is because a closed cycle cooling system using cooling towers and condensers which will dissipate the waste heat into the ambient air rather than the surface water body. Only the intermittent losses of water from the system will be supplemented from the ground water and there will not be a discharge of water out of the system into the river unless there is an accident or a temporary shutdown due to operational maintenance. Although the baseline information of the water quality has been taken into consideration and depicted in Chapter-5 of this report.

6.3.4 AIR QUALITY

The proposed 51 MW Gas Fired Power Plant is a relatively cleaner technology for electricity production, especially when natural gas with no sulfur content (as is the case here) is used as fuel. It is expected to produce minimal impact on the air quality of the surrounding environment. Only NO_x emission, particularly during operation of the Gas Engine (GE) tends to be a problem because of the high combustion temperature. However, use of Dry Low NO_x (DNL) burner technology in this project is likely to reduce NO_x emission significantly. After commissioning of the plant, the stack emissions will satisfy the emissions standards for NO_x, CO and Particulate Matter (PM). The effect of stack emissions (NO_x during operation of the GT; and NO_x, CO and PM during operation of the gas fired power plant) on ambient air quality has been assessed as a part of the ESIA. Thermal emission, particularly during the operation period of the Gas Engine, is also an important issue.

6.3.4.1 EFFECT OF STACK EMISSIONS ON AMBIENT AIR QUALITY

Computer aided mathematical models are being used to predict the increase in air pollutants concentration on ambient air quality due to any increase in the emission load in the atmosphere. For the proposed project, computations of 24-hour average ground level concentrations were carried out using ISC-AERMOD View model, which is a recommended model by USEPA for prediction of air quality from point, area and line sources. It is based on Gaussian dispersion which incorporates the Pasquile-Gifford (P-G) dispersion parameters for estimating horizontal cross wind and vertical dispersion.

ISCST-3 model has been developed to simulate the effect of emissions from continuous point sources on neighborhood air quality. The ISCST-3 model was adopted from the USEPA guideline models and routinely used as a regulatory tool to predict air pollution impact from as high as 500 point sources simultaneously and at 10,000 receptors. The ISCST-3 is an hour-by-hour steady state Gaussian model which takes into account the following special features:

- Terrain adjustments.
- Stack-tip downwash.
- Gradual plume rise.
- Buoyancy-induced dispersion, Complex terrain treatment
- Consideration of partial reflection.
- Plume reflection off elevated terrain.
- Building downwash.
- Partial penetration of elevated inversions is accounted for.
- Hourly source emission rate, exit velocity and stack gas temperature.

The impacts of primary air pollutant are predicted using ISC-AERMOD View model, which has been selected keeping in view the terrain around the project site. This model is widely recognized as predictive tool in impact assessment for air environment. The model has been

applied with flat terrain, gradual plume rise and buoyancy induced dispersion options in the present study.

The model with the following options has been employed to predict the cumulative ground level concentrations due to the proposed emissions from stacks of boilers and incinerators.

- Predictions have been carried out to estimate concentration values over radial distance of 5 km around the sources.
- Terrain data for the entire study area has been calculated by using SRTM data. This was further processed to generate the study specific terrain data in AERMAP.
- Cartesian receptor network with elevated terrain was considered.
- Emission rates from the point sources were considered as constant during the entire period.
- The ground level concentrations computed are as basis without any consideration of decay coefficient.
- Calm winds recorded during the study period were also taken into consideration.
- 24-hour mean meteorological data extracted from the meteorological data of September 1, 2014 to October 31, 2014 has been employed to compute the mean ground level concentrations to study the impact on study area.
- Average ground level concentrations have been superimposed with the help of ISC-AERMOD View Model in Google Earth.

The results of the Air Quality Modeling clearly indicate that the baseline concentrations of NOx as well as predicted concentrations are well within the limits specified in Bangladesh standards. The details of the Air Quality Modeling are described in **Annex-XII.**

6.3.4.2 THERMAL EMISSION

It should be noted that a number of power generators and industries around the site are contributing to the increase in ambient air temperature. Operation of the proposed power plant, together with the other plants and industries may increase ambient temperature around the project site. Nevertheless, mitigation measures should be adopted to mitigate the adverse impacts resulting from such increase in ambient temperature.

6.3.5 SOCIO-ECONOMIC IMPACTS

During operation phase, no significant negative impact is anticipated on socio-economic environmental parameters. Significant positive impacts are expected due to improvement in power supply. This will reduce load shedding in Dhaka city and contribute to the national economy. Well-being of the surrounding population, especially Dhaka city, will be significantly improved due to generation of electricity during peak hours. Currently Dhaka

city is reeling under unbearable load shedding. Such load shedding is hampering normal day to day activities of the city including schooling.

Industrial Activities:
Existing Industries will be benefited from additional and uninterrupted power supply from this proposed plant. New industries will come up, which will in turn increase socioeconomic growth of the region.
Employment:

Employment will be generated in the industrial sector. Besides, some employment will be generated for the operation and maintenance of the new power plant.

National Economy:

National economy will be benefited by the availability of additional supply of power to industrial sectors. Industries will be able to use more of their capacity, which now frequently suffers from power outage. Industries will also be able to reduce their dependence on diesel for back-up power generation, which will save additional expenditure and foreign currency. Given the current load shedding situation, impact of this additional power generation on national economy will be significant.

6.3.6 CUMULATIVE IMPACT

6.3.6.1 AIR QUALITY

In this study, efforts have been made to assess cumulative impacts of the proposed power plant on air quality. There are a large number emission sources (e.g., Ashugonj Fertilizer Factory (AFF), other power plants etc.) surrounding the proposed project area (Table-6.3-2), all of which contribute to air pollution. Data on the nature and rate of emissions from these diverse sources are almost nonexistent. Similarly, there are significant uncertainties regarding future developments in this area and potential emissions from such sources. Therefore, in this study, the cumulative impact on ambient air quality has been assessed by considering background concentrations of the pollutants. It should be mentioned here that the list of some industries been collected from the project baseline survey work by the consultant but the emission of the plants/industries information was not manageable from them. So, all the point sources within 10Km radius with emission level data and therefore comparison were not possible to formulate to understand the cumulative emission of the project area. In this regards consultant has calculated the emission of the industries in line with the emission factor calculation and conversion by using AP42 information. It is well acquainted from the calculation that MPCL contribution in the Ashuganj Airshed is only 4.82%. The cumulative impact of air seems too much where the role of emission of MPCL is less.
However, the details and assumptions of the air quality modeling exercise are explained in **Annex XII** (Air pollution modeling for operation phase of the power plant). From the model data it is apparent that the baseline concentrations of NOx as well as predicted

concentrations are well within the limits specified in Bangladesh standards and WHO guidelines.

List of Power plant and factories within 10Km radius of the project area is listed in Table 6.3-2.

Table-6.3-2 List of Factories and Power Plants within 10km radius of MPCL, Charchartola,Ashugonj, B-Baria

Sl. No.	Name of Installation	Products & Services	Capacity	Emission Contribution (mg/m3)	Remarks
1	Ashugonj Fertilizer and Chemical Company Limited	Urea factory	1300 MT/day	0.271	
2	Ashugonj Fertilizer and Chemical Company Limited	Captive Power Plant	27 MW, Steam Turbine	39.5	
3	Ashugonj Power Station Company Limited	Govt. Power Plants	774 MW (Steam Turnine, Gas Turbine & Gas Engine based)	1104.4	
4	United Ashuganj Power Ltd.	IPP Power Plant	53 MW, Gas Engine based	76	
5	Agrico Power Plant	IPP Power Plant	95 MW, Gas Engine based	136	
6	Precision Energy Limited	IPP Power Plant	55 MW, Gas Engine based	79	
7	**Emission of the Power Plants other than MPCL**			1435	
8	Midland Power Co. Ltd.	IPP Power Plant	51 MW, Gas Engine based	72.8	4.83% contribution of the total emission

6.3.6.2 NOISE LEVEL

The cumulative effect of the noise to be generated by the proposed 51 MW gas fired power plant during the operational phase has been modeled during the study. These modeled values are for conditions where there were no noise barriers, such as buildings or trees between these plants. Since there are a number of buildings as well as trees and boundary walls the receptor is expected to experience noise much less than this value. The cumulative effect of the proposed plant is expected to be dominated by the noise generated by AFF the plant nearest to the Power Plant. The model shows that the L_{eq} of the noise generated by the proposed 51 MW Power Plant at a distance of 200m from the plant site is expected to be about 62.77dBA (**Annex-XIV**). These modeled values are for conditions where there were no noise barriers, such as buildings or trees between these plants. Since there are a number of buildings as well as trees and boundary walls the receptor is expected to experience noise much less than this value. The cumulative effect of both of these proposed plants at a common point is expected to be dominated by the noise generated by the plant nearest to the receptor.

6.4 IMPACT EVALUATION

This section provides an evaluation of the impacts of project activities (described in Sections 6.2 and 6.3) on the physico-chemical, ecological and socio-economic parameters, both during construction and operation phases of the project. For convenience, the impacts have been categorized as "positive impact", "no impact", and "negative impact". Again the intensity of positive and negative impacts have been classified (qualitatively) into "low", "moderate" and "high" categories. Short-term (Sh) and long-term (Lo) nature of impacts have also been identified.

6.4.1 CONSTRUCTION PHASE

6.4.1.1 IMPACT ON PHYSICO-CHEMICAL PARAMETERS

Table 6.4-1 summarizes the effect of project activities on physico-chemical environmental parameters during construction phase of the project. The physico-chemical environmental parameters that could be affected by the project activities include water and soil quality, air quality and noise level. As discussed in Section 6.2, water and soil quality could be affected mainly by project activities such as mobilization of equipment and personnel (e.g., solid and liquid waste from labor sheds), and site preparation. Effects of solid and liquid wastes generated during construction phase would not be very significant, especially if mitigation measures as outlined in **Section 6.5** are adopted. The overall negative impact of such activities is likely to be "short-term (Sh)" and of "low" intensity.

Table 6.4-1 Effect of project activities on physico-chemical environmental parameters during construction phase

Physico-chemical parameters	Environmental Examination						
	Positive Impact			No Impact	Negative Impact		
	Low	Moderate	High		Low	Moderate	High
Water and Soil Quality					X (Sh)		
Air Quality					X (Sh)		
Noise Level						X (Sh)	

Sh=Short-term; Lo=Long-term

6.4.1.2 IMPACT ON ECOLOGICAL PARAMETERS

Table 6.4-2 shows the effects of the project activities during construction phase on ecological parameters. As noted earlier in Section 6.2.2, the project area is not very sensitive ecologically and hence the impacts of project activities on most ecological parameters are not very significant. Therefore, impacts of project activities on flora, fauna, and fish would be of "moderate" intensity.

Table 6.4-2 Effect of project activities on ecological parameters during construction phase

Ecological parameters	Environmental Examination						
	Positive Impact			No Impact	Negative Impact		
	Low	Moderate	High		Low	Moderate	High
Aquatic flora					X (Lo)		
Terrestrial flora					X (Lo)		

Aquatic fauna	X (Sh)
Terrestrial fauna	X (Sh)
Fish	X (Sh)

Sh=Short-term; Lo=Long-term

6.4.1.3 IMPACT ON SOCIO-ECONOMIC PARAMETERS

Table 6.4-3 shows the effects of the project activities during construction phase on socio-economic parameters. The project activities during construction phase will have some adverse impact on public health, transport and communication, and well being due to increased noise pollution and vibration, and local air pollution within and around the project site.

Table 6.4-3 Effect of project activities on socio-economic parameters during construction

Socio-economic parameters	Environmental Examination						
	Positive Impact			No Impact	Negative Impact		
	Low	Moderate	High		Low	Moderate	High
Health and well being						X (Sh)	
Navigation					X (Sh)		
Transport and Communication						X (Sh)	
Employment	X (Sh)						

Sh=Short-term; Lo=Long-term

6.4.2 OPERATION PHASE

6.4.2.1 IMPACT ON PHYSICO-CHEMICAL PARAMETERS

Table 6.4-4 summarizes the effect of project activities on physico-chemical environmental parameters during operation phase of the project. Effect of project activities during operation phase on physico-chemical environmental parameters will be mostly of "low" intensity.

Table 6.4-4 Effect of project activities on physico-chemical environmental parameters during operation phase

Physico-chemical parameters	Environmental Examination						
	Positive Impact			No Impact	Negative Impact		
	Low	Moderate	High		Low	Moderate	High
Water and Soil Quality					X (Sh)		
Traffic Flow					X (Lo)		
Air Quality						X (Lo)	
Noise Level						X (Lo)	

Sh=Short-term; Lo=Long-term

As the Government of Bangladesh has a long term plan to develop the region as the region earmarked for electricity production, it is recommended to impose restrictions on industries generating significant amount of particulate matter.

6.4.2.2 IMPACT ON ECOLOGICAL PARAMETERS

Table 6.4-5 summarizes the effect of project activities on ecological parameters during operation phase of the project. Most ecological parameters will not be affected by the project activities during operation phase.

Table 6.4-5 Effect of project activities on ecological parameters during operation phase

Ecological parameters	Environmental Examination						
	Positive Impact			No Impact	Negative Impact		
	Low	Moderate	High		Low	Moderate	High
Aquatic flora					X (Lo)		
Terrestrial flora				X			
Aquatic fauna					X (Lo)		
Terrestrial fauna				X			
Fish				X			

Sh=Short-term; Lo=Long-term

6.4.2.3 IMPACT ON SOCIO-ECONOMIC PARAMETERS

As shown in Table 6.4-6 the project will mostly have beneficial impacts on socio-economic parameters during operation phase. National economy will be benefited by the availability of additional supply of power to industrial sectors. Since the power plant is located in an industrial zone, the industries will benefit from additional and uninterrupted power supply from this proposed plant. New industries will also come up, which will in turn increase socioeconomic growth of the region; employment is also likely to increase in the industrial sector.

Table 6.4-6: Effect of project activities on socio-economic parameters during operation phase

Socio-economic parameters	Environmental Examination						
	Positive Impact			No Impact	Negative Impact		
	Low	Moderate	High		Low	Moderate	High
Health and well being		X (Lo)					
Navigation				X			
Transport				X			
Employment		X (Lo)					
Industrial Activities		X (Lo)					
National Economy		X (Lo)					

Sh=Short-term; Lo=Long-term

6.5 MITIGATION MEASURES

6.5.1 CONSTRUCTION PHASE

6.5.1.1 CONSTRUCTION DEBRIS AND WASTE

Project construction activities will result in generation of considerable amount of inert solid wastes, including lumber, excess concrete, metal and glass scrap, and empty containers used for non- hazardous substances. Management of these wastes will be the responsibility of the Contractors. Typical management practices include recycling, proper temporary storage of waste and debris, and housekeeping of work areas. The wastes left after recycling will be transported to disposal in municipal land fill area. No part of this type of construction waste should be mixed with the domestic solid waste generated within the MPCL; these solid wastes should be handled separately.

6.5.1.2 SOLID WASTE

The solid wastes of domestic nature generated mainly in the labor sheds should be collected and stored separately (i.e., without mixing it with construction wastes/debris) in appropriate containers within the construction site. The solid wastes should be disposed of away from the site (e.g., in a municipal landfill/waste dumping ground) outside the complex, at the responsibility of the Contractor. For assessing quantity of solid waste (of domestic nature) to be generated at the construction site, a generation rate of 0.2 kg per worker per day may be used. It should be noted that at present, solid waste generated within the MPCL are collected in drums (approximately one for ten families), where the solid waste from the surrounding residences is disposed off. There are personnel who collect waste from these drums and dispose them at the dumping site.

The current practice of open disposal of solid waste is not a sound and acceptable practice. If open dumping of solid waste is continued disease vectors may grow in number and spread diseases among the inhabitants within and outside the complex.

6.5.1.3 LIQUID WASTE/WASTEWATER

The human wastes at the labour should be appropriately disposed of through construction of sanitary latrines connected to appropriately designed septic tank system (consisting of septic tank and soakage pit). For this purpose, a wastewater generation rate of 50 lpcd may be assumed. The septic tank system may be designed following the procedure described in Ahmed and Rahman (2003). However, care should be taken in designing the septic tanks and soak pits as the groundwater table in the area remains close to the surface during wet season. Wastewater generated from different construction activities is not likely to be significant in volume. Disposal of such wastewater may be carried out by draining them in shallow pits (1 to 1.5 m deep) dug in the ground at appropriate locations, and filling them up with sand at the end of the construction phase. In all cases, the wastewater streams should be separated from the storm water stream, which will be disposed of separately utilizing the existing storm water disposal system at the MPCL Complex.**Annex-XIII** describes the Storm water drainage layout plan including septic tanks details for 100 users.

6.5.1.4 TRAFFIC FLOW

Haulage routes should be selected away from sensitive establishments such as residential areas, schools and hospitals. Also, especial care should be taken while transporting the equipments through existing installations. Where routes pass through sensitive sites it is recommended to install barriers to protect sites from noise and emission. Maintenance of engines and exhaust systems are recommended to minimize emission. In order to prevent noise and air pollution it is recommended to construct permanent hard surfaces in the roads connecting to the construction site. It is also recommended to inspect the roadway regularly.

Moreover, unpaved roads should be well compacted and maintained through sprinkling using binder and additives.

6.5.1.5 AIR QUALITY

Construction materials at the site should be properly covered while hauled and stored, roads properly cleaned and water sprayed in order to minimize concentration of dust in air. Vehicle movement to and from the site should be properly managed to ensure that is does not significantly aggravate the traffic problem and air pollution. Stone (aggregate) crushing activities should not be allowed within the MPCL complex. Health status of working staff should also be monitored regularly at the nearby Health Center of the MPCL complex.

6.5.1.6 NOISE LEVEL

It should be noted that noise-sources are point sources and will be used for a short duration during the initial stages of the construction works. However, to a receptor at a distance of 60m away from the resources the cumulative effects of the generated noise may cause annoyance. When ground cover or normal unpacked earth (i.e., a soft site) exists between the source and receptor, the ground becomes absorptive to sound energy. Absorptive ground results in an additional noise reduction over distance of 1.5 dB per doubling of distance.
The proposed mitigation measures of the heavy machinery operations for construction works are listed below:

- Normal working hours of the contractor will be between 06:00 and 21:00 hours from Sunday to Saturday. If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of the noise criteria at nearby Noise Sensitive Receptors (NSRs);
- Only well-maintained equipment should be operated on-site;
- Regular maintenance of equipment including lubricating moving parts, tightening loose parts and replacing worn out components should be conducted;
- Machines and construction plant items (e.g. trucks) that may be in intermittent use should be shut down or throttled down between work periods;
- Low noise equipment should be used as far as practicable;
- The number of equipment operating simultaneously should be reduced as far as practicable;

- Equipment known to emit noise strongly in one direction should be orientated so that the noise is directed away from nearby NSRs as far as practicable;
- Noise enclosures should be erected around stationary equipment;
- Noise barriers should be installed such that the nearest receptors are shielded from the line of sight;
- Noisy machinery (such as breakers and rollers) should be located as far away from NSRs as practicable;
- Material stockpiles and other structures should be utilized, where practicable, to screen noise from on-site construction activities.

The proposed mitigation measures of the increased traffic volume for construction works are listed below:

- Only those vehicles meeting the standards stipulated in Schedule-5 of the Environmental Conservation Rules, 1997 shall be used;
- Vehicles should be regularly maintained; and
- Transportation of materials on and off site through existing community areas should be avoided at all times.

6.5.1.7 OCCUPATIONAL HEALTH AND SAFETY OF WORKERS

Workers should have personal protective equipment (PPE) for protection against noise and others hazards .Contractors should comply with the relevant IFC guidelines of occupational health and safety of the workers. The Contractors

- Shall observe and maintain standards of Health and Safety towards all of his employees not less than those laid down by the national standards or statutory regulations.
- Shall provide all appropriate protective clothing and equipment for the work to be done and ensure its proper use. Where required, safety nets, the contractor shall provide belts, harnesses and lines. The "safety directives for work equipment" and "safety directives for protective gears", as specified in the Occupational Health and Safety Guidelines shall be followed.
- Shall provide and maintain in prominent and well-marked positions all necessary first-aid equipment, medical supplies and other related facilities. A sufficient number of trained personnel will be required to be available at all times to render first aid.
- Must provide or ensure that appropriate safety and/or health signs are in place at their work sites where hazards cannot be avoided or reduced.
- Shall report to the Engineer promptly and in writing particulars of any accident or unusual or unforeseen occurrences on the site, whether these are likely to affect progress of the work or not.

6.5.1.8 SOCIO-ECONOMIC IMPACT

Health hazard resulting from dust and noise pollution will impacted on the society of the nearby residence. Scheduling of project activities should be done in such a way that major noise producing activities are not carried out during nighttimes. Traffic hazard during construction will increase and need to be carefully managed for the safety of locality and many industrial laborers of the surrounding area.

6.5.2 OPERATION PHASE

Most of the socio-economic parameters will experience beneficial effects during the operation phase of the power plant project. Efforts should be made to enhance these beneficial impacts (see **Table 6.4-6**), which may include incentives for proper growth of industries in the area.

During the operational phase exceedingly high level of noise is expected to be generated within the confines of the turbine and generator installations. Prolonged exposure to such high level of noise may cause permanent hearing loss. Therefore, proper protective measures should be adopted during the operation and inspection of this equipment. Under nocircumstances the operators should be allowed to enter these installations without properprotective gears such as ear muffs. Double-paneled glass doors and windows, along withsound absorbing soft padding on the walls of the turbine and generator room, should beprovided for reducing noise exposure to the power plant personnel.Sound proof canopy could be used for reducing the sound level of the engine. This canopy can also help the generator from dust and water.

Some adverse impact during the operation phase of the plant will come from emission of NOxand Particulate Matter (PM) from the power plant. Use of Dry Low NOx (DNL) technology inthis project is likely to reduce NOx emission significantly. Plantation of fast growing trees around theproject siteis recommended to reduce adverse impacts of emissions, especially thermalemission, from the power plant. These trees will also act as sound barriers. The indigenousspecies of tree suggested for plantation are listed in Table 6.5-1. In addition to this, in thestack design due consideration should be given to providing proper insulation. Since theproject is located in an area where the air quality is deteriorating day by day, the InternationalFinance Corporation (IFC) stack design guidelines for a degraded air-shed should be adopted.(See **Annex VI** for the guidelines).

Mitigation measures of the Occupational Health and Safety issues for the workers during the operation of the plant are listed below:

- Comply with Occupational health and safety guidelines presented in Section 2.0 of the General EHS Guidelines published by IFC. The General EHS Guidelines of IFC covers various OHS aspects including General facility design and operation; Communication and training; Physical hazards; Chemical hazards; PPE; Special hazard environments; and OHS Monitoring and record keeping programs;
- Comply with Occupational health and safety guidelines presented in Section 1.2 of the EHS Guidelines for Thermal Power Plants published by IFC for the health and safety impacts particular to operation of power plants.
- As part of HSE&SMS, Project will formulate and implement: Occupational H&S Policy, Occupational H&S related Vision and Mission Statements, Occupational H&S Manual, Health and Safety related regulatory register, Health and Safety SOPs, H&S Auditing systems, OHS Training systems, Health and Safety records, Senior Management Review systems etc.

As discussed earlier, presence of excess particulate matter in the air may adversely affect theoperation of the Gas Engine power plant through reduction of air filter life. Hence

effortsshould be made to make sure that industries around the project site comply with national airquality standards (GoB, 1997). Restrictions may also be imposed on installation of industriesin the area that emit significant amount of particulate matter. Assistance of DoE may besought in this regard.

Table 6.5-1 Tree species recommended for plantation within the MPP

Sl. No	Common Name	Scientific Name	Typical spacing between trees
1	Nagessor	*Mesua nagassarium*	5 m
2	Akasmoni	*Acacia longifolia*	5 m – 7 m
3	Babla	*Acacia Arabica*	5 m
4	Bahera	*Terminalia belerica*	5 m
5	Sissoo	*Dalbergia sissoo*	5 m
6	Rain tree	*Albizia procera*	6 m – 10 m
7	Krishnachura	*Delomix regia*	5 m

CHAPTER-7: INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

7.1 INTRODUCTION

Participation is a process, through which stakeholders influence and share control over development initiatives, the decisions and the resources, which affects them. Participation of stakeholders in the projects is also a primary requirement in developing an appropriate management plan that addresses project's requirement and suited to the needs of the stakeholders. Stakeholder's involvement is also vastly increases the probability of successful implementation of management plan. In order to make consultation and disclosure process effective and fruitful, comprehensive planning is required to assure that local government, NGOs, host population and project staff interacts regularly and purposefully, throughout all stages of the project and contribute toward a common goal.

Public opinion has been collected through interview and focus group discussion meeting. For better understanding the socio-economic and environmental condition two focus group discussions were held with the local people in the closest settlement area of the existing power plant. Interview was held with different government official representatives.

7.2 APPROACH AND METHODOLOGY FOR CONSULTATION

The approach undertaken for consultation involved the following key processes.

- Mapping and Identification of key stakeholders such as primary (direct project influence) and secondary (indirect project influence) stakeholders;
- Undertaking interviews and focus group discussions (FGD) with the respective stakeholders;
- Assessing the influence and impact of the project on these stakeholder groups;
- Summarizing of key findings and observations from the consultations; and

7.3 STAKEHOLDER ASSESSMENT

A stakeholder is defined as "a person, group, or organization that has direct or indirect stake in a project/organization because it can affect or be affected by the Project or its Proponent's actions, objectives, and policies". Stakeholders vary in terms of degree of interest, influence and control they have over the Project or the proponent. In the present study, all the stakeholders have been primarily categorized into two categories that have been identified as:

- Primary Stakeholders: include people, groups, institutions that either have a direct influence on the project or are directly impacted (positively or adversely) by the project and its activities; and
- Secondary stakeholders: are those that have a bearing on the project and its activities by the virtue of their being closely linked or associated with the primary stakeholders and due to the influence they have on the primary stakeholder groups.

- Apart from categorization, the stakeholders have also been classified in accordance with the level of influence they have over the project as well as their priority to the project proponent in terms of importance.
- The influence and priority have both been primarily rates as:
  - ✓ High Influence/Priority: This implies a high degree of influence of the stakeholder on the project in terms of participation and decision making or high priority for project proponent to engage that stakeholder.
  - ✓ Medium Influence/Priority: This implies a moderate level of influence and participation of the stakeholder in the project as well as a priority level for project proponent to engage the stakeholder who are neither highly critical nor are insignificant in terms of influence.
  - ✓ Low Influence/Priority: This implies a low degree of influence of the stakeholder on the project in terms of participation and decision making or low priority for project proponent to engage that stakeholder.

Based on the above attributes, the following

Table 7.3-1delineates the stakeholders identified for the project and their analysis.

Table 7.3-1: Stakeholder Mapping for the Project

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
Project Management				
Midland Power Company Limited (MPCL)	Primary	MPCL is the primary project proponent own a controlling stake of 100% in the project	Highest	• Are the primary project proponents • Responsible for operation of this project • Primary financial beneficiaries • Responsible for all the project related risks and impact liabilities
Community				
Land Losers	Primary	Land Owners impacted with respect to loss of land and potential livelihood impact.	Medium	• Lack of information during land acquisition process • Support to land losers in terms to temporary sustenance and employment opportunities • Preference for Employment opportunities
Local Community	Primary	• Primarily includes adjacent community to the power plant especially CharChartala	Medium	• No major restrictions around the project site especially with respect to grazing land • Project bring development to the area • Increase in employment opportunities and preference in job

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
				• Improvement in electrical supply and infrastructure in the area • Minimise impact
Regulatory/Administrative Authorities & Agencies				
Dept. of Environment, Bangladesh	Primary	The Department of Environment is the primary government regulatory authority for Environmental protection in Bangladesh.	High	• Responsible for monitoring project's Environmental compliance throughout the project lifecycle
Other Regulatory & Permitting Authorities	Primary		High	• Agencies required for obtaining permits and licenses for operation of the project • Primary involvement during operation phases
Political Administration				
Upazilla (sub District Level) Political Administration	Secondary	Elected representative of people at sub-district level for a fixed tenure	Medium	• Key linkage between the community and the project proponent
Union leaders & local representatives	Secondary	Elected representative at union level i.e. village level for a fixed tenure	Medium	• Plays important role in providing public opinion and sentiment on the project • Empowered to provide consent and authorization for establishment of project on behalf of the community

7.4 SUMMARY OF CONSULTATION

The details of consultations held with issues raised or discussed and suggestions provided by the respective stakeholders are presented in **Table 7.4-1**and Photographs are presented in **ANNEXVII.**

Table 7.4-1: Details of Consultations Held for the Project

Date	Stakeholder Details	Details of participants	Issues discussed/raised	Response/ Suggestions made
29/09/14	Department of Fisheries	1. Md. Shafayet Alam, Ashuganj Upazila Fisheries officer, 01718687063 2. Md. Shahidul Hossain, Asst. Fisheries	• Primary fishing sanctuary located in and around in Ashuganj • Understanding on the Fishermen community	• There is no designated fishing sanctuary in the Meghna River of Ashuganj Upazila • Approximately 3000

Date	Stakeholder Details	Details of participants	Issues discussed/raised	Response/ Suggestions made
		Officer 01716664756	• Any impacts on the aquatic population in the Meghna River from the Midland Power Plant	lives in the Ashuganj upazila involved in fishing activities • Due to their zero discharge in surface. No impact ever recorded by the Midland power plant to the Meghna river.
29/09/14	Upazila Women Vice Chairman	1. Rehana Akter	• Benefit from the project • Any women involvement during construction of the power plant • Any impact due to the power plant	• It is a national asset and we require more plant to meet the national electricity demand. • Local people were involved in this power plant during construction and benefited • No local women were involved during construction • Till present no impact recorded or any complain raise after construction of the power plant.
29/09/14	Department of Agriculture Extension	1. Towfique Ahmed Khan, Upazila Agriculture Officer, Ashuganj, 01938815761 2. Jewel Rana, Agricultural Extension Officer, Ahuganj, 01716017856 3. Narayan Cahndra Das, Sub Asst. Agricultural Officer, Ashuganj, 01813154520	• Understanding and Broad overview of the agricultural sector in Ashuganj • Information on the crops grown in the area and agricultural practices • Any direct impact in agriculture due to the establishment of the power plant	• Agriculture is the primary mainstay of the upazila and contain 300 hactor cultivable land • Net food demand is 30870 metric ton and net production is 24903 metric ton whereas the food deficiency is 5967 metric ton in this upazila. • The agricultural practices in the region are a mix of both cultivating one's own land as well as sharecropping. • There is no agricultural land close to the power plant so no chance to contaminate the

Date	Stakeholder Details	Details of participants	Issues discussed/raised	Response/ Suggestions made
				agricultural field.
29/09/14	Union Parishad office, Char Chartala	1. Md. Ayub Khan, Chairman, Char Chartala Union, Ashuganj, 01718125936 2. Ashiqur Rahman, Secretary, Char Chartala Union, Ashuganj	• Understanding about the power plant • Expectations from the plant authority • Any local people involvement in the power plant • Any impact or complain arise due to the plant operation	• This power plant develop the area as an industrial setup and in this region the land value is increasing day by day. • Local peoples were involved during the construction period and presently 7-8 persons are doing job in this power plant. • No complain arisen after the plant operation • Only the noise level is high of the power plant. • Demand from the authority is to establish a primary school and mosque

7.5 FOCUS GROUP DISCUSSION

Discussions were held with the communities who are lives in close to the power plant. Two focus group discussions were held in the char chartala village. The overall outputs from the FGD are given below. Photographs of FGDs and list of participants are presented in the **ANNEX VIII.**

1. Main environmental concern is noise pollution that is generated from the power plant. Overall the noise of this power is comparatively low compared to other industry.
2. During construction stage all of the affected households got proper compensation.
3. During winter season transmission line wire make noise which is disturbing.
4. This plant do not causes any surface water pollution
5. The plant authority should develop the existing connecting road
6. Few local people have gotten job in this power plant
7. Required more job opportunity in the plant specially jobless young people
8. Proper fire fighting system is to be preserved in the plant for safety

Public Comments	Responses of Management
Main environmental concern is noise pollution that is generated from the power plant. Overall the noise of this power plant	Plant authority properly maintain the noise pollution management procedure

Public Comments	Responses of Management
is comparatively low rather than other industry.	
During construction stage all of the affected households got proper compensation	Authority has been provided proper compensation to the affected people.
This plant do not causes any surface water pollution	This plant does not discharge effluent in the surface water.
The plant authority should develop the existing connecting road	Authority is on process to develop the connection road by taking help from LGED.
Few local people have gotten job in this power plant. Require more job opportunity in the plant specially jobless young people	If any opportunities arise for non technical work the affected households will get this benefit as a priority basis.
Proper fire fighting system is to be preserved in the plant for safety	This plant has well fire fighting facilities

7.6 PUBLIC DISCLOSURE

The final ESIA report will need to be disclosed in an accessible place (e.g. local government offices, libraries, community centers, etc.), and a summary translated into local language (Bengali) for the project-affected people and other stakeholders. The world bank will post the final ESIA document on its website so affected people, other stakeholders, and the general public can provide meaningful inputs into the project design and implementation.

CHAPTER 8:
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 SCOPE OF EMP

The primary objective of the environmental management and monitoring is to record environmental impacts resulting from the project activities and to ensure implementation of the "mitigation measures" identified earlier in order to reduce adverse impacts and enhance positive impacts from specific project activities. Besides, it would also address any unexpected or unforeseen environmental impacts that may arise during construction and operation phases of the project.

The EMP should clearly lay out: (a) the measures to be taken during both construction and operation phases of the project to eliminate or offset adverse environmental impacts, or reduce them to acceptable levels; (b) the actions needed to implement these measures; and (c) a monitoring plan to assess the effectiveness of the mitigation measures employed. Environmental management and monitoring activities for the proposed power plant project could be divided into management and monitoring: (a) during construction phase, and (b) during operation phase.

8.2 WORK PLANS AND SCHEDULES

8.2.1 CONSTRUCTION PHASE

The environmental management program should be carried out as an integrated part of the project planning and execution. It must not be seen merely as an activity limited to monitoring and regulating activities against a pre-determined checklist of required actions. Rather it must interact dynamically as project implementation proceeds, dealing flexibly with environmental impacts, both expected and unexpected.

For this purpose, it is recommended that the MPCL for this specific project should take the overall responsibility of environmental management and monitoring. The MPCL will form a team with required manpower and expertise to ensure proper environmental monitoring, as specified in Section 8.4, and to take appropriate measures to mitigate any adverse impact and to enhance beneficial impacts, resulting from the project activities. The MPCL through its team will make sure that the Contractor undertake and implement appropriate measures as stipulated in the contract document, or as directed by the GM, MPCL to ensure proper environmental management of the project activities. It should be emphasized that local communities should be involved in the management of activities that have potential impacts on them (e.g., traffic congestion in the surrounding areas). They should be properly consulted before taking any management decision that may affect them. Environmental management is likely to be most successful if such decisions are taken in consultation with the local community. The environmental management during the construction phase should primarily be focused on addressing the possible negative impacts arising from:

(a) Generation and disposal of sewage, solid waste and construction waste

(b) Increased traffic
(c) Generation of dust (particulate matter)
(d) Generation of noise
(e) Deterioration of water quality

The environmental management should also focus on enhancing the possible beneficial impacts arising from employment of local workforce for construction works. Table 8.2-1 summarizes the potentially significant environmental impacts during construction phase, the measures needed to eliminate or offset adverse impacts and enhance positive impacts. The monitoring plan and monitoring schedule has been presented in Section 8.4.

Table 8.2-1 Potentially significant environmental impact during construction phase and mitigation measures

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
Influx of workers	• Generation of sewage and solid waste	• Construction of sanitary latrine and septic tank system (one latrine for 20 persons) • Erecting "no litter" sign, provision of waste bins/cans, where appropriate • Waste minimization, recycle and reuse • Proper disposal of solid waste (in designated waste bins)	Contractor (Monitoring by MPCL)
	• Possible spread of disease from workers	• Clean bill of health a condition for employment • Regular medical monitoring of workers	Contractor (Monitoring by MPCL)
Transportation of equipment, materials and personnel; storage of materials	• Increased traffic/navigation • Generation of noise, especially affecting the nearby residential areas	• Speed reduction to 10 km per hour within the MPCL complex	Contractor (Monitoring by MPCL)
	• Deterioration of air quality from increased vehicular movement, affecting people in the surrounding areas • Wind-blown dust from material (e.g., line aggregate) storage areas	• Keeping vehicles under good condition, with regular checking of vehicle condition to ensure compliance with national standards • Watering unpaved/dusty roads (at least twice a day; cost estimate provided) • Sprinkling and covering stockpiles • Covering top of trucks carrying materials to the site and carrying construction debris away from the site	Contractor (Monitoring by MPCL)
Construction activities, including operation of construction equipment	• Generation of noise from construction activities (general plant and access road construction),	• Use of noise suppressors and mufflers in heavy equipment • Avoiding, as much as possible, construction equipment producing excessive noise during night • Avoiding prolonged exposure to noise (produced by equipment) by workers • Creating a buffer zone around the construction site to reduce disturbance to protect from the	Contractor (Monitoring by MPCL)

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
		health hazard	
	• Deterioration of air quality from wind-blown dust and possible use of equipment, such as stone (aggregate crushers)	• Not using equipment such as stone crushers at site, which produce significant amount of particulate matter • Keeping construction equipment and generators in good operating condition • Using equipment, especially generators with high levels of emission control (e.g., TIER-4). • Immediate use of construction spoils as filling materials • Immediate disposal/sale of excavated materials • Continuous watering of bare areas	Contractor (Monitoring by MPCL)
	• Generation of construction waste	• Hauling of construction debris away from the site and their appropriate disposal in a sanitary landfill	Contractor (Monitoring by MPCL)
	• Accidents	• Regular inspection and maintenance of equipment • Environmental health and safety briefing • Provision of protective gear	Contractor (Monitoring by MPCL)
	• Spills and leaks leading to soil and water contamination with hydrocarbon and PAHs	• Good house keeping • Proper handling of lubricating oil and fuel • Collection, proper treatment, and disposal of spills	Contractor (Monitoring by MPCL)
	• Employment of work/labor force	• Local people should be employed in the project activities as much as possible.	Contractor (Monitoring by MPCL)
	• I f cultural resources are found during construction	• Follow the "Chance Find Procedure" World Bank Operational guidelines OP 4. 11	Contractor (Monitoring by MPCL)

Implementation Schedule

In accordance to the provision of the Contract document, the Contractor shall prepare an "Implementation Schedule" for the measures to be carried out as part of the environmental management and monitoring. Table8.2-2 shows a tentative plan for environmental reporting.

Table 8.2-2 Environmental management and monitoring reporting

Stage or Topic	Frequency/ Stage	Contributors
Initial review	Before start of work	MPCL, Consultant
Routine Progress Report	Monthly	Project Engineer
Specific Problems and Solutions	As required	Project Engineer
Mid-term Review: • review of activities • possible modification to	Approximate mid-way through the project	Consultant

Stage or Topic	Frequency/ Stage	Contributors
procedure and/or overall plan		
Final Review: • review of program • recommendation for similar future program	Toward the end of the project	MPCL, Consultant, Contractor

8.2.2 OPERATION PHASE

Most of the environmental parameters will experience beneficial effects during the operation phase of the power plant project. Efforts should be made to enhance these beneficial impacts, which may include incentives for proper growth of industries in the area. The plant management authority (MPCL) should be responsible for overall environmental management during operation phase of the project. The environmental management during the operation phase should primarily be focused on addressing the following issues:

a. Emission from the power plant
b. Generation of noise
c. Waste generation at the plant

Table 8.2-3 summarizes the potentially significant environmental impacts during operation phase, the measures needed to eliminate or offset adverse impacts and enhance positive impacts. The monitoring plan and monitoring schedule has been presented in Section 8.4. As mentioned earlier, the implementation schedule for environmental management and monitoring during the construction phase will be prepared by the Contractor as part of construction contract following recommended mitigation measures of potentially significant impacts given in Table 8.2-1. Resources required for implementation of mitigation and enhancement measures and monitoring during construction will be borne by the Contractor. Most of the mitigation and enhancement measures identified for operation phase (see Table8.2-3), e.g., use of tall stack, using low NOx burners, selective catalytic converters, using silencers for generators and turbines, have already been addressed during the design phase and resources required will be within the estimated cost of the plant construction. Resources required for implementing environmental monitoring plans during both construction and operation phases are given in Section 8.3

Table 8.2-3 Potentially significant environmental impact during operation phase and mitigation measures

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
Power Generation	• Emission from the power plant	• Using stack as specified in the bid document • Using low nitrogen oxide burners, as specified in the bid document • Installation of stack emission monitoring equipment for major pollutants. An in-house Continuous Air Monitoring Station (CAMS) may be established. • In stack design due consideration	MPCL

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
		should be given to proper insulation • Planting of trees around the project site • Restrictions may also be imposed on installation of industries in the area that emit significant amount of particulate matter	
	• Generation of noise	• Provision of silencers for generators and turbines • Planting of trees around the project site • Regular plant maintenance • Regular noise monitoring • Use of ear-muffs and ear-plugs by plant personnel working in the generator and turbine facilities of the plant	MPCL
Water Consumption	• Depletion of groundwater resources	• Regular monitoring of groundwater level	MPCL
Waste generation	• Inappropriate disposal of sewage causing environmental pollution • Generation of solid waste including sludge from demineralizer. • Possible water pollution	• Good housekeeping • Proper construction and maintenance of wastewater disposal system for the plant premises • Ensuring proper storage, treatment, and disposal of all solid waste • Monitoring of effluent quality from treatment plant (monitoring requirement and cost estimate provided) • Monitoring of river water quality (monitoring requirement and cost estimate provided)	MPCL

8.3 ENVIRONMENTAL MONITORING PLAN

8.3.1 MONITORING PARAMETERS

8.3.1.1 CONSTRUCTION PHASE

Ambient air quality monitoring: Measurements of selected air quality parameters, particulate matter (PM_{10}, $PM_{2.5}$) need to be carried out during the construction period in accordance with the monitoring plan presented in Table 8.3-1. Measurement should be carried out at a location, which is sensitive with respect to air quality, e.g., near the residences.

River water monitoring: A water quality monitoring program is necessary for the Meghna river as the project is at the bank of the River. During construction work there might have some disturbances to the surface water. For this some baseline water quality i.e. Water temperature and dissolved oxygen (DO) along with BOD5, COD, Oil and Grease need to be monitored every month as a part of the program.

Groundwater monitoring: Groundwater level should be monitored during construction phase, particularly during the dry weather period from October to May. This should be done in order to prevent excessive lowering of groundwater level while abstracting for construction purposes.

Soil quality monitoring: Contamination of soil and bed sediment may occur due to accidental spillage of chemicals. Therefore, selected heavy metal content (Cr, Cd, Pb) and presence of Oil and Grease need to be monitored during the construction period.

Noise level monitoring: Use of heavy construction equipment may increase the noise level at the work location of the project site. Therefore, comprehensive noise monitoring during different stages of construction is essential.

Process waste monitoring: Records of generated process wastes should be kept according to the regulations concerning types of waste. Registration sheets for hazardous waste and for process non-hazardous waste should be maintained.

8.3.1.2 OPERATIONAL PHASE

Meteorological measurements: Meteorological monitoring should be conducted to monitor the wind direction and speed, temperature, humidity and precipitation.

Atmospheric emissions monitoring: Monitoring of emissions of CO, NOx, PM10, PM2.5, and temperature of flue gases should be carried out.

Ambient air quality monitoring: Continuous and/or periodic measurement of the air quality indicators e.g., NOx, PM10, PM2.5, and temperature needs to be carried out. At least one stationary monitoring station may be installed.

River water monitoring: Although the proposed plant is not expected to be a contributor to the deterioration of water quality of the Meghna river, a water quality monitoring program during the dry periods is necessary for the region. Water temperature and dissolved oxygen (DO) during March -May and October-December can to be monitored as part of the program.

Groundwater monitoring: The groundwater level along with the selected drinking water quality parameters (e.g., pH, Color, Turbidity, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms) may be monitored.

Noise level monitoring: Indoor noise levels in the generator and turbine facilities along with the outdoor noise at the nearby residence premises and near the air condenser system need to be monitored regularly.

Table 8.3-1 Monitoring plan during construction phase of the project

Issue	Parameters	Monitoring Frequency
Ambient air quality	CO, NOx, PM_{10} and $PM_{2.5}$	Once a month
River water	Water temp., DO, BOD5, COD, Oil and Grease	Once a month
Groundwater	Groundwater level	Once every two months during October to May
Soil Quality	Cr, Cd, Pb and Oil and Grease	Twice during the construction phase
Noise level	Noise at different locations	Every week, particularly during operation of heavy equipment
Process waste	Solid waste	Every week
Occupational health and Safety (worker health, working environment)	Noise, air quality, worker health status check	Once in a month (surveillance of workplace environment)

Note: Actual monitoring time and location will be decided by MPCL. The Contractor will be responsible for carrying out the monitoring during the construction phase.

8.3.2 MONITORING SCHEDULE

Tables 8.3-1 and 8.3-2 provide a summary of the monitoring schedule for the construction and operational phases, respectively for the proposed power plant. Table 8.3-3 gives the estimated cost of environmental monitoring during the construction phase. Table 8.3-4 and 8.3-5 provide estimated amount of environmental monitoring and training costs.

Table 8.3-2 Monitoring plan during operational phase of the project

Issue	Parameters	Monitoring Frequency
Meteorological measurements	Wind direction and speed, temperature, humidity and precipitation.	Continuous monitoring by installing appropriate instrument
Stack emissions	CO, NOx, PM10, PM2.5and temperature	Once every six month and after major repair/maintenance
Ambient air quality	CO, NOx, PM10, PM2.5, temperature	Once quarterly**
River water	Water temperature and DO	Once a month (March-May, October-December)
Effluent quality	pH, DO, Sulfate, TSS, TDS, BOD, COD, Total N, Total P	Once a week
Groundwater	pH, Color, Turbidity, TDS, Ammonia, Nitrate, Phosphate, As, Fe , Mn and Coliforms; Groundwater level	Twice a year
Noise level	Noise at different locations	Once every three months
River morphology	River cross-section	Once a year during design life of the plant
Vegetation	Number and Condition	Once a year
Occupational health and safety	Health status and safety	Twice a year

*Actual monitoring time and location will be decided by the proposed Environmental Management Unit (EMU).During the operation phase, the monitoring may be carried out by the EMU through its own staff and equipment, if available, or can be out-sourced to a competent Contractor. ** Continuous monitoring if a CAMS is established. Proposed EMU is structured in* ***Annex-XVI*** *of the Emergency Preparedness and Response Plan of MPCL.*

Table 8.3-3Cost Estimate for Environmental Monitoring during Construction Phase

Items	Number	Per Unit Cost (Tk.)	Total Cost (per Month)(Tk.)
Ambient air	PM2.5, PM10 = 2	16,000/-	32000
	NOx, CO = 1	8,000/-	8000
River water	2	12,000/-	24000
Groundwater	1	8500/-	8500
Noise level	4	10000/-	40000
Process waste	4	7000/-	28000
Water spraying for dust control	At least twice a day	10,000/-per month	10000
Plantation of Trees	250	300/-	75000
Total Cost During Construction Phase			**2,25,500**

Table 8.3-4 Cost estimate for environmental monitoring during operational phase

Items	Number (Per Year)	Per Unit Cost (Tk.)	Total Cost (Per Year) (Tk.)
Meteorological instrumentation with continuous data recorder	LS = unit	3,000,000/-*	3,000,000
Ambient Air	12	40000/-	480,000
Atmospheric Emissions	12	50,000/-	600,000
River water	6	20,000/-	120,000
Groundwater	2	15,000/-	30,000
Noise level	4	15000/-	60,000
Total Cost During Operation Phase			**4,290,000**

*Meteorological Instrument with data recorder will be purchased in the 1st year of operation.

Table 8.3-5Cost estimate for training during operational phase

Items	Number (Per Year)	Per Unit Cost (Tk.)	Total Cost (Per Year) (Tk.)
Safety and occupational health	2	250,000/-	500,000
Environmental management system	2	250,000/-	500,000
Total cost during operational phase			**1,000,000**

8.3.3 RESOURCES AND IMPLEMENTATION

The environmental parameters to be monitored during the construction and operational phases along with the monitoring schedule have been presented in the previous sections. The responsibilities for the implementation of the proposed monitoring plan may be entrusted with the contractor in association with the MPCL personnel.

It is very important to make sure that the potentially significant impact during both the construction and operation phases are properly addresses through adaptation of the proposed mitigation and enhancement measures outlined in Tables 8.2-1 and 8.2-3. It is equally important to undertake environmental monitoring during both the construction and operation phases according to the proposed monitoring plan outlined in Tables 8.3-1 and 8.3-2. These tables should therefore be made integral parts of the Contract Document of the proposed power plant project.

8.4 OCCUPATIONAL HEALTH AND SAFETY

Occupational health and safety means preventing accidents and work related ill health. Improved health and safety management can bring significant benefits to the business. It reduces individual and human costs of accidents and ill health, direct and indirect cost to the business, improves customer perception and company profile and workers' morale.

Under occupational health hazards, one can group several categories of working conditions impairing the health conditions of workers, though this impairment is slow. Safety relates more to health hazards that results from accidents and can cause instantaneous impairment of the workers' health.

8.4.1 GENERAL REQUIREMENTS

In Bangladesh the main law related to occupational health and safety is Labor Law 2006. The law has provisions on occupational hygiene, occupational diseases, industrial accidents, protection of women and young persons in dangerous occupation. The salient features of the general requirements for the workers' health and safety stated in this law is presented in Table 8.4-1.

8.4.2 WORKPLACE ENVIRONMENTAL QUALITY

The proposed power plant project has several phases - the construction of infrastructure and installation and commissioning of plant equipment, operation of the plant etc.

8.4.2.1 HEALTH HAZARDS

The construction phase includes site preparation and plant construction, access road construction etc. The health hazards associated with these activities are mainly due to dust and noise pollution. Excessive noise contributes to loss of hearing and triggers physiological and psychological body changes. Dust pollution can cause eye and respiratory irritation and in some cases allergic reactions. The inhalation of exhaust gases from vehicles and machinery are also harmful for health. Stress can be caused by working in shifts, high work load, poor living condition of workers etc.

Table 8.4-1 General requirements for workers' health and safety

Issues	Requirements
Health and Hygiene	• Cleanliness • Ventilation and temperature • Dust and fumes • Disposal of wastes and effluents • Overcrowding • Illumination • Latrines and urinals • Spittoons and dustbins
Safety	• Safety for building and equipment • Precautions in case of fire

Issues	Requirements
	• Fencing of machinery • Floor, stair and passage way • Work on or near machinery in motion • Carrying of excessive weights
Compensation for accidents at work	• Owner's responsibility for compensation • Amount of compensation • Report on fatal accident and treatment • Compensation on contract and contract registration • Appeal
Dust and Fumes	• Any dust or fumes or other impurities likely to be injurious to the workers, effective measures shall be taken to prevent its accumulation and its inhalation by workers
Overcrowding	• No work room in any factory shall be overcrowded • At least five hundred cubic feet of space shall be provided for every worker employed in a work room
Latrines and urinals	• Sufficient latrines and urinals shall be provided • Shall be maintained in clean and sanitary condition • Shall be adequately lighted and ventilated
Precautions in case of fire	• Shall be provided with means of escape in case of fire • Effective measures shall be taken to ensure that all the workers are familiar with the means of escape • Fire fighting apparatus should be provide and maintained
First aid	• Provided and maintained first aid facility • One for everyone hundred and fifty workers • Shall be kept with a responsible trained person who shall be available during the working hours • In every facility where five hundred or more workers are employed, a dispensary shall be provided and maintained
Disposal of wastes and effluents	• Provide with proper disposal system for solid waste and effluents. • In case of a factory where no public sewerage system exists, prior approval of the arrangements should be made for the disposal of wastes and effluents
Occupational and poisoning diseases	• 16 occupational diseases notifiable to the Chief Inspector of Factories: 1. lead poisoning 2. lead tetraethyl poisoning 3.phosphorous poisoning 4. mercury poisoning 5. manganese poisoning 6. arsenic poisoning 7. poisoning by nitrous fume 8. carbon di sulfide poisoning 9. benzene poisoning 10. Chrome ulceration 11. Anthrax 12.silicosis 13. Poisoning by halogens 14. Primary epitheliomatous cancer of the skin 15. Toxic anemia 16. pathological manifestation due to radium or x-rays
Compensation	• If personal injury is caused to workmen by accident arising in the course of employment, employer shall be liable to pay compensation • 36 occupational diseases for compensation payable • Monthly payment as compensation for temporary disablement are: • Compensation should be paid for the period of disablement or for one year whichever period is shorter 1. Such compensation shall be paid at the rate of full monthly wages for the first two months 2. Two thirds of the monthly wages for the next two months and at the rate of the half of the monthly wages for the subsequent months 3. In case of chronic occupational diseases , half of the monthly wages during the period of disablement for a maximum period of two years shall be paid

A quantification of the measure of severity in health hazards is not well defined. They are

slow acting and cumulative, their effects may not be visible for years. During plant installation and commissioning phase, use of chemicals (paints, solvents, thinners etc) batteries, welding materials, lubricants etc. may contribute to health hazards to the workers. These substances may be carcinogenic or detrimental in other ways. Use of industrial solvents can cause anemia, liver and kidney damage, cardiovascular diseases and neurological disorder.

8.4.2.2 REMEDIAL MEASURE

To minimize the hazards arising from the activities at different phases of plant construction and operation, the following measures should be taken:

- employees should be informed of the potential health impacts they are facing
- the employer should inform his employees of these potential hazards, arrange proper medical examination prior to and during employment, as well as tests and analyses necessary for the detection of diseases
- works with volatile toxic chemicals should be undertaken in a well ventilated place
- laborers handling offensive toxic chemicals should be provided with and forced to use protective clothing
- workers exposed to an excessive amount of noise should be provided with protective gear and be relieved frequently from their post
- workers exposed to large amounts of dust should be provided with adequate protective gear
- frequent spraying of water should be undertaken to minimize dust pollution
- persons undertaking construction and installation works should have access to amenities for their welfare and personal hygiene needs such as sanitary toilets, potable drinking water, washing facilities, shelter sheds etc.
- proper disposal of waste and sullage should be arranged
- health education and information on hygiene should be provided to the workers
- regular checks on food quality should be arranged within the work site

8.4.2.3 SAFETY

Safety implies the reduction of risk of accidents at the work site. Accident prevention is more valuable than any mitigatory or compensatory measures. This may be achieved through strict rules and procedures for the execution of specific tasks, enforcement of the rules, and discipline amongst workers, maintenance of machineries used and by providing all necessary gear or equipment that may enhance the safety of the workers.

The following guidelines should be followed to maintain the safety of the workers:

- workers have to be informed about the possible damage or hazards related to their respective jobs
- if pedestrian, traffic or plant movements at or near the site are affected by construction works, the person with control of the construction project must ensure that these movements are safely managed so as to eliminate or otherwise to control any associated health and safety risks

- must ensure sufficient lighting in the area where a person performs construction work or may be required to pass through, including access ways and emergency exit or passage without risk to health and safety
- construction site needs to provide safe access to and egress from all places where they may be required to work or pass through. This includes the provision of emergency access and egress route that must be free from obstructions
- adequate perimeter fencing should be installed on the site before construction work commences and that should be maintained during the construction work and signs should be placed which is clearly visible from outside the site including emergency telephone numbers.
- must ensure that electrical installations materials, equipment and apparatus are designed, installed, used, maintained and tested to eliminate the risk of electrical shock, burns, fire or explosion.
- construction site should be kept orderly and tidy. Access ways should be kept clear of materials and debris and maintained in a non-slippery condition. Materials should be stored in an orderly manner so that it does not pose any risk to the health or safety of any person
- arrangements of first aid facility should me made accessible when construction work is being undertaken.

8.4.3 WORK IN CONFINED SPACES

In the operational phase of the plant, the work will mainly be limited in confined spaces. In this phase, noise pollution may pose risk to health. It has been observed that the measured noise level near the generators and turbines ranged from 90 dBA to 110 dBA. This level of noise limits the continuous exposure to the workers from 2 to 4 hrs beyond which hearing impairment may be caused. If the installation of generators and turbines are within a confined space and monitored through glass windows, it will not pose any serious threat. However precautions should be undertaken during routine inspections and maintenance works. Supervisors, inspectors and related personnel should wear noise protectors like ear plugs or ear muffs. Wearer should be given a choice between ear muffs and plugs as muffs are easy to use but may be a nuisance in a confined work space and be uncomfortable in hot environment. Whereas ear plugs don't get in the way in confined spaces but may provide little protection if not used carefully.

As the employees will work in confined spaces, the air pollution may not pose a health risk. However, the ambient temperature may be high due to plant operation and measures should be taken to keep temperature within a comfortable limit. Where damage to plant presents an electrical hazard, the plant should be disconnected from the electricity supply main and should not be used until the damaged part is repaired or replaced. Adequate care should be taken to minimize stress and ergonomic design should be improved to minimize health hazards. First aid facilities should be available and evacuation plans for emergency situations should be in place with adequate drills, instructions and signs. Adequate fire fighting arrangements should be installed and maintained on a regular basis.

Where appropriate strict work procedure and guidelines are to be defined for different jobs

and be informed to the relevant staff. Regular medical examination should be arranged for the staff exposed to occupational health hazards. Areas where people may be exposed to excessive noise should be sign posted as "Hearing Protection Areas" and their boundaries should be clearly defined. No person should enter this area unless wearing personal hearing protectors.

8.4.4 HAZARDOUS MATERIAL HANDLING AND STORAGE

During construction of the plant, commercially available chemicals (paints, thinners, etc.) will be used and stored in the construction area. Hence small amount of unused or spent chemicals (used paints, motor oils) will be generated. Hazardous wastes likely to be generated during routine project operations include oily water, spent catalyst, lubricants and cleaning solvents. Operation and maintenance of the plant also generates some hazardous wastes. These include waste oil, boiler bottom ash, spent solvents, batteries, fluorescent light tubes, lubricating oils etc. The project will also involve the construction and operation of gas pipe line and handling of large amount of natural gas. Natural gas poses some risk of both fire and explosion. Continuous gas pipeline monitoring, installation of shutoff valves is essential to avoid any fire/explosion and rupture risks of the pipeline. Any kind of leakage monitoring of the pipeline should be taken care of through regular patrolling of the gas pipeline route by patrolman.

Used lead acid batteries contain lead, sulfuric acid and several kinds of plastics which are hazardous to human health. Therefore the ideal place to store used lead acid batteries is inside an acid resistant sealed container to minimize the risk of an accidental spillage. However this is not often the case and the following set of storage guidelines should be adopted:

- the storage place must be sheltered from rain and other water sources and if possible, away from heat sources
- the storage place must have a ground cover
- the storage place must have an exhaust ventilation system in order to avoid gas accumulation
- the storage place must have a restricted access and be identified as a hazardous material storing place
- any other lead materials which may eventually arise, such as plumbing, should be conveniently packaged and stored in accordance with its characteristics

It is recommended that where dangerous goods are stored and handled, that premises should be provided with fire protection and firefighting equipment. These equipment should be installed, tested and maintained in accordance with the manufacturer's guidelines. The employer must ensure that a procedure for dealing with emergencies is in place, implemented, maintained and communicated to persons on the premises who may be affected by or respond to an emergency. Ignition sources in hazardous areas should be eliminated. The facility staff should be trained and equipped with personal protective gear such as rubber gloves, boots, hard hats, apron or splash suit and a face shield with safety glasses or goggles.

Laborers handling offensive toxic chemicals should be provided with and forced to use

protective clothing. Works with volatile toxic chemicals should be undertaken in a well ventilated place. Arrangements should be made for sufficient and suitable lighting.

Safe access within and to and from the premises should be ensured. Unauthorized access and activity on the premises should be prevented. These measures will reduce the chances of accidents and facilitate a safe environment for the workers, the staff and the plant.

8.4.5 TRAINING

Training is an integral part of a preventive strategy. The target groups requiring training should be managers, supervisors, and technicians and related staff who may be exposed to risk at work. The following issues should be addressed in training of the managers, staff and workers:

- Workers should be trained to use the engineering controls where installed
- Arrange workplace consultation on noise control
- Workers should participate in training and contribute to the noise management strategy
- Employee representatives should represent the views of workers to management about occupational health and safety and report to workers about management policy
- Persons likely to be exposed to risks should be provided with information and instruction in safety procedures associated with the plant at the work place.
- Relevant health and safety information should be provided to persons involved in installation and commissioning, use and testing of the plant.
- Information on emergency procedures relating to the plant should be displayed in a manner that can be readily observed by persons who may be affected by the operation of the plant.
- Training should be provided to use firefighting equipment when necessary.
- Facility staff needs to be trained in the safety procedures that are to be implemented during unloading, transfer and storage of hazardous materials.

8.4.6 RECORD KEEPING AND REPORTING

Record keeping and reporting is one of the requirements of any QA/QC system and essentially of a good management tool. Properly maintained records of construction, installation, training, equipment maintenance, operation, fault detection and remedy can help in reducing risks of accidents, legal costs and thereby overall cost of operation of a plant. Records also help in identifying causes of any accident and elimination of the same accident in future. Records may be maintained for the proposed plant as follows.

8.4.6.1 PLANT CONSTRUCTION

A person with control of a construction project or control of construction work should retain records for a reasonable period after the completion of the construction project of the occupational health and safety induction training and any other training given to persons directly engaged or trained by them to undertake construction work on the project.

8.4.6.2 PLANT OPERATION

During operation of the plant, arrangements should be made to keep records on any relevant tests, maintenance, inspection, commissioning and alteration of the plant, and make those records available to any employee or relevant health and safety representative.

8.4.6.3 NOISE

Audiometric test records of employees should be kept during the employee's period of employment and longer as necessary, as they may provide a useful reference for workers' compensation. The records should be kept in a safe, secure place and held as confidential documents.

8.4.6.4 HAZARDOUS SUBSTANCES

Assessment reports which indicate a need for monitoring and/or health surveillance together with the results of monitoring and/or health surveillance shall be kept as records in a suitable form for at least 30 years from the date of the last entry made. Retention for a period of at least 30 years is necessary because some health effects, such as cancers, may take a long time to become evident. The information kept will be valuable in epidemiological studies and for developing effective control strategies.

All other records, including assessment reports not indicating a need for monitoring and/or health surveillance and records of induction and training, shall be maintained for at least five years in a suitable form.

8.5 ENVIRONMENTAL MANAGEMENT SYSTEMS (EMS)

An EMU shall be established to properly implement the EMP in the power plant. Proposed EMU in the MPCL organogram is proposed and details are annexed in Annex-XVI. The environmental manager will be responsible for monitoring of the implemented EMP. The responsibility of the EMU will follow as per assignment indicated in the organizational setup as placed at the organogram. Project management may equip the unit with appropriate manpower, equipments and fund for smooth implementation of the monitoring works. An EMS is a tool designed to enable organizations to target, achieve and demonstrate continuous improvement in environmental performance. It is one integrated management process with a number of stages, which includes an environmental audit. There are a number of standards (e.g. the British Standard BS7750 (BS11992), the European Eco-Management and Audit Scheme for Industry (CEC, 1993)). These consist of most or all of the following elements depending on the standard, to:

- adopt an environmental policy to confirm and promote commitment to continual improvement in environmental performance;
- undertake an environmental review to identify significant environmental issues and effects;
- set up environmental programs of objectives, targets and actions;

- establish an environmental management system to ensure the implementation of the necessary actions to achieve these objectives;
- undertake periodic environmental audits to assess the performance of such components;
- prepare an environmental statement on environmental performance; and
- obtain independent verification of the environmental statement.

Also there is ISO 14001 which is a voluntary international standard for environmental management systems ("EMS"). ISO 14001:2004 provides the requirements for an EMS and ISO 14004:2004 gives general EMS guidelines. An EMS meeting the requirements of ISO 14001:2004 is a management tool enabling an organization of any size or type to: (1) identify and control the environmental impact of its activities, products or services; (2) improve its environmental performance continually, and (3) implement a systematic approach to setting environmental objectives and targets, to achieving these and to demonstrating that they have been achieved.

It is expected that the Environmental Management Team of the MPCL will be trained to conduct environmental auditing of its power generation facilities so that the objective of achieving a better environment is realized. Culmination of such activities will be successful ISO 14001 certification.

CHAPTER 9:
RISK ASSESSMENT AND MANAGEMENT

9.1 INTRODUCTION

The problem of protecting human health and the environment may best be defined as the management of risk. The failure to manage risk effectively and to establish priorities rationally translates ultimately into a failure to protect health, safety, and the environment. Through the use of risk assessment, concerned authorities can estimate the relative level of risks posed by different substances, products and activities and can establish priorities in determining whether, and how, to regulate.

The risk assessment should constitute an organization's best effort to employ advanced scientific and technical methods to predict accurately the sizes of the risks. Once the relevant risks are estimated accurately and objectively through the risk assessment process, it can then be decided how best that risks could be addressed in the risk management phase.

Risk assessment is the technical process for estimating the level of risks posed by operational processes or products, i.e. the probability that a given harm will occur as a result of the processes or products. Risk assessment is applied to a substance, proceeds in four major steps:

- Hazard identification: determining what kinds of adverse health effects a substance, product or activity can cause
- Dose - response assessment: predicting the degree of adverse effects at a given exposure level
- Exposure assessment: estimating the amount of exposure, and
- Risk characterization: combining the foregoing into a numerical range of predicted deaths or injuries associated with actual exposure event

Risk management options are then evaluated in a proposed solution to provide reduction of risk to the exposed population. Specific actions that are identified and selected may include consideration of engineering constraints as well as regulatory, social, political and economic issues related to the exposure. Quantitative assessment of risks associated with hazard identification, dose-response assessment, exposure estimation and risk characterization were beyond the scope of the present study. However, this study takes a qualitative approach to identify common hazards within the power plant and recommends measures for managing these risks with accidents and external threats.

9.2 POWER PLANT RISKS ASSESSMENT

The process of electricity generation from gas is by no means risk free because of high temperature and pressure conditions within the plants, rotating machineries and high voltages involved. Apart from risks associated with emissions, noise generation, solid waste, hazardous waste and wastewater disposal as a result of construction and operation, the gas fired power plants put human beings and the environment inside and outside of the plant to a certain degree of risk of accident and sometime loss of life. It is therefore essential that a

risk management plan be devised in order to both reduce risk of accident and to take the correct action during accidents. Important risks of accidents in thermal power plants leading to disasters or emergency situations may occur during following events:

- Risks during emergency
    - Fire
    - Explosion
    - Oil/acid spillage
    - Toxic chemical spillage
    - Electrocution
- Risks due to natural disasters
    - Flood
    - Cyclone
    - Earthquake
    - Storm
    - Lightning
- Risks due to external threats
    - Sabotage
    - War situation
    - Water/food poisoning

Several strategic areas within the power plant can be identified as places of potential risks during plant operation: Areas prone to explosion are:

- Boiler area
- Turbine hall

Premises prone to fire and electrocution are:

- Electrical rooms
- Transformer area
- Cable tunnel Premises where people can be exposed to toxic chemicals:
- Storage facilities for chemicals

In power plants accidents can occur at two different levels. First, these may occur due to fires, explosions, oil or chemical spillage and spontaneous ignition of inflammable materials. In such events, operators working inside the plant and at various strategic hazard locations will be affected.

Second, risks are also associated with external threats of sabotage. Failure of automatic control/warning systems, failure of fuel oil storage tanks and chemical release from acid and alkali stores and handling also pose great degree of associated risks.

9.3 MANAGING THE RISKS

As mentioned earlier, in order to reduce the risks associated with accidents, internal and external threats, and natural disasters, a risk management program is essential. Risk management planning can be done during design and planning stage of the plant as well as during plant operation. While risk management is mainly preventive in nature during the plant operation stage, the design and planning stage of the plant can incorporate changes in

basic engineering to include safety design for all processes, safety margins for equipment, and plant layout. The following steps among others are important in managing the risks mentioned:

- The power plant should be located on a reasonably large plot of land giving ample space to locate all units whilst maintaining safe distances between them.
- The plant layout should provide roads of adequate width and service corridors so that no undue problems arise in the event of fires or other hazards.
- Gas storage is to be designed with adequate precautions in respect of fire hazard control.
- Storage of hazardous substances such as acids and alkalis should be sited in protected areas.
- With respect to plant operation, safe operating procedures should be laid down and followed to ensure safety, optimum operation and economy.
- A fire fighting group with adequate manpower and facilities such as water tank of sufficient capacity, CO_2 tank, foam tank, portable fire extinguishers should be provided and facilities located at strategic locations e.g. generator area, high voltage panel, control rooms, and fuel tank area.
- Regular checks on safe operating practices should be performed.

In order to achieve the objective of minimizing risks at the Midland power plant complex, in addition to Environmental Management Unit for the complex, a disaster management unit with adequate manpower and facilities for each plant within the complex must be in place. The unit will be trained to act in a very short time in a pre-determined sequence to deal effectively and efficiently with any disaster, emergency or major accident to keep the loss of life, human injury, material, plant machineries, and impacts on the environment to the minimum.

9.4 EMERGENCY RESPONSE PLAN

Emergency response plans are developed to address a range of plausible risk scenarios and emphasize the tasks required to respond to a physical event. The emergency response plan (ERP) for the proposed power plant has been developed listing various actions to be performed in a very short period of time in a pre-determined sequence if it is to deal effectively and efficiently with any emergency, major accident or natural disaster. The primary objective of the plan is to keep the loss of life, material, machinery/equipment damage, and impacts on the environment to minimum.

9.4.1 Emergency Response Cell

It is highly recommended that an Emergency Response Cell (ERC) adequately equipped with highly trained manpower and appropriate gears is established within the power plant complex in order to effectively implement the emergency response plan. The main functions of the emergency response cell should include the following:

- Identification of various types of emergencies

- Identification of groups, communities, and areas those are vulnerable to different kinds of emergencies
- Preparing service teams for various operations within the organization through extensive training
- Establishment of early detection system for emergencies
- Developing reliable, instant information communication system
- Mobilizing all units in the complex within a very short time to address any emergency

9.4.2 Emergency Preparedness

The ERC headed by a trained Manager should establish an Emergency Control Room with links to all plant control rooms and all other services. The ERC shall work as a team of the following officials:

- Emergency Manager (Team Leader),
- Fire Officer,
- Safety Officer,
- Chief Security Officer,
- Chief Medical Officer,
- Rescue Officer, and
- Public Relations Officer

The Senior Environmental Engineer of the proposed Environmental Management Unit for the Midland Power Plant Complex with adequate skills of facing emergency situation can act as the Emergency Manager of ERC. The Emergency Manager shall have the prerogative of shutting down the relevant units or the complete plant, which are affected or may further deteriorate damages, in case of an emergency. The EM however, shall have to report to the Chief Engineer of the complex of such an event without any delay.

The team will be responsible for preparing and executing a specific emergency response plan for the power plant complex. The team should meet at regular intervals to update the plan, based on plant emergency data and changes in support agencies.

The team should undertake some trial runs, e.g. fire drill, in order to be fully prepared and to improve upon the communication links, response time, availability and workability of emergency gears and other critical factors.

Upon receiving information about an accident, the ERC team will assemble in the Emergency Control Room within the shortest possible time and formulate emergency control procedure.

9.4.3 Fire Fighting Services

- The Fire Officer (FO) will be the commanding officer of the firefighting services. The FO will head a fire fighting team of trained officers and workers. The size of the team

should be determined by the MPCL considering requirement of all existing and proposed power plants within the complex.

- Adequate firefighting equipment e.g. fire extinguishers of different types appropriate for different strategic locations must be planned according to requirements of existing and future plants in the complex.
- Depending on the scale of emergency, the firefighting team will work in close association with security and maintenance personnel of the complex. Additional assistance may also be sought from outside fire stations when required.
- Preparedness is extremely important for efficient and effective firefighting services at the time of emergency. This can be better achieved by organizing fire drills at regular intervals, e.g. once every two weeks during dry summer months and once every two months during wet months involving all team members, all other service groups, all staff of the power plant complex, and utilizing all firefighting gears.

9.4.4 Emergency Medical Services

- The Chief Medical Officer will be responsible for providing medical services within the Midland Power plant complex at the time of any emergency. The services should also be rendered to people living in the close vicinity of the complex and affected by any accident within the plant complex.
- The existing Medical Center, nearby the Midland Power Plant (MPP) must be equipped with adequate medical personnel and equipment for providing emergency services in addition to normal Medicare services to population of the complex.
- A team of well trained Medical Officers specializing in burn injury, orthopedics, electrocution, chemical toxicity or poisoning, and shock treatment must be available at the nearby power plant Medical Center. The number of officers may be determined considering the total number of staff and their family members in the complex. Special attention must be given to child injury treatment.

The following services must be on alert at all times in the plant complex.

- First aid services for attending patients on the spot. The Medical Center should provide training on first aid services to some designated staffs of important areas of operation, e.g. boiler area, turbine hall, transformer area, electrical rooms, and chemical storage facilities, for immediate attention to the injured.
- Ambulance services for transport of casualties from spot to nearby Medical Center, and from nearby Medical Center to outside hospital, as necessary. Facilities for transportation of fatalities to appropriate hospital or to relatives or to the police following prescribed procedure should be available.
- All potential areas for emergency/ accidents in the plant complex must have an information chart including contact phone numbers of relevant services.

9.4.5 Rescue Services

Without going for additional manpower, the rescue team can be formed with potential staffs of the Power Plant Complex, e.g. from medical services, security services and fire fighting

services, for conducting rescue operations following an emergency. A senior member can be designated Rescue Officer who will be responsible for formulating rescue plan and guiding the team. Important functions include:

- Cut-off electricity, gas or water supply to accident spots
- Rescue people from debris of collapsed structures
- Demolish damaged structures that may endanger human lives
- Rescue people from fire areas with adequate protection
- Assist other services promptly to save human lives
- Salvage equipment from debris
- Isolate damaged equipment or machineries that may endanger human lives
- Provide repair services as appropriate to restore operations

9.4.6 Security Services

The Midland Power Plant Complex will have a strong independent security team headed by the Chief Security Officer and will be responsible for the overall security of the plant complex, its equipment, machineries, buildings, utilities, and the community living within the complex. The security office shall maintain liaison with other emergency services at the time of emergency and during normal hours.

The Chief Security Officer shall communicate with local police and other law enforcing agencies and seek assistance as may be needed during an emergency. The security team will also regulate vehicular traffic inside the complex. In particular they will ensure that all roads are unobstructed during emergencies.

9.4.7 Public Relations Services

- The Public Relations Officer (PRO) of the Power Plant Complex will be responsible for communicating emergency related information to concerned officials within the complex. The PRO however, will consult the Emergency Manager before communication with outside agencies.
- The PRO will be responsible for warning people in and around the complex against potential fire hazards, or possible chemical contamination of water.
- The PRO will keep close contact with outside local community and provide direction, and participate along with management team in the welfare services for the affected communities.

9.5 CONCLUDING REMARKS

Apart from the services mentioned above, the Environmental Management Unit and the Emergency Response Cell must ensure that all staffs working within the Power Plant Complex are oriented, through orientation programs, about the dos and don'ts during emergencies as well as overall environmental aspects and issues related to power plant operations. Annex- XVI Emergency Preparedness and Response Plan describes the risk assessment and its management of the MPCL.

It is however, to be emphasized that the emergency response plan (ERP) outlined above is to be used as guide only and that the Environmental Management Unit and the Emergency Response Cell shall develop their own environmental management system (EMS) following ISO 14001 and the emergency response plan (ERP) respectively in consultation with and involving the Midland Power Plant (MPP).

CHAPTER 10:
GRIEVANCE REDRESS MECHANISM

10.1 INTRODUCTION

Experience from past projects shows that project implementation is a complex process involving numerous interested and aggrieved parties giving rise to likely instances of conflict, allegations, etc. Most of the conflicts and allegations appear not to be of a serious nature but may snowball into a bigger issue if not given adequate attention from the beginning itself.

Some of the potential points that could give rise to grievances could be related to compensation payment, improper estimation of affected assets, failure to fulfill commitments, poor management of construction activities, inappropriate planning of vehicle movement, and cultural conflicts between migrant workers and local communities etc.

Therefore, it is imperative to have an internal mechanism in place where the aggrieved party/s can lodge their complaints and get it amicably settled prior to approaching the formal mode of solution available to them i.e. access to legal system through courts. In order to provide a formal forum to the aggrieved parties to deal with issues arising out of project, it is proposed that a joint grievance redress mechanism be instituted for both environmental and social related issues.

The proposed Grievance Redress mechanism (GRM) will be developed for the Project in order to settle as many disputes as possible through consultations. Such a mechanism is important as it is expected that most cases, if not all, would be resolved amicably; and the process, as a whole, will promote dispute settlement through mediation to reduce litigation. However, the options of legal recourse will not be restricted in any way by the project proponent.

10.2 OBJECTIVES OF GRIEVANCE REDRESS MECHANISM

The basic objective of the GRM shall be to provide an accessible mechanism to the affected people, community and any stakeholder(s) having stake in the project to raise their issues and grievances as well as concerns. The Grievance Redress Cell (GRC) shall be officially recognized "non-judicial" body that will seek to resolve non-judicial disputes arising out of various matters related to the implementation of the ESMP, as well as other aspects of the project, as may deemed fit to be raised before the GRC.

The fundamental objective of GRM is to resolve any resettlement and environmental related grievances locally in consultation with the aggrieved party to facilitate smooth implementation of the EMP. Another important objective is to democratize the development process at the local level and to establish accountability towards the stakeholders.

10.3 COMPOSITION OF GRC AND ULC

It is suggested to have two levels of grievance redress mechanism for the project, viz. Grievance redress Cell (GRC) at the project level and another at Union level committee (ULC). The aim of having two levels of grievance redress mechanism is to provide a higher forum to the aggrieved party, if the same is not satisfied with the decision of GRC.

GRC will be driven internally by MPCL and shall have the following representation to ensure fair and timely solution to the grievances:

- Community officer serving as grievance officer;

- MPCL Environment and social officer
- Project management representative;
- MPCL EHS representative;

The composition of ULC will have the following members:

- Char Chartala Union Parishad Chairman or his representative
- MPCL Project Manager
- MPCL Environment and social officer
- Local elected Union Member
- Representative of affected people and women

The normal route to be followed for any grievance shall be GRC, and in casenot satisfied then to ULC; however, the grievances can be directly taken toULC too. The ULC shall be empowered to take a decision which is binding on MPCL and considered final. However, the decision of ULC is not binding onaggrieved person; he or she can take the legal course if not satisfied with theoutcome of GRC decision.

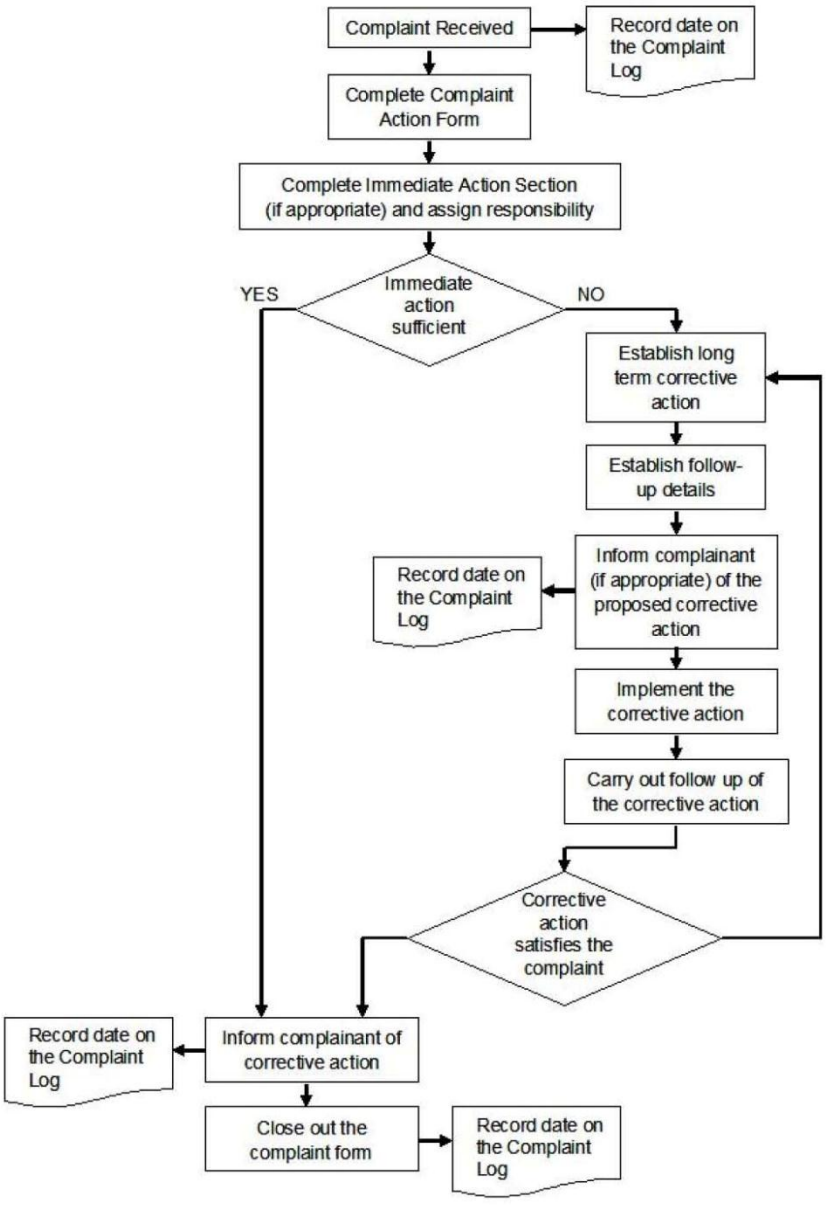


Figure-10.3-1 Flow Chart of Grievance Procedure

The representation in the committee makes project affected persons to have trust and build confidence in the system. The grievance redress committee reports its plan and activities to the Implementation committee.

GRC will maintain a Complaints Database, which will contain all the information on complaints or grievances received from the communities or other stakeholders. This would include: the type of complaint, location, time, actions to address these complaints, and final outcome.

The procedures to be followed and adopted by the grievance redress should be transparent and simple to understand or uniform process for registering complaints provide project affected persons with free access to the procedures. The response time between activating the procedure and reaching a resolution should be as short as possible. An effective monitoring system will inform project management about the frequency and nature of grievances. GRC will arrange half yearly meetings where the activities and the outcomes/measures taken according to the Complaints Database are to be monitored and reviewed by third party consultant to ensure the required transparency. In addition to the above, if there are any grievances related to social or environmental management issues in the project area, the GRC will record these grievances and suggestions and pass it on to the relevant consultant for necessary action and follow-up.

In case a dispute is not resolved by arbitrational tribunal, then if any of the Party disagrees, the aggrieved party has the right to appeal to the ordinary courts of law.

However, the preferred option of dispute settlement ought to be the option of settling the dispute amicably because recourse to courts may take a very long time even years before a final decision is made and therefore, should not be the preferred option for both parties concerned.

A grievance form is presented below and hard copies of both English and Bangla will be made available at the MPCL project office.

Table 10.3-1: Sample Grievance Reporting Form

Reference No.	Date:
Contact Details	Name
	Address
	Telephone Number/Cell Number:
	Email:
How would you prefer to be contacted (please tick box)	▪ By Phone ▪ By Email
Details of your Grievance: (Please describe the problems, how it happened, when , where, and how many times, as relevant)	
What is your suggested resolution for the grievance?	
Signature of complainant/ Thump impression of complainant	Signature of person filling the form (MPCL Representative)

CHAPTER 11:
CONCLUSIONS AND RECOMMENDATIONS

11.1 CONCLUSION

There is no alternative but to add more power generating units to the existing power system of Bangladesh within a shortest possible time frame. This is due not only to meet the increase in demand, but also due to aging of the existing power generating units, many of which will near their life cycle very shortly. Both, base load and peaking plants are necessary to be added to the system, so that the whole system can run economically and efficiently. Gas Engines are most suited for meeting the peaking demand and also have the capacity to run at continuous base load.

In accordance with the agreement with the MPCL, an Environmental and Social Impact Assessment (ESIA) of the 51 MW Gas Fired Power Plant at Ashugonj has been carried out, which included development of an Environmental Management Plan (EMP), covering both the construction and operational phases of the project. The detailed ESIA of the power plant was conducted following the guideline (GoB, 1997) of the Department of Environment (DoE) of GoB and the relevant operational policies (e.g., OP 4.01) of the World Bank, and in consultation with the Environmental Consultant of World Bank.

In this study, the effects of the project activities on physico-chemical, ecological and socioeconomic (i.e., human interest related) parameters during both construction and operation phases have been assessed. The impacts have been identified, predicted and evaluated, and mitigation measures suggested for both construction and operation phases of the proposed power plant. The important physico-chemical environmental parameters that are likely to be affected by the project activities include air quality and noise level.

The study suggests that most of the adverse impacts on the physico-chemical environment are of low to moderate in nature and therefore, could be offset or minimized if the mitigation measures are adequately implemented. Since the project site is located in a developed area that does not appear to be very sensitive ecologically, the impacts of project activities on most ecological parameters (e.g., floral and faunal habitat and diversity) are mostly insignificant.

Noise level has been identified as a significant potential impact of the proposed power plant during both the construction and operation phases. The noise generated from construction activities during the construction phase might become a source of annoyance at the habitat located close to the project site.

The project workers should not be exposed to the noise produced by the construction equipment for a prolonged period to prevent permanent hearing loss. A rotational work plan is advised for the workers and operators of this equipment. During the operational phase, high level of noise is expected to be generated within the confines of the turbine and generator installations. Prolonged exposure to such high level of noise may cause permanent

hearing loss. Therefore, proper protective measures should be adopted during the operation and inspection of this equipment. Modeling study revealed that the cumulative noise effect of the proposed 51MW gas fired Power plant during the operational phase at a common point is expected to be dominated by the noise generated by the plant nearest to the receptor.

Some adverse impact during the operation phase of the plant will come from thermal emission and NO_x and PM emission from the power plant. However, modeling study suggests that the effect of increased NO_x and PM in the ambient air due to emission from the power plants will not be very significant.

The power plant has been constructed within a designated area inside the MPCL owned complex. So there was no need for land acquisition. Additionally, there was no settlement in this designated area, and the area was not used for any income generation activities. Therefore, no population has been displaced and no resettlement was required for the construction of the power plant, and no loss of income was associated with the project.

During operation phase, no significant negative impact is anticipated on socio-economic environmental parameters. Significant positive impacts are expected due to improvement in power supply. This will reduce load shedding in Dhaka city and contribute to the national economy. Well-being of the surrounding population, especially Dhaka city, will be significantly improved due to generation of electricity during peak hours. Currently Dhaka city is reeling under unbearable load shedding.

During public consultations carried out as a part of the ESIA study, people welcomed the proposed power plant project at Ashugonj. However, they recommended installing a plant of good quality, which will be able to provide uninterrupted power and will be able to keep anticipated air and noise pollution to a minimum level.

11.2 RECOMMENDATIONS

The environmental assessment carried out for the proposed Midland Power Plant at Ashugonj, suggests low to moderate scale of adverse impacts, which can be reduced to acceptable level through recommended mitigation measures as mentioned in the EMP. Further, since the project is expected to be financed by the World Bank as well, it has to comply with the concerned operational policy statements of the Bank in force so that it is environmentally sound and sustainable and thus to enable the project proponent in improving their decision making in all its operational activities. It is therefore recommended that the proposed 51MW gas fired power plant may be installed at the MPCL owned land at Ashugonj, Brahmanbaria provided the suggested mitigation measures are adequately implemented. It is also recommended that the environmental monitoring plan be effectively implemented in order to identify any changes in the predicted impacts and take appropriate measures to off-set any unexpected adverse effects.

Apart from risks associated with emissions, noise generation, solid waste, hazardous waste and wastewater disposal as a result of construction and operation activities, the gas fired

power plant put human beings and the environment inside and outside of the plant to a certain degree of risk of accident and sometime loss of life. An emergency response plan (ERP) for the proposed power plant has been developed listing various actions to be performed in a very short period of time in a pre-determined sequence if it is to deal effectively and efficiently with any emergency, major accident or natural disaster.

It will be the obligation of the EPC contractor to submit their Environmental Management Action Plan (EMAP) before commencement of work. The EMAP should specify all affected environmental values, all potential impacts on environmental values, mitigation strategies, relevant monitoring together with appropriate indicators and performance criteria, reporting requirements and, if an undesirable impact or unforeseen level of impact occurs, the appropriate corrective actions available.

LIST OF REFERENCES

1. Environment and Engineering Associates, March 2012, Environmental Impact Assessment (EIA) for "Midland Power Company Ltd." 51MW Gas Fired Power Plant, Asugonj, Brahmanbaria, Bangladesh.
2. Banglapedia (2003), 'Banglapedia: National Encyclopedia of Bangladesh (Volume 1 to 10)', Asiatic Society of Bangladesh, Dhaka, Bangladesh
3. BBS (2011),'Bangladesh Population Census 2011', Bangladesh Bureau of Statistics, Dhaka, Bangladesh.
4. BPDB (2011), Official Website of the Bangladesh Power Development Board, Ministry of Power Energy and Mineral Resources, http://www.bpdb.gov.bd/bpdb/
5. BRTC, BUET (2012), Updating the Environmental Impact Assessment of the World Bank Financed 335 MW Combined Cycle Power Plant at Siddhirganj.
6. GoB (1997), Environmental Conservation Rules 1997, Department of Environment, Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, June 1997.
7. GoB (1997a), EA Guidelines for Industries, Department of Environment, Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, June 1997.
8. GoB (2005), SRO No. 220-Rule/2005, Revision of the Environment Conservation Rules 1997, Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, Dhaka.
9. IUCN Bangladesh (2002), Bio-ecological Zones of Bangladesh. The World Conservation Union, Bangladesh Country Office, Dhaka, Bangladesh. pp.139.
10. IUCN Bangladesh (2000a), Red book of Threatened Amphibians and Reptiles of Bangladesh. IUCN-Bangladesh, House 11, Road 138, Gulshan 1, Dhaka, Bangladesh. Pp. 95.
11. IUCN Bangladesh (2000b), Red book of Threatened Birds of Bangladesh. IUCN-Bangladesh, House 11, Road 138, Gulshan 1, Dhaka, Bangladesh. Pp.116.
12. IUCN Bangladesh (2000c), Red book of Threatened Mammals of Bangladesh. IUCN Bangladesh, House 11, Road 138, Gulshan 1, Dhaka, Bangladesh. Pp. 71.
13. IUCN Bangladesh (2000d), Red Book of Threatened Fishes of Bangladesh. IUCN Bangladesh, House 11, Road 138, Gulshan 1, Dhaka, Bangladesh. Pp. 116.
14. Ministry of Power Energy and Mineral Resources (2011), Official website, http:// http://www.powerdivision.gov.bd/
15. World Bank Group and IFC (2007), Environmental Health and Safety Guidelines, International Finance Corporation and the World Bank.
16. World Bank (1999a), Operational Manual –OP 4.01, The World Bank operation manual for environmental assessment, Washington.
17. Environmental Resources Management (S) Pte. Ltd (August 2012), Draft Environmental Impact Assessment Report of 217.9 MW Gas-Fired Combined Cycle Power Plant Project, Bhola, Bangladesh,
18. Uncontrolled Emission Factors For 2-Stroke Lean-Burn Engines information from AP42

ANNEX–I to XX