Environmental & Social Impact Assessment (ESIA)

OF

Dhaka Southern Power Generations Limited (DSPGL)

[Daulatpur, Nababganj, Dhaka]

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Abbreviation

ABBREVIATION

AECL	Adroit Environment Consultants Limited
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BPDB	Bangladesh Power Development Board
CDMP	Comprehensive Disaster Management Program
CO_2	Carbon Dioxide
DAE	Department of Agricultural Extension
DC	Deputy Commissioner
DOE	Department of Environment
DMB	Disaster Management Bureau
DPZ	Detailed Planning Zones
DSPGL	Dhaka Southern Power Generations Limited
ECA	Environment Conservation Act 1995
ECR	Environment Conservation Rules 1997
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESIA	Environmental & Social Impact Assessment
EMS	Environmental Management System
EPZ	Export Processing Zone
ESMF	Environmental and Social Management Framework
ESSF	Environmental and Social Safeguards Framework
GSHAP	Global Seismic Hazard Assessment Program
GIS	Geographic Information System

GOB	Government of Bangladesh
HFO	Heavy Fuel Oil
HYV	High-yielding Varieties
IEE	Initial Environmental Examination
IUCN	International Union for Conservation of Nature
MIM	Management Information & Monitoring
MoEF	Ministry of Environment and Forests
NEMAP	National Environmental Management Action Plan
NGO	Non-Government Organization
NOx	Oxides of Nitrogen
OP	Operation Policy
PGA	Peak Ground Acceleration
PPIDF	Private Public Infrastructure Development Facility
$PM_{2.5}$	Particulate Matter < 2.5µm
PM_{10}	Particulate Matter < 10µm
REB	Rural electrification Board
SO_2	Oxides of Sulfur
SPM	Suspended Particulate Matter
TOR	Terms of Reference
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
UNDP	United Nations Development Programme
UNCED	United Nations Conference on the Environment and Development
WB	World Bank

WEIGHTS AND MEASURES

^{o}C	degree Celsius
dB(A)	decibel acoustic
GWh	giga watt hour
ha	hectare
km	kilometer
km/h	kilometer per hour
kWe	kilowatt-electric
KV	Kilo volt(s)
KVA	kilo Volt-Amps
m	meter
mm	millimeter
m3	cubic meter
m3/hr	cubic meters per hour
mg/l	milligrams per liter
m/s	meters per second
MTPA	metric tons per annum
MW	megawatt
ppm	parts per million
ppt	parts per thousand
Rpm	revolutions per minute
TPD	tons per day
µg/m3	microgram per cubic meter

Glossary

GLOSSARY

Adverse impact: An impact that is considered undesirable.

Ambient air: Surrounding air.

Aquatic: Growing or living in or near water.

Bangla: Bengali language.

Baseline (or existing) conditions: The 'baseline' essentially comprises the factual understanding and interpretation of existing environmental, social and health conditions of where the business activity is proposed. Understanding the baseline shall also include those trends present within it, and especially how changes could occur regardless of the presence of the project, i.e. the 'No-development Option'.

Bazar: Market.

Beel: A 'back swamp' or depression. Can be either perennial or seasonal.

Beneficial impacts: Impacts, which are considered to be desirable and useful.

Biological diversity: The variety of life forms, the different plants, animals and micro organisms, genes they contain and the ecosystems they form. It is usually considered at three levels: genetic diversity, species diversity and ecological diversity.

Char: Newly accreted land: Land, sometimes islands, within main river channels and nearby mainland or in the estuary, subject to erosion and accretion.

Ecosystem: A dynamic complex of plant, animal, fungal and microorganism communities and associated non-living environment interacting as an ecological unit.

Emission: The total amount of solid, liquid or gaseous pollutant emitted into the atmosphere from a given source within a given time, as indicated, for e.g., in grams per cubic meter of gas or by a relative measure, upon discharge from the source.

Endangered species: Species in danger of extinction and whose survival is unlikely if the existing conditions continue to operate. Included among those are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to suffer from immediate danger of extinction.

Environmental effects: The measurable changes, in the natural system of productivity and environmental quality, resulting from a development activity.

Environmental impact assessment (EIA) / Environmental assessment: The systematic, reproducible and interdisciplinary identification, prediction and evaluation, mitigation and management of impacts from a proposed development and its reasonable alternatives, sometimes known as environmental assessment.

Environmental Impact: An estimate or judgment of the significance and value of environmental effects for natural, socio-economic and human receptors.

Environment Management Plan (EMP): A Plan to undertake an array of follow-up activities which provide for the sound environmental management of a project/ intervention so that adverse environmental impacts are minimized and mitigated; beneficial environmental effects are maximized; and sustainable development is ensured.

Environmental Management: Managing the productive use of natural resources without reducing their productivity and quality.

Erosion: Process in which wind and water removes materials from their original place; for instance, soil washed away from an agricultural field.

Evaluation: The process of looking back at what has been really done or accomplished.

Fauna: A collective term denoting the animals occurring in a particular region or period.

Field Reconnaissance: A field activity that confirms the information gathered through secondary sources. This field study is essentially a rapid appraisal.

Flora: All of the plants found in a given area.

Habitat: The natural home or environment for a plant or animal.

Household: A household is identified as a dwelling unit where one or more persons live and eat together with common cooking arrangement. Persons living in the same dwelling unit having separate cooking arrangements constitute separate household.

Important Environmental Component (IEC): These are environmental components of biophysical or socio-economic importance to one or more interested parties. The use of important environmental components helps to focus the environmental assessment.

Initial Environmental Assessment / Evaluation: Preliminary analysis undertaken to ascertain whether there are sufficient likely significant adverse impacts to warrant a 'full' EIA. In some countries, use of initial assessment forms a meaning of "screening" proposed projects.

Khal: Small Channel, canal.

Land use: Types include agriculture, horticulture, settlement, pisciculture and industries.

Mauza: A Bangla word for the smallest government administrative area corresponding to village revenue unit.

Mitigation: An action, which may prevent or minimize adverse impacts and enhance beneficial impacts.

Negative Impact: Negative change from the existing situation due to the project.

Public involvement / Public consultation: A range of techniques that can be used to inform, consult or interact with stakeholders' affected / to be affected by a proposal.

Reversible impact: An environmental impact that recovers either through natural process or with human assistance (e.g. cutting off fish migration by an embankment might be reversible at a later stage if a proper regulator is built).

Stakeholders: Those who may be potentially affected by a proposal, e.g. Local people, the proponent, government agencies, NGOs, donors and others, all parties who may be affected by the project or to take an interest in it.

Taka: Unit of Bangladeshi currency.

Terrestrial: Living on land.

Thana: Sub-district level of government administration, comprising several unions under district.

Union: Smallest unit of local self government comprising several villages.

Upazila: Sub-district name. Upozila introduced in 1982.

Zila: Bengali word of district.

Executive Summary

Executive Summary

1. Introduction

This report represents the results of Environmental & Social Impact Assessment (ESIA) of Dhaka Southern Power Generations Ltd (DSPGL) at Daulatpur, Nawabganj, Dhaka. DSPGL has signed Project Agreements, comprising of Implementation Agreement (IA) and Power Purchase Agreement (PPA) for setting up 55MW Heavy Fuel Oil Power Project on BOO Basis. The proposed power plant is situated in the vacant land of REB. Total operation period of the project will be 15 years from the date of COD (Commercial Operation Date). The authority has obtained Environmental Site Clearance Certificate from Department of Environment (DoE) vide letter No.30.26.72.4.100.060513/ admin/clearance/26; Date: 30.07.2013.

The company will install equipment to generate 55 (nominal) MWe power in the plant. The plant will consist of 3 units of highly efficient MAN HFO Generator sets and two steam co-generation system operated with waste heat from the HFO engines to supply to the national grid at Nawabganj, Dhaka. The plant will be equipped with a FGD (Flue gas desulfurization) system to reduce SO_x emission by about 90%. The objective of this study is to provide an examination and assessment of the principal environmental impacts of the industry. DSPGL is located in the rural atmosphere of Daulatpur, Nawabganj area. There are no particularly sensitive ecological, cultural and archeological sites in the area. The plant will not involve any relocation of human settlement, as the project is situated on vacant land purchased by Rural Electrification Board (REB) long before. The area enjoys necessary infrastructure facilities for years, which include communication, electricity, telecommunication etc. This ESIA report comprises 12 sections and the contents of these sections are summarized below.

2. Policy and Legal Considerations

This ESIA report has been prepared by following the methodology prescribed in the EIA guidelines for industries of DOE, ECA95 and ECR97, that are the main legislative documents relating to environment protection in Bangladesh. The report is also compliant with WB group's operational policies and guidelines. Steps to consult potentially affected people by the project and to disclose the ESIA report to the public have been taken for compliance with the Bank's policy (OP 4.01) in the ESIA preparation, although these are non-mandatory as per national legislations. The environmental classifications for industrial projects in Bangladesh are based on "inclusion lists" given in the ECR97 with 'RED' being the highest category. Power Plant is listed in the '**Red Category**' in ECR97 (i.e., serial no.6 in the ECR97 Red list in Schedule-1.). WB environmental categorization is based on potential impacts and according to WB criteria (OP/BP 4.01); and this project has been classified in the **'B'** category.

3. Description of the Project

The plant is to be powered by 3 reciprocating HFO internal combustion engines made by MAN 18V48/60TS, each of capacity 19.3 MW. Besides, the plant will have a co-

generation unit consists of Superheated Steam boiler and steam turbine to produce 1.6 MW electricity. The cogeneration Steam Turbine system will have a Cooling Tower to supply water to the steam condensation unit. The flue gas coming out from the waste heat boiler will be passed through the FGD plant to reduce the SO2 emission through the stack by about 90%. With the FGD, the emission level for SO2 will be equivalent to 0.38% Sulfur HFO which is in compliance of WB group's guidelines requirement of 2% sulfur content in fuel for internal combustion engine based power plants of 50 MWh or more in non-degraded air shed. The basic information of the project are given below:

1. Name of the Project	Nababganj 55 MW Power Plant
2. Project Proponent	Tahzeeb Alam Siddique
3. Project Location	Daulatpur, Nawabganj, Dhaka, Bangladesh
Corporate Office	House # 426, Flat #D, Road # 30, New DOHS, Mohakhali, Dhaka-1206
Main Sponsor	Doreen Power Generations and Systems Ltd. Rupali Engineers and Traders Ltd.
4. Type of Business	Power Generation
5. Raw Materials	The main raw material of the project is HFO (Furnace Oil)
6. By-product, if any	None
7. Net Plant Capacity	55 MW
8. Project Cost	BDT 3516.11 Million
9. Total Area of Land	7 Acres
10. Total Covered Area	5 Acres
11. Total Developed Land	7 Acres
12. Employment	Administration -15, Production - 47 and Environmental Management - 3 Total 65 Persons
13. Fuel Requirement	Heavy Fuel Oil (furnace oil), 68.80 million liter/year, Imported
14. Water Requirement	100m^3/hour, Deep well

The installed capacity of the project is 59.5 MWe (nominal). However, the declared capacity of the power plant is 55 MW as per the PPA with the Bangladesh Power Development Board. The project will have some ancillary other facilities, as water treatment plant, demineralized water treatment (reverse osmosis), oily water separation plant, gypsum dewatering plant etc to support the main equipment of the project.

The plant is located at Daulatpur, Nawabganj, Dhaka (23^{o}40'11.20" N: 91^{o}16'53.7"E) having an area of about 7 acres land. The plant will not involve any relocation of human settlement, as the project is situated on the purchased vacant land of REB based on willing sellers and buyer negotiations without any undue influence from the buyer. The land Lease documents are given in the annex-14.The distance of the existing plant is

about 40 km from the zero point (i.e. GPO) of Dhaka. The ground elevation and HFL (which is road level) of the site is about 7.276 meters above AMSL and the floor level of the plant is around 1.22m above the HFL. The project site is located in a rural area of Daulatpur and there is no such industrial set up within the 10km radius of the project. The site has all the infrastructural facilities like road communication, electrical grid lines, telecommunications etc. The fuel (HFO) will be transported by water way of Dhaleshwary river 400m away from the plant site and unloaded through a small jetty to be built by the DSPGL. The HFO will be transported through underground pipeline from the jetty to the plant storage tank. The DSPGL will also construct 4.4 km transmission line from the project site to the Hasnabad grid station along the road side of LGED & RHD.

4. Baseline Environment

Baseline environment is concerned with existing physical, chemical and biological conditions of the area where the plant is going to be set up. The surface water, ground water, ambient air quality and noise level have been analyzed to evaluate the primary baseline of the area. The data from Continuous Air Monitoring Station(CAMS) of DOE at Narayanganj have also been used to evaluate the monthly concentrations of PM2.5 and PM10 in the project area.

In the vicinity of the plant, the main surface water body is the river Dhaleshwary at 400m from the site. The quality of the river water has been analyzed and found satisfactory. Ground water exists at a shallow depth (generally below 5.0 m) in the area. Ground water is a stable source of water for industrial use in this area. Hardness and iron content for the ground water are moderately high and groundwater will be appropriately treated for use in the plant. In common with other peri-urban or rural areas; birds like Crow, Salik, Chorui, doel, ghughu, Kokil, etc are seen at times at the project site. There are no wildlife, natural forest and vegetation, endangered species of present in and around the plant site. There are a number of different types of trees like coconut, jack fruit, mango, mehogoni, krisnochura etc. around the plant site.

The climate of the region is of tropical monsoon type. According to Bangladesh Meteorological Department, the maximum temperature of 2011 at project site is 36.2° C in September and minimum temperature is 8.2 °C in January are recoded. Mean relative humidity for an average year (2011) is recorded as 70% and on a monthly basis; it ranges from 54% in February to 82% in August. At normal times, the maximum and minimum wind speeds at Nawabganj are 3.8 Knots/hr and 2.0 Knots/hr respectively in 2011. The prevailing wind direction is from south-southwest during the monsoon period and north/north-west during winter. The rainfall is mostly confined in the monsoon season i.e., between May to October. Maximum rainfall in Aug 2011 is 409 mm and 0 mm from Nov-Feb respectively.

Dhaka City (GPO) is about 40 km away from the plant site and the area belongs to the different air shed from the Dhaka City. The air quality parameter values in the air shed doesn't exceed national Air Quality Standards during dry season (i.e., November-May). The data from the DOE CAMS (continuous air quality monitoring stations) is not available near the project area, where we have compared the CAMS data from Narayanganj which is a heavily industrially polluted air shed. So, to establish a realistic baseline air quality, AECL has undertaken a 24 hour monitoring for 3 days, which shows that the parameters are within the NAAQS (National Ambient Air Quality Standards) for PM10 and PM2.5 which means that the project area falls under non degraded air shed. The baseline levels for other criteria pollutant i.e., CO, SO2, NO2 and O3 are compliant with NAAQS.Baseline noise levels were measured during the study period in four locations around the plant site and were found to be below 70dBA.

5. Potential Impacts of the Proposed Project

The purpose of impact evaluation is to assign relative significance to the predicted impacts associated with the project, and thus determine the order in which impacts are to be avoided or mitigated. It should be noted that impact evaluation are somewhat subjective as the impacts can't always be quantified before the event. The following are the main objectives of impact evaluation: (i) Distinguish between impacts that are of most concern (need to be avoided/ mitigated) and those that are considered to be less important; (ii) Organize measures of significance in a way that allows a comparison of alternative project proposals; and (iii) Facilitate the communication of results to the concerned public and to decision makers. Key elements for assessing impact significance are: (i) Scientific and professional judgment; (ii) Disturbance/disruption of valued ecological systems; (iii) Degree of negative impact on social values and quality of life; and (iv) Public perception versus the scientific/professional opinion of the risks/benefits involved.

The construction of the plant can create some adverse impact on the existing environment. The acoustic impacts, dust emission, traffic congestion and sanitation during the construction period would be limited to construction of the plant, site preparation and due to installation of power plant itself. Since the plant would be set up on DSPGL's own land, the resettlement would not be an issue here. During construction, the plant authority will adopt all necessary measures to reduce the probable environmental impacts from different aspects.

Identification of potential impacts due to the plant location and operation of the plant has been done using a checklist. The checklist contains the environmental effects and impacts designated to stimulate the analysis and to consider broadly the possible consequence of contemplated actions. The significant impacts in different phases i.e., (i) due project location and design, (ii) construction phase and (ii) operation phase have been identified using the process. As the land development of the project has started now, there are some impacts for air quality, surface water quality and drainage pattern

are concern. The impacts due to operation are most important, which are: (i) Air Emissions especially SO2, (ii) Noise, (iii) Water pollution, (iv) Occupational health, and (v) Emergency/disaster impact.

6. Prediction and Evaluation of Impacts

As the proposed power plant will utilize Heavy Fuel Oil (HFO) as fuel, the pollutants of potential concern are Particulates, sulfur dioxide, oxides of nitrogen, carbon dioxide and carbon monoxide during the operation period of the project. Each of these pollutants has been examined to ensure the Bangladesh emission limit standard as well as IFC/WB, where appropriate, the required emission control techniques would be incorporated into the mitigation measures. The ground concentration of NO_x and SO_2 emission have been determined by air emission dispersion modeling by using USEPA approved AERMOD model up to a distance of 10km radius to the project site.

As explained above, the main potential environmental impacts, which may arise as a result of construction of the power plant, can be grouped as follows: (i) Atmospheric emissions and Air quality, (ii) Noise generation, (iii) Oil spillage, and (iv) Water pollution and waste water disposal These aspects have been examined and the findings are summarized below.

Atmospheric Emission and Air Quality: Emission of Particulates (PM 10 and PM 2.5), sulfur dioxide, Nitrogen Oxides and Carbon dioxides are the major concern of air pollution for the project. The Co-generation system which produces steam by using the waste heat from the HFO Engines, will reduce the exhaust heat temperature from 300^0C to 194^0C. In addition to that, the project authority will also install a flue gas de-sulfurization (FGD) plant to reduce the Sulfur content from the exhaust which will remove approximately 90% Sulfur from the exhaust. With the FDG, the SO2 emission will be equivalent to HFO with 0.38% Sulfur which is compliant with the Bank group's (i.e., IFC) thermal power guidelines value of 2% for non-degraded air shed. To evaluate the ground concentration of the above emissions to the surrounding environment, an emission dispersion modeling (USEPA approved AERMOD model) has been done and the result shows that all the criteria pollutants (i.e.,PM, SO2, and NO2) will be within the Bangladesh NAAQS and Bank group's (i.e., IFC) thermal power guidelines from the plant after installing the FGD .

Noise: The project will generate 112 dBA noise (equivalent noise from 3 engines) in the engine room, 90 dBA in the steam turbine room and 65 dBA from the stack after silencer. The project authority will take necessary noise abatement measures (brick wall + Styrofoam + brick wall = 150mm + 100mm + 150mm) to prevent the engine room noise emitted outside the project boundary. The stack noise emission dispersion has been predicted by means of noise impact modeling. The maximum result has been predicted as 27.62 dBA at 10m distance and 4.60 dBA at 300m radius from the project site. There is a school located around 220m northeast and few homestead at 100m northwest to the project site where the approximated noise contribution is less than 9

dBA and 13.81 dBA respectively. If we consider school time is started from 9.00am to 6.00pm, the average ambient noise level at that time is around 53 dBA (table 4.15), the combined noise effect from the power plant and ambient noise can be found from the link –(http://www.sengpielaudio.com/calculator-spl.htm), and applying the formula of ($\sum L = 10.\ Log_{10}\ (10^{L1/10} + 10^{L2/10})$ dBA, the calculation has been presented below:

The calculated table is presented below:

Radius in m	10	20	50	100	200	300
Output Sound power level in dBA	27.62	23.02	18.41	13.81	9.21	4.60
Ambient sound level in Dba	53	53	53	53	53	53
Summation of two sound level	53.01	53.004	53.001	53.00	53.00	53.00

The above result shows that the noise level after 100m from the power plant will not affect the ambient noise level of the area, so, there would not create any noise problem due to the power plant to the nearest homestead and the school.

Oil spillage: The plant management will transport the HFO from the Dhaleshwary river jetty near the project site and unload the vessel to the HFO storage tanks through pipeline. A 1500MT capacity light vessel will unload the HFO 4-5 times in a month. This little activity will not create any problem to local water navigation and the aquatic life in the river. The HFO unloading area would be well protected with hard standing floor so that there is no scope of oil spillage. The HFO storage tank will have secondary containment with 110% capacity of the storage tanks; so that the oil could be retained in the containment in case of any accidental spillage or disaster. Appropriate lubricant spillage prevention and management measures will also be undertaken.

Transmission Line: The project will construct 4.40 km transmission line from the project site to Hasnabad Substation, Keraniganj. This 4.40 km transmission line follows the LGED road and RHD road. According to the DSPGL, private land will not be used for transmission line. Along the LGED road and RHD road 04 residential and 54 commercial establishments are found close to the road. But the transmission line will not affect any of these structures. Physical displacement will not be required due to the project interventions.

Liquid Discharge: The power plant will produce only a small quantity of wastewater since it has mainly air cooling and close looped water cooling system. The steam turbine will have a condensation cooling system by a close loop cooling tower. Only small amount of make-up water (75 cu.m/hour) will be needed in the system. The project would have a water treatment plant with a facility of multimedia and Iron filter followed by 1st stage Reverse Osmosis (RO) and the water would be collected in a storage tank. The make-up water for the condenser cooling tower will be supplied from this storage tank and remaining water would be pumped to the 2nd stage RO for producing de-mineralized (DI) water which would be fed to the waste heat steam boiler.

The domestic liquid wastes would be disposed through a septic tank system. The surface drainage network would be connected with an interceptor prior to discharge to surface drainage system. The interceptor will trap the oily matter present in the water for appropriate disposal.

7. Environmental Management Plan (EMP)

In the context of a project, Environmental Management Plan (EMP) is concerned with the implementation of the measures necessary to minimize and offset the adverse impacts and to enhance beneficial impacts. Unless the mitigation and benefit enhancement measures are identified in EIA and fully implemented, the prime function of the EIA cannot be achieved. Thus, the objectives of EMP for the present project are: (i) Identification of Monitoring requirements and Monitoring indicators; (ii) Mitigation measures to reduce or eliminate negative impacts; and (iii) Enhancement measures to maximize positive impacts. Environmental management plan has to be considered as part of the plant's overall management and it would be part of the plant operational manual.

Monitoring of the performance of a plant is very important and sometimes vital. Industrial units in Bangladesh generally do not monitor the environmental parameters related to plant operation, thereby neglecting the environment. For surveillance of the environmental performance of an industry, and monitoring of the quality of the local environment, environment in the work-zone and the general impact zone have to be performed on a regular basis. A management set up has to be created for the environmental monitoring program which can ensure compliance with national environmental standards. To this end a committee (Environmental Management and Safety Committee) will be created with plant manager as head and with 2-4 other members. The committee must meet at least once in a quarter and take stock of the environmental status of the plant. The main emission from the plants (i.e., air emissions, noise and any other) are to be analyzed as per SOP for the plant. Any additional monitoring required should be defined and resources allocated for the purpose. The proceeding of the committee should be recorded and used to produce quarterly and annual environmental reports indicating compliance or otherwise of the environmental regulations. These reports should be submitted to the DOE and shared with the World Bank. The quarterly and annual monitoring reports will also be placed on the company website for public scrutiny.

The cost of the Environmental Management Plan (EMP) is divided into several parts to reflect the different phases of the project and the requirements of each phase. The cost of EMP must include the costs of the capacity building, public consultation and the quality control requirements for a period of 5 years of operation. An allocation will be made for EMP every year in budget estimated for the DSPGL.

8. Emergency Response and Occupational Health & Safety

Under the supervision of the 'Environment Management and Safety Committee', all plant personnel will have responsibilities assigned to them during emergency. The documented responsibility will be included in a program manual which can constitute a part of the plants operation manual. Compliance with the responsibilities should be monitored and if these are not carried out for any reason, corrective measures should be taken.

The plant management will prepare an occupational health safety policy manual which should be updated from time to time. The policy should be signed and dated by the Chief Safety Officer who may be the Plant Manager. The policy should be discussed with all the plant personnel. The Chief Safety Officer should periodically review the policy and re-issue the policy.

9. Alternative Analysis

The 'No Build' alternative in the present case would mean continued power deficiency, in the face increasing demand for industrial and economic growth which leads to poverty reduction. So, the 'No build' alternative is unacceptable, and the potential socio-economic benefits of implementation of such a project far outweigh the adverse impacts, all of which can be controlled and minimized to an acceptable level.

The project site was a privately owned by REB, which was vacant thus involved no resettlement issues. Being located in the rural atmosphere and there is no remarkable settlement around the site, the site was considered for construction of the plant. After analysis various possible alternatives, this ESIA finds the plant's environmental impacts at the selected site are acceptable if the management procedures delineated are properly implemented. Therefore, the site has been considered suitable for the plant.

10. Stakeholder Consultation and disclosure

Stakeholder consultations are very important and sensitive issues for setting up a new industry in any area of Bangladesh. The process was initiated with an open objective to ensure people's participation right from the planning stage of the project. More specially, this was aimed at improving the study taking into account opinions from the people of the impacted area. Primary stakeholders were consulted during informal and formal meetings (by paper advertisement in Bangla and English daily newspaper) held in the project area from March 2013 to December, 2013. Separate stakeholder consultations have been conducted for the construction of electric transmission lines and with the school committee & guardian representatives. The deliberations and attendance in these meetings have been documented. The consultation process was carried out in the Bangla languages. During these meetings a simple, non-technical,

description of the project was given, with an overview of the project's likely human and environmental impact. The community consultations demonstrated that goodwill towards the project proponents indeed exists; approval for project activities by the communities was evident. The consultations were considered as a good gesture and appreciated, by the men and women. The stakeholders' consultation process will be continued in the operation phase of the plant, so that issues of public concern can be addressed.

The ESIA report will be uploaded in the Company's website and a copy of ESIA is kept at the plant for public review. The executive summary will be translated into Bangla and will also be made available to the public.

11. Grievance Redress Mechanism

The Project Management has established a procedure to answer to project-related queries and address complaints and grievances about any irregularities in application of the guidelines adopted for assessment and mitigation of environmental safeguards impacts. The complaints related to plant operation that may create inconveniences to agency/individual should be addressed based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly without resorting to expensive, time-consuming legal actions. DSPGL has constituted a grievance redress committee (GRC) headed by a UP Chairman of Kailail Union Corporation with project Director as the member-secretary of GRC. To ensure impartiality and transparency, hearings on complaints will remain open to the public. The GRC will record the details of the complaints and the reasons that led to acceptance or rejection of the particular cases. The GRC will keep records of all resolved and unresolved complaints and grievances and make them available for review as and when asked for by appropriate authority, WB and any organizations known to be working with urban development issues. However, it should be noted that the GRC process will not pre-empt and aggrieved person's right to seek redress in the courts of law.

12. Conclusion and Recommendations

The present ESIA report finds that though there are certain adverse environmental impacts associated with the industrial unit under consideration, these are manageable.

The project is indispensable in view of the current energy shortage scenario in Bangladesh. The impact on the social environment is positive given the job and business opportunities created for local residents from the project. The project will help in the industrialization, accelerating socioeconomic growth, and improving quality of life. One of the most critical issues for the project is safety. This has been adequately addressed through compliance with national building code (BNBC) in the construction to ensure safety during natural disasters like earthquake and cyclone and a full-containment for the HFO storage tank.

The project has been designed to comply with the country's environmental laws and regulations, especially on air emissions, ambient air quality, wastewater effluent, and noise. The project management has taken steps to ensure that the plant meets the World Bank's environmental standards. To mitigate the impact of the use of high sulfur HFO in the plant, a FDG is being installed to reduce sulfur-di-oxide emission by 90%. Given the management measures and monitoring commitments by the DSPGL for the project, environmental impact of the project will be manageable.

Given the proponent's commitments, actions undertaken for further measures to be adopted in due course of time as required, the Dhaka Southern Power Generation Ltd. is going to be a nationally important and environmentally sustainable industrial venture.

Chapter -1
Introduction

Chapter-1

INTRODUCTION

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND:

Electricity is the major source of power for country's most of the economic activities. It is the key ingredient of socio-economic development of the country. Adequate and reliable supply of electricity is an important pre-requisite for attracting both domestic and foreign investment. Reliable supply of electricity is a pre-condition for poverty reduction and economic development. In Bangladesh, 47% of total populations have access to electricity but reliable and quality power is still a faraway. To alleviate poverty in the face of resource limitations and high population density, Bangladesh requires an economic growth rate of more than 7% p. a. In order to achieve this growth rate, electricity growth needs to be achieved by 10%. By best utilizing the natural, human and agricultural resources the desired pace of GDP growth could be attained by increasing electricity generation at much higher rate, which is the key target for development.

According to Ministry of Power, Energy & Mineral Resources, Bangladesh presently total electricity generation capacity is 5376 MW. Of this capacity 3331 MW is from public sector and 2045 MW is from the private sector, which is 62% and 38% respectively of the total generation capacity. Considering 10 - 15 % Maintenance and Forced Outage, Available Generation Capacity is in the range of 4500 – 4800 MW without fuel constraint.

Problems in the Bangladesh's electric power sector include corruption in administration, high system losses, delays in completion of new plants, low plant efficiencies, erratic power supply, electricity theft, blackouts, and shortages of funds for power plant maintenance, diversion of electricity to irrigation in rural areas. Overall, the country's generation plants have been unable to meet system demand over the past decade.

A recent survey reveals that power outages result in a loss of industrial output worth $1 billion a year which reduces the GDP growth by about half a percentage point in Bangladesh. A major hurdle in efficiently delivering power is caused by the inefficient distribution system. It is estimated that the total transmission and distribution losses in Bangladesh amount to one-third of the total generation, the value of which is equal to US $247 million per year.

Recognizing the need to improve the performance of the power sector, the government adopted a policy paper titled Power Sector Reforms in Bangladesh (PSRB) in 2001. PSRB outlined the reform process to gradually remove constraints in the sector through improvements in the sector and corporate governance, introduction of competition, and

public private partnerships. The PSRB envisioned in the long term a structure of the power sector based on (i) separation of sector regulation and operation; (ii) autonomy and commercial orientation of the sector entities; (iii) separation of generation, transmission, and distribution; and (iv) increased private sector participation. Transmission assets would remain in the public sector, while generation and distribution assets would have both public and private ownership.

The government has approved proposals for setting up 49 power plants (RPPs) with a total capacity of 5319 megawatt to improve the power situation during the last three years tenure. According to news "**Biddut Barta"** published in different national dailies including the daily **Prothom Alo** and the daily **Ittefaq** on January 02, 2012 that 5036.5 MW of electricity was produced on 1st January, 2012 whereas on the same day of the previous year total electricity generation was 3749.5 MW.

It is a well-recognized fact that each development activity has an impact on the natural molding of the environment. As development activities are of prime importance for the economic growth and fulfillment of basic needs of the society, the environmental aspects of development activities must be taken into account and due attention must be paid to protect the environment. The first step in this direction is to evaluate the probable impacts of the project on the surrounding environment so that suitable measures could be taken during early stages of the project to minimize negative impacts.

The socio-cultural roots of our present environmental crisis lie in the paradigms of scientific materialism and economic determinism, which fail to recognize the physical limits, imposed by ecological systems on economic activity. The economies must expand within ecosystems, which have limited regenerative capacities. Contrary to the neoclassical theory of continuous material growth, economic activities directly undermine the potential for development through over-exploitation of natural resources, and indirectly compromise future production through the discharge of residuals. The entrenchment with quantitative growth as a major instrument of social policy is thus quite paradoxical.

The emergence of the concept of sustainable development in recent years has brought in the general realization that societal perceptions must shift towards ecological determinism so as to achieve qualitative growth within the limits of ecosystem carrying capacity. The carrying capacity based planning process, innovative technologies for enhanced material and energy effectively of production and consumption, structural economic change towards less resource-intensive sectors, and preventive environmental management through increasingly interventionist policies are some of the strategies for reconciling developmental goals with ecological capabilities.

Proper location / sitting, its process and waste abatement and control are very important for a development activity to be environmentally sound. To ensure this, an **Environmental & Social Impact Assessment (ESIA**) is a very effective tool, which delineates what

needs to be done to make a development activity suitably located and operate in an environment friendly way.
The ESIA will, therefore, examine the technical aspects of the project activities, which are likely to interact with the surrounding environment. This ESIA study will cover possible activities and impacts with the environment and community. The report will also provide a suggestive EMP along with certain mitigation measures plan with a view to reduce effect of the adverse impacts.

Dhaka Southern Power Generations Ltd. (DSPGL) has signed Project Agreements, comprising of Implementation Agreement (IA) and Power Purchase Agreement (PPA) for setting up 55MW Heavy Fuel Oil Power Project on BOO Basis at Daulatpur, Nawabganj, Dhaka. The proposed power plant is situated in the vacant land of REB. Total operation period of the project will be 15 years from the date of COD (Commercial Operation Date). The authority has obtained Environmental Site Clearance Certificate from Department of Environment (DoE) vide letter No.30.26.72.4.100.060513/admin/clearance/26; Date: 30.07.2013.

There are no particularly sensitive ecological, cultural and archeological targets. The plants shall not have to relocate any human settlement, as the project is situated on purchased nonagricultural land. The area enjoys necessary facilities for years, which include communication, gas, electricity, telecommunication etc.

Proper location, its process and waste abatement and control are very important for a development activity. To ensure this, an **Environmental & Social Impact Assessment (ESIA**) is a very effective tool, which delineates what needs to be done to make a development activity suitably located and operated in an environment friendly way.

1.2 OBJECTIVE

This report presents the findings of an **Environmental & Social Impact Assessment (ESIA)** of the project namely **Dhaka Southern Power Generations Ltd. (DSPGL).** They will install 55 MW 3 units of ultra-efficient MAN 18V48/60 HFO Generator sets with combined capacity of 55 MW at the grid at **Nawabganj, Dhaka**. The objective of the study is to provide an examination and assessment of the principal environmental impacts of the industry. The outline of an environmental management plan also suggested with an indication of the extent of work to be done to keep the development and environment compatible. In this context, it should be noted that the term “environment” and its derivatives have been used in a wide sense, which covers not only physical and chemical aspect, but also the human dimension. The specific objectives of this ESIA are to:

- Present a brief discussion on the ESIA process and its role in the planning and implementation of development projects;

- Present a general description of the project and the process;

- Present a description of the pre-project environment;

- Delineate the significant environmental issues found and believed to be involved;
- Identify the environmental impacts of the project and quantify them to the extent possible;

- Suggest the plan for management of the environment, during the implementation and operation of the plant.

- Assess social impacts due to the project and avoid or minimize adverse impacts by alternative design options

- Suggest corrective measures to mitigate adverse social impacts and prepare resettlement action plan; if required.

1.3 STUDY AREA

The proposed **Dhaka Southern Power Generations Ltd. (DSPGL)** plant will be set up at Daulatpur, Nawabganj, Dhaka. The proposed project site is located at mouza of Doulatpur, Union Kailail, Upazilla Nawabganj, Dhaka. The proposed project would be set up in the land of Rural Electrification Board (REB). The access road from the Kailail Union road to the project is in between the graveyard and the High school playground. The River Dhaleshwari, situated in the North side is adjacent to the project. The location is well communicated by road and river ways. The site covers an area of 6.98 acres of land including access road. The REB acquired this land from the local people in 2010 and handed over to the Dhaka Southern **Power Generations Ltd. (DSPGL)** in February 2013. The access project road (from project site to Dhaleshwari, River) will cross the Kailail Union road. Width of the access road is 50 feet (15 meter).

1.4 SCOPE OF WORK

The description of the environment and social baseline conditions are made encompassing all relevant current baseline data on the environmental and social characteristics of the study area including physical, biological, ecological and social environments. In the backdrop of the above scenarios, the relevant regulations and standards governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, land use control, land acquisition, compensation, etc. at every level are described.

In action to the above, an analysis was conducted of reasonable alternatives in meeting the ultimate objects of the project including the 'no action' alternative, alternative means of meeting the energy requirements, alternative means of delivering gas, alternative methods of construction including cost and reliability factors, alternative options to

reduce adverse social and resettlement impacts and suggest appropriate mitigation measures.

Viewed against these, all significant impacts were identified and evaluated including atmospheric emissions and changes in ambient air quality, discharge of effluent and ambient water quality impacts, changes in ambient noise and local land use patterns, impacts due to land acquisition, impacts of the project and its activates on the community's access to social infrastructure (e .g. potable water, health centers, school, irrigation and extension services), and local developments.

Following identification of potential impacts, efforts have been taken to distinguish between positive and negative impacts, direct and indirect impacts including impacts from possible accidents and long-term impacts. Attempts are made to describe the impacts quantitatively in terms of environmental and social cost and benefits and assigning economic values where feasible.

Finally, an Environmental, Safety and Social Management Plan (SMP) to mitigate negative impacts has been developed, including a detailed Environmental and Social Management Plan with feasible and cost-effective measures to prevent or reduce significant negative impacts to an acceptable level, and containing detailed implementation plans, monitoring indicators and clear allocation of responsibility among project sponsors construction contractors, government agencies, and community-based organization. Also, an Environmental and Safety Management Plan, focusing on mitigation measures to address the environmental and safety consequences associated with the project for both construction and operational phases has been prepared. Also, a Social Management Plan is developed which includes a Resettlement Action Plan to address the adverse impacts on project-affected persons displaced by the power plant construction. It is to be mentioned that before preparation on the above, construction and participation with the affected persons were undertaken formally.

1.5 THE ESIA TEAM

Adroit Environment Consultants Ltd. (AECL) has prepared this report under the guidance and supervision of Dr. Nasir Uddin Khan. The total team composition and their expertise have been given in the table below:

Professional	Name	Expertise in the relevant field
EIA & Emission Modeling Expert	Dr. Nasir Uddin Khan	Highly experienced on conducting EIA of various nature in home and abroad. Have vast experience on identifying different environmental impacts and suggesting mitigation measures for any project. Experienced on emission and noise modeling of various projects. Experienced on Project stakeholder engagement - Public consultation and Disclosure Plans.
Legal & Policy experts, EIA analyst	Mohammad Reazuddin Former Director (Technical) & Former Chairman, Environmental Clearance Technical Committee, Department of Environment (DoE)	Experienced on environmental issues, Legislative bindings, legal and policy framework in conjunction with the Department of Environment, ADB, World Bank/IFC or other donor agencies. Have vast knowledge on EIA report review and analysis.
Power Plant Engineer	Engr. Zahurul Islam Khan	Expert on power plant operation and EIA report.
Socio-economist	Mukul Ashraf	Experienced on Social baseline studies, community needs assessment, Social and Community Health Impact Studies/Assessments etc.
Field Investigator/ co-coordinator	Engr. Irfan Ullah	Make Liaison with all field staff and Consultants; allocate staff & resources to different places when necessary. Background of organizing site visits, surveys, liaison with community, public and govt. organizations, etc.
	Md. Akter-uz-Zaman	Background of organizing site visits, surveys, liaison with community, public and govt. organizations, Base line data collection etc.
	Mr. Golam Mostafa	Base line data collection, sample collection from site, sample preservation and laboratory analysis.
	Mr. Ratan Biswas	Base line data collection, secondary data collection, sample collection and site survey

1.6 LIMITATIONS

An IEE/EIA/ESIA is generally carried out as an integral part of the Feasibility Study (FS) or together with it and before going into the final design phase and into the construction phase of a particular development project. If so than the findings of the ESIA could be incorporated in the project design, overall planning and budget and that the project could be implemented accordingly. When an ESIA is conducted separately as just an add-on, often it does not get due importance in the overall implementation of the project, which undermines the role of the ESIAs and can contribute to environmental damages.

In case of **Dhaka Southern Power Generations Ltd. (DSPGL),** an IEE has been prepared at the initial stage of the project. Though the IEE was prepared as a separate document of Feasibility Study (FS), but all the Significant Environmental Impacts (SEIs) were identified in IEE for the above project and conclusions for site clearance were made accordingly. DoE has cleared the present site with subject to undertaking an ESIA and adoption of necessary and effective pollution control measures. So, this report has been prepared to fulfill the requirement of DoE and emphasizes have been on the issues which has been considered to be significant in IEE and the conditions imposed in site clearance by DoE. Keeping all into consideration the present report delineates the environmental factors and conclusions are made accordingly.

Services performed by the consultant are conducted in a manner consistent with that level of care and skill generally exercised by members of the engineering and consulting profession. The report may not exhaustively cover an investigation of all possible aspects and circumstances that may exist. However, an effort is made to discover all meaningful areas under the stipulated time available.

In evaluating subject site, consultant relies in good faith on information provided by client's management or employees. The Consultant assume that the information provided is factual, accurate and accepts no responsibility for any deficiency, misstatement or inaccuracies contained in this report as a result of omission or misrepresentation of any person interviewed or contacted. However, the consultant notifies the contradictions and errors in the data, where it seems appropriate.

It should be recognized that the information given in the report is time specific and with the passage of time the relevancy of data and analysis may suffer. Specific circumstances and condition of site can change due to which conclusion and opinions may also change

1.7 ACKNOWLEDGEMENT

In this ESIA study many individuals and agencies helped in gathering data and providing information & services. Almost all of them were most helpful & cooperative to provide data & related information and discus with them surrounding environmental issues. We also are thankful to the DoE personnel of **Dhaka Division** for their Co-operation in various aspects of this study.

Chapter -2

Policy and Legal Consideration

Chapter-2

POLICY AND LEGAL CONSIDERATION

2.0 POLICY AND LEGAL CONSIDERATION

2.1 BACKGROUND

For protecting the environment from industrial pollution and environmental degradation, Government of Bangladesh has promulgated some policies, strategies, laws, rules & regulations and action plans. The clauses and requirements of these regulatory legislations and policy imperatives must be taken in to consideration for compliance by the proponents/operators of any industrial establishment in the country.

As an institutional arrangement, Government of Bangladesh has designated the "Department of Environment" (DOE) with the sole responsibility for the regulatory functions to enforce of the provisions of environmental laws, rules and regulations to prevent environmental degradation in the country. Under these legal provisions, the industrial entrepreneurs must take mitigation measures for protecting the environment from pollution impacts and must get 'Environmental Clearance' from DOE before setting up and running their industries. These rules are equally applicable to both new and the existing industries. There are some other sectoral rules related to the industrial projects, which predate environmental legislations. These legislations have become effectively obsolete with the promulgation of the ECA,1995 and the ECR, 1997 and their subsequent amended versions.

Dhaka Southern Power Generation Ltd (DSPGL) is committed to the protection of the environment through compliance of the existing environmental laws, rules and regulations of Bangladesh. The project authority is also keen to abide by the international conventions and standards for making the industry environment friendly. The environmental classifications for industrial projects in Bangladesh are based on "inclusion lists" given in the ECR97 with 'RED' being the highest. Power Plant is listed in the '**Red Category**' in ECR97 (i.e., serial no.6 in the ECR97 Red list in Schedule-1.). WB environmental categorization is based on potential impacts and according to WB criteria (OP/BP 4.01), this project has been classified in the **'B'** category.

The social impact assessment has been carried out following World Bank OP 4.12 and relevant laws and regulations of Bangladesh. Acquisition and Requisition of Immovable Property Ordinance 1982 (Ordinance II) with subsequent amendment in 1993 has also been considered in land acquisition process for the project in 2010.

The prevailing national policies, strategies, laws, rules, action plans etc. on environment are discussed briefly in the following. The WB group's operational policies and guidelines are also briefly discussed as the project is likely to be co-financed by the WB through the IPFF project.

2.2 POLICIES

2.2.1 Industrial Policy 1991

The Industrial policy of 1991 contains the following clauses in respect of environmental protection

- To conserve ecological balance and prevent pollution during industrialization
- To take effective steps for pollution control and conservation of environment during industrialization

To ensure embodying of necessary pollution control and preventive measures by industrial investment project endangering environment.

2.2.2 National Environmental Policy 1992

Bangladesh National Environmental Policy (*GoB, 1992*) was approved in May 1992, and sets out the basic framework for environmental action, together with a set of broad sectoral action guidelines. Key elements of the policy are:

- Maintenance of the ecological balance and overall progress and development of the country through protection and improvement of the environment.
- Protection of the country against natural disasters
- Identification the regulation of all types of activities which pollute and degrade the environment
- Ensuring sustainable utilization of all natural resources
- Active association with all environmentally-related international initiatives

Environmental policy contains the following specific objectives with respect to the industrial sector:

- To adopt corrective measures in phases in industries that causes pollution.

- To conduct Environmental Impact Assessments for all new public & private industries.

- To ban the establishment of any industry that produces goods cause environmental pollution, closure of such existing industries in phases and discouragement of the use of such goods through the development and/or introduction of environmentally sound substitutes.

- To ensure sustainable use of raw materials in the industries to prevent their wastage.

2.2.3 National Conservation Strategy

National Conservation Strategy *(GoB/IUCN, 1992*) was drafted in late 1991 and submitted to the Government in early 1992. This was approved in principle; however the final approval of the document is yet to be made by the cabinet. It underwent a number of modifications over the last five years, and is waiting to be placed before the cabinet finally sometime in late September 1997. For sustainable development in industrial sector, the report offered various recommendations; some of those are as follows:

- Industries based on nonrenewable resources should be made to adopt technology which conserves raw materials, and existing industries should be given incentives to install technical fixes to reduce wastage rate

- All industries, especially those based on imported raw materials, should be subjected to EIA and adoption of pollution prevention/control technologies should be enforced.

- No hazardous or toxic materials/wastes should be imported for use as raw material.

- Import of appropriate and environmentally sound technology should be ensured.

- Complete dependence on imported technology & machinery for industrial development should gradually be reduced so that industrial development is sustainable with local skills and resources.

2.2.4 National Environmental Management Action Plan (NEMAP), 1995

National Environmental Management Action Plan, also referred to as NEMAP (GoB, 1995) 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 during the period 1995 to 2005, and sets out the framework within which the recommendations of the National Conservation Strategy are to be implemented.

NEMAP has the broad objectives of:

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

One of the key elements of NEMAP is that sectoral environmental concerns are identified. In outline, the environmental issues of the industrial sector include the following:

- Pollution arising from various industrial processes and plants throughout the country causing varying degrees of degradation of the receiving environment (Air, Water, and Land).
- There is a general absence of pollution abatement in terms of waste minimization and treatment.
- Low level of environmental awareness amongst industrialists and entrepreneurs.
- Lack of technology, appropriate to efficient use of resources and waste minimization leading to unnecessary pollution loading in the environment.
- Economic constraints on pollution abatement and waste minimization such as the cost of new technology, the competitiveness of labor, and intensive production methods as compared to more modern methods.
- Concentration of industry and hence pollution in specific areas which exacerbate localized environmental degradation and exceed the carrying capacity of the receiving bodies.
- Unplanned industrial development has resulted in several industries located within or close to residential areas, which adversely affects human health and quality of human environment.

- Establishment of industries at the cost of good agricultural lands and in the residential areas.

- Lack of incentives to industrialists to incorporate emission/discharge treatment plant in their industries.

2.3 NATIONAL LEGISLATION

2.3.1 Environment Conservation Act 1995 (ECA 1995)

Formal concern at the national level, for the state of environment in Bangladesh can be traced back to at least Independence and passing of the Water Pollution Control Act in 1973. Under this a small unit was established in the Directorate of Public Health Engineering (DPHE) to monitor pollution of ground water and surface water.

In order to expand the scope of environmental management and to strengthen the powers for achieving it, the Government issued the Environmental Pollution Control Ordinance in 1977. The ordinance provided for the establishment of an Environmental Pollution Control Board, which was charged with formulating policies and proposing measures for their implementation. In 1982, the board was renamed as Department of Environmental Pollution Control (DEPC). Four divisional offices were established in Dhaka, Chittagong, Khulna and Bogra. A special presidential order again renamed the DEPC to the Department of Environment (DOE) and placed under newly formed ministry of Environment and Forest (MoEF) in 1989.

The national environmental legislation known as **Environmental Conservation Act, 1995 (*ECA'95*)** is currently the main legislative document relating to environmental protection in Bangladesh, which repealed the earlier environment pollution control ordinance of 1997 and has been promulgated in 1995. The main objectives of ECA'95 are:

- Conservation and improvement of environment, and

- Control and mitigation of pollution of environment.

The main strategies of the act can be summarized as:

- Declaration of ecologically critical areas, and restriction on the operation and process, which can be carried, out or cannot be initiated in the ecologically critical areas.

- Regulation in respect of vehicles emitting smoke harmful for the environment.

- Environmental clearance

- Regulation of the industries and other development activities - discharge permit.

- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes.
- Promulgation of standard limit for discharging and emitting waste.

- Formulation and declaration of environmental guidelines.

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

A set of the relevant rules to implement the ECA' 95 has been promulgated (August 1997). The rules mainly consist of:

- 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 pollution activities of the existing or proposed industries/development projects/activities.

- Procedure for obtaining environmental clearance;

- Requirement for undertaking IEE and EIA as well as formulating EMP according to categories of industries/development projects/activities;

- Procedure for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.

The Rules incorporate "inclusion lists" of projects requiring varying degrees of environmental investigation.

Green: Industries/development projects/activities are considered relatively pollution-free and therefore do not require an environmental clearance certificate from the DOE and no environmental study.

Orange: Industries/development projects/activities fall into two categories. Orange "A" are less polluted and Orange "B" are moderately polluted required to submit general information, a process flow diagram and schematic diagrams of waste treatment facilities along with their application to DOE for obtaining environmental site clearance and environmental clearance.

Red: Industries/development projects/activities are those which may cause 'significant adverse' environmental impacts and are therefore required to submit an EIA report. It should be noted that they might obtain an environmental site clearance on the basis of an IEE report, and subsequently submit an EIA report for obtaining environmental clearance along with other necessary papers.

Environmental standards in operation in Bangladesh also Promulgated under the Environment Conservation Rules 1997. There are standards prescribed for varying water sources, ambient air, noise, odor, industrial effluent and emission discharges, vehicular emission etc.

The Bangladesh standards intend to impose restrictions on the volume and concentrations of wastewater/solid waste/gaseous emission etc. discharged into the environment. In addition a number of surrogate pollution parameters like Biochemical Oxygen Demand, or Chemical Oxygen Demand; Total Suspended Solids, etc. are specified in terms of concentration and/or total allowable quality discharged in case of waste water/solid waste. Additionally specific parameters depending on the manufacturing process are specified such as phenol, cyanide, copper, zinc, chromium etc. Air emission quality standards refer mostly to concentration of mass emission of various types of particulate, sulfur dioxide, and oxides of nitrogen and in some cases volatile organic compounds and other substances.

The Bangladesh standards in general are less stringent compared to the developed countries. This is in view to promote and encourage industrialization in the country. The Bangladesh standards are not for any specific period of time. There is no provision for partial compliance too.

The ambient standard of water quality, air quality and noise are presented in Table 2.1 to Table 2.5 in the following page. Standards refer to discharges to freshwater bodies with values in parentheses referring to direct discharges to agricultural land.

Table 2.1: Inland Surface Water Quality Standards

Best practice based Classification	P^H	BOD mg/l	DO mg/l	Total Coliform No./100
Source of drinking water for supply only after disinfecting	6.5-8.5	2 or less	6 or above	50 or less
Water usable for recreational activity	6.5-8.5	3 or less	5 or above	200 or less
Source of drinking water for supply after conventional treatment	6.5-8.5	6 or less	6 or above	5,000 or less
Water usable by fisheries	6.5-8.5	6 or less	5 or	-

			above	
Water usable by various process and cooling industries	6.5-8.5	10 or less	5 or above	5,000 or less
Water usable for irrigation	6.5-8.5	10 or less	5 or above	1,000 or less

Source: ECR- Schedule 3

Table 2.2: Standards for Waste from Industrial Units

Parameters	Unit	Inland Surface Water	Irrigated Land
Biological Oxygen Demand (BOD_5) at 20^0 C	mg/l	50	100
Chemical Oxygen Demand (COD)	mg/l	200	400
Dissolve Oxygen (DO)	mg/l	4.5-8	4.5-8
Total Dissolved Solids (TDS)	µmho/cm	2,100	2,100
P^H		6-9	6-9
Suspended Solid (SS)	mg/l	150	200
Chloride	mg/l	600	600
Iron	µmho/cm	2	2

Source: ECR- Schedule 10

Table 2.3: Ambient Air Quality Standards

AIR POLLUTANT	STANDARDS	AVERAGE TIME
1	2	3
Carbon Monoxide (CO)	10 mg/m^3 (9 ppm) (Ka)	8-hour
	40 mg/m^3 (35 ppm) (Ka)	1-hour
Lead (Pb)	0.5 µg/m^3	Annual
Oxides of Nitrogen (NO_x)	100 µg/m^3 (0.053 ppm)	Annual
Suspended Particulate Matter (SPM)	200 µg/m^3	8-hour
PM_{10}	50 µg/m^3 (Kha)	Annual
	150 µg/m^3 (Ga)	24-hour
$PM_{2.5}$	15 µg/m^3	Annual
	65 µg/m^3	24-hour
Ozone (O_3)	235 µg/m^3 (0.12 ppm) (Gha)	1-hour
	157 µg/m^3 (0.08 ppm)	8-hour
Sulfur di Oxide (SO_2)	80 µg/m^3 (0.03 ppm)	Annual
	365 µg/m^3 (0.14 ppm) (Ka)	24-hour

Source: ECR- Schedule 2 (Amended in 2005)

Abbreviation: ppm: Parts Per Million
Notes:

(Ka) Not to be exceeded more than once per year
(Kha) Annual average value will be less than or equal to 50 microgram/cubic meter
(Ga) Average value of 24 hours will be less or equal to 150 microgram/cubic meter for one day each year.
(Gha) Maximum average value for every one hour each year will be equal or less than 0.12 ppm.

At national level, sensitive areas include national monuments, health resorts, hospitals, archaeological sites and educational establishments.

Table 2.4: Standards for Gaseous Emission from Industries

Parameters for power plant (<200 MW)	Standard present
Particulate	350 mg/Nm^3
Oxides of Nitrogen	30 ppm

Source: ECR- Schedule 11

Table 2.5: Ambient Noise Standards

Areas	Day Time dBa	Night Time dBa
Silence Zone: Zone A	50	40
Residential Area: Zone B	55	45
Mixed Activity Area: Zone C	60	50
Commercial Area: Zone D	70	60
Industrial Area	75	70

Source: ECR- Schedule 1 (Amendment in 2006)

The second column of limits values refer to day time (06.00 to 21:00) and the third column to night time (21.00 to 06.00). A silence zone is defined as an area within 100m, around hospitals or educational institutions.

2.4 World Bank Group's Operation Policies, Guidelines and Performance Standards

2.4.1 Environmental and Social Guidelines of the World Bank

The World Bank procedures for EA study cover policies, guidelines and good practices. Such guidelines therefore follow the national best practices in undertaking any development project in Bangladesh. The environment safeguards policies applicable to the proposed project are the following:

• *Environmental Assessment (EA) (OP 4.01/BP/GP 4.01)*: An Environmental Assessment is conducted to ensure that IFC-financed projects are environmentally sound and sustainable, and that decision-making is improved through appropriate analysis of actions and of their likely environmental impacts. Any IFC-funded project that is likely to have potential adverse environmental risks and impacts in its area of influence requires an EA indicating the potential risks, mitigation measures and environmental management framework or plan.

• *Natural Habitats (OP/BP 4.04)***:** Natural habitats are land and water areas where most of the original native plant and animal species are still present. Natural habitats comprise many types of terrestrial, freshwater, coastal, and marine ecosystems. They include areas lightly modified by human activities, but retaining their ecological functions and native species. The Natural habitats policy is triggered by any project (including any subproject under a sector investment or financial intermediary loan) with the potential to cause significant conversion (loss) or degradation of natural habitats, whether directly (through construction) or indirectly (through human activities induced by the project). The policy has separate requirements for critical (either legally or proposed to be protected or high ecological value) and non-critical natural habitats. World Bank's interpretation of "significant conversion or degradation" is on a case-by-case basis for each project, based on the information obtained through the EA.

• *Forestry (OP/GP 4.36)*: This policy is triggered by forest sector activities and World Bank sponsored other interventions, which have the potential to impact significantly upon forested areas. The World Bank does not finance commercial logging operations but aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty and encourage economic development.

• *Cultural Property (OPN 4.11)*: Physical cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above ground, underground, or underwater. The

Bank seeks to assist countries to manage their physical cultural resources and to avoid or mitigate adverse impact of development projects on these resources. This policy is triggered for any project that requires an EA.

• *Policy on Disclosure of Information, 2002*: There are disclosure requirements at every part of the project preparation and implementation process. Consultation with affected groups and local community should take place during scoping and before Terms of references (ToRs) are prepared; when the draft EA is prepared; and throughout project implementation as necessary. The Borrower makes the draft EA and any separate EA report available in country in a local language and at a public place accessible to project-affected groups and local community prior to appraisal.

2.4.2 IFC Performance Standards

IFC has set out 8 (eight) performance standards in respect of various parameters pertaining to a proposed project. These eight performance standards of IFC with their corresponding parameters as under:

• Performance Standard 1: Social and Environmental Assessment and Management System

• Performance Standard 2: Labour and Working Conditions

• Performance Standard 3: Pollution Prevention and Abatement

• Performance Standard 4: Community Health, Safety and Security

• Performance Standard 5: Land Acquisition and Involuntary Resettlement

• Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management

• Performance Standard 7: Indigenous Peoples

• Performance Standard 8: Cultural Heritage.

Of the above eight performance standards set by IFC, the Performance Standard 1 envisages establishing the importance of: (i) integrated assessment to identify the social and environmental impacts, risks and opportunities; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client's management of social and environmental impacts throughout the life of the project. The rest seven of the performance standards, i.e., Performance Standards 2 through 8 seek to ascertain

establishing requirements to avoid, reduce, mitigate or compensate the impacts on people and the environment, and to improve conditions where appropriate.

2.4.3 World Bank OP 4.12 (Involuntary Resettlement)

The project interventions do not require acquisition of private lands and displace people from the main power plant area, approach road and transmission line. The power plant site and approach road (6.98 acre) was acquired in 2010 by Rural Electrification Board and paid compensation to all of the land owners. The land was handed over to the DSPGL in February 2013. The land was fully free from encumbrance and no physical displacement took place due to project interventions. The transmission line is passing through a market place and few settlements along the LGED road and RHD road but the proposed alignment of transmission line will not displace any of the house or shops. Some of the trees planted beside the LGED road and RHD road will need to be fell down during stinging of the evacuation line. These trees are on the government land and no private owners claimed ownership. The project thus does not trigger the World Bank Operational Policy (OP) 4.12 on Involuntary Resettlement that requires that the economic, social, and environmental risks out of involuntary resettlement are mitigated and livelihoods of the financially displaced persons are restored. Compensation for the acquired land was paid at replacement value and affected people expressed their satisfaction on the price of land so far paid to them through DC office, Dhaka. Involuntary resettlement may cause severe long term hardship, impoverishment, and damage unless appropriate measures are carefully planned and carried out. For these reasons, the overall objectives of the policy of involuntary resettlement (OP 4.12) are the following:

(a) Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.

(b) Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits.

(c) Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.

(d) Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

The policy requires that the following measures are taken to achieve the above objectives:

(a) The resettlement plan includes measures to ensure that the displaced persons are
   i. informed about their options and rights pertaining to resettlement;
   ii. consulted on, offered choices among, and provided with technically and economically feasible resettlement alternatives; and
   iii. provided prompt and effective compensation at full replacement cost for losses of assets attributable directly to the project.

(b) If the impacts include physical relocation, the resettlement plan or resettlement policy framework includes measures to ensure that the displaced persons are
   i. provided assistance (such as moving allowances) during relocation; and
   ii. provided with residential housing, or housing sites, or, as required, agricultural sites for which a combination of productive potential, convenient re-location sites, and other factors is at least equivalent to the advantages of the old site.

(c) Where necessary to achieve the objectives of the policy, the resettlement plan also include measures to ensure that displaced persons are
   i. offered support after displacement, for a transition period, based on a reasonable estimate of the time likely to be needed to restore their livelihood and standards of living; and
   ii. provided with development assistance in addition to compensation measures such as land preparation, credit facilities, training, or job opportunities.

2.4.4 World Bank OP 4.10 (Indigenous People)

There is no indegious people in the project area and no one has been affected by the proejct interventions. Therefore, World Bank OP 4.10 does not trigger in this project.

2.4.5 Environmental, Health, and Safety Guidelines for Thermal Power Plants

The Environmental, Health, and Safety (EHS) Guidelines of the WB group are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). This document on thermal power plants (IFC 2008) includes information relevant to combustion processes fueled by gaseous, liquid and solid fossil fuels and biomass and designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type (except for solid waste which is covered under a separate Guideline for Waste Management Facilities), with a total rated heat input capacity above 50 Megawatt thermal input (MWth) on Higher Heating Value (HHV) basis. It applies to boilers, reciprocating engines, and combustion turbines in new and existing facilities. Annex A contains a detailed description of industry activities for

this sector, and Annex B contains guidance for Environmental Assessment (EA) of thermal power projects.

2.5 ENVIRONMENTAL CLEARANCE

Formal EIA guidelines in Bangladesh are set out in “Rules and Regulations under the 1995 Environmental Protection Acts” as published in the official Gazette on August 27, 1997. Any proponent planning an industrial project is currently required under Paragraph 12 of the Environmental Protection Acts, 1995 to obtain “environmental clearance letter:” from the Department of Environment.

The first to obtain environmental clearance is for the project proponent to complete & submit an application form which may be obtained from the appropriate DoE regional offices as per the category. The application is accompanied by other supporting documents (i.e. project profile, lay-out plan, NOC from local authority, Govt fees etc.) reviewed by the divisional and district offices of DOE who has the authority to request supporting documents as applicable. The divisional office has the power to take decision on Green and Amber-A & B category projects and the Red category projects are forwarded to head office for approval. The proposed projects receive an environmental site clearance at the beginning and the environmental clearance subject to the implementation of the project activities and all mitigation measures suggested in the IEE report or in the application. In case of Red category, the client needs to submit an IEE report for site clearance and EIA to obtain EIA approval and environmental clearance.

2.6 POWER SCENARIO AND MASTER PLAN IN BANGLADESH

Power and energy are vital factors that determine the growth path of a developing country like Bangladesh whereas; electricity is the major source of power for country's most of the economic activities. Consistent supply of power and energy can ensure development of the economy. Nonetheless the huge demand supply gap prevailing in the power sector has turned out to be a hurdle for the economic expansion of the nation.

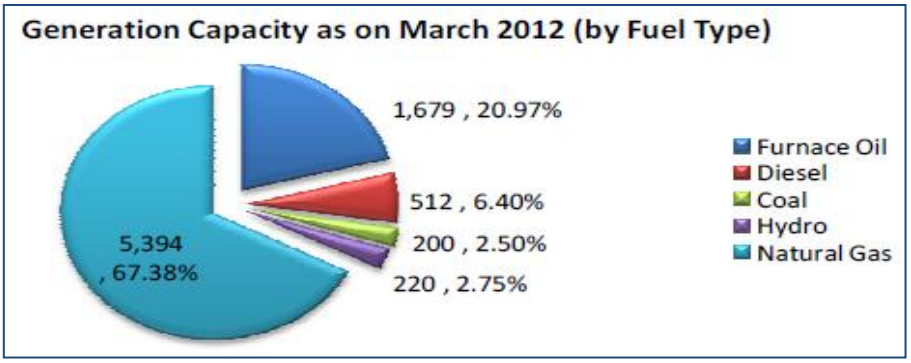
The per capital electricity consumption in Bangladesh remains one of the lowest in the Asian region, At present, only about 47% of the total population of Bangladesh has access to electricity. Even though power has reached many urban areas, approximately 53,000 of the 68,000 villages are connected to power. Further, one million retail electricity connections are pending. The contribution of power sector to GDP ratio has been stagnant around 1.3% for last 5 years with the power generation being increased annually by 2.8% during this period. The majority of power produced in the country is used for commercial purposes. Hence, the electricity supply to households remains delicate which is also a politically sensitive issue. The demand for electricity in the rural areas has experienced significant growth over the years mainly driven by agriculture

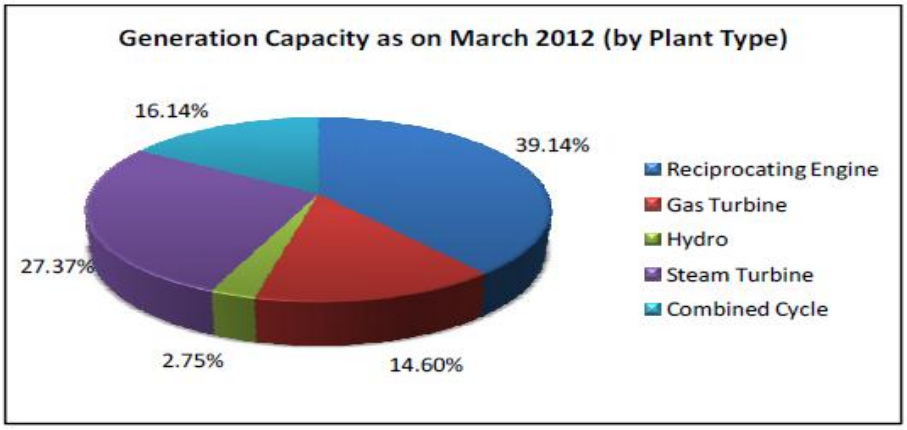
and small & medium enterprises.

According to Bangladesh Power Development Board (BPDB) presently the installed capacity as on July 2012 in the power sector is 6,693.00 MW, whereas the derated generation capacity is 6,061.00 MW. According to a demand projection analysis, the peak electricity demand is more than 7000 MW in 2012 and 7400 MW in 2013. So, still there is a gap between supply and generation of electricity. The generation capacities on basis of fuel type and plant type as on March 2012 and installed capacities as on December 2011 are shown in the charts below.

Because of the critical nature, the Government of Bangladesh has given highest priority to the power sector to enhance the generation capacity. BPDB has come up with a comprehensive plan to meet the surging demand in power. Accordingly, the government plans to eliminate the demand supply gap by the end of 2012 and achieve the ultimate goal of providing "electricity to all" by 2021 by having generation capacity of 20,000 MW. To ensure overall and balanced development of the sector government has devised immediate, short term, medium term and long term generation plans. The plans have been developed based on a techno-economic analysis and least cost options. Accordingly, the generation capacity would triple to 13,554MW by 2016.

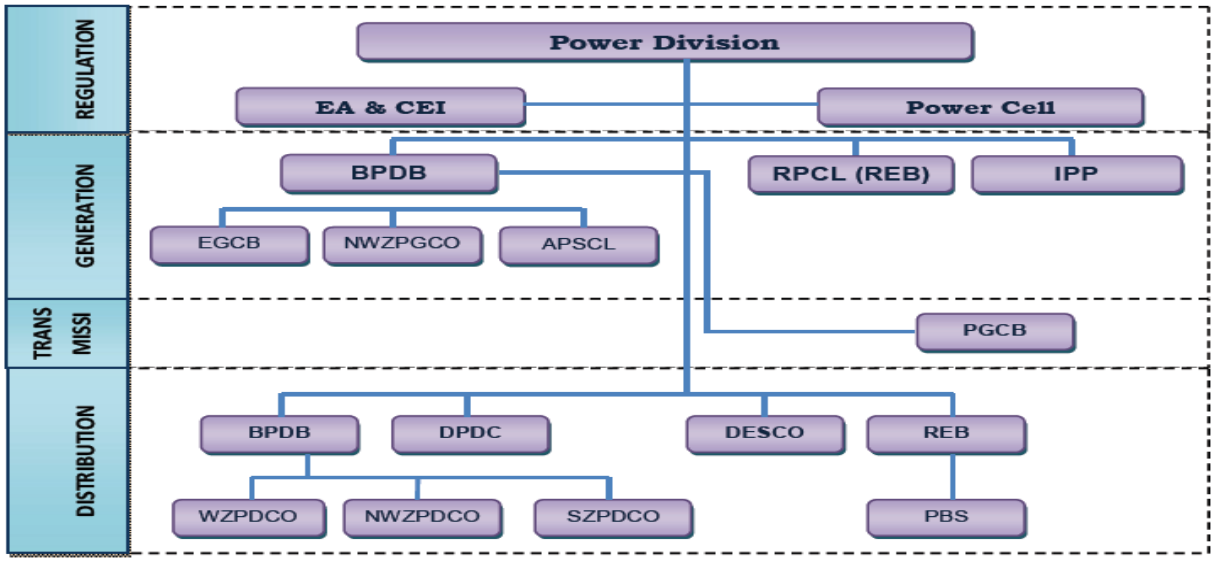
However, the timely implementation of above plans is a concern as there are issues with regards to availability of finance, competency of project sponsors and inherent bureaucracies and other bottlenecks in the system. Further, the demand estimates for power may also be understated to some extent. Strategies have been made to meet the investment requirement by involving private sector with Government through Public Private Partnership (PPP) initiatives. A successful IPP model has been designed with a lot of comforts and protection to investors.





2.7 INSTITUTIONAL STRUCTURE OF POWER SECTOR IN BANGLADESH

Power Division is responsible for formulating policy relating to power and supervise, control and monitor the developmental activities in the power sector of the country. To implement its mandate, the Power Division is supported by a number of organizations, related with generation, transmission and distribution. The overall organizational structure and linkage is shown below:



Chapter 3
Description of the Proposed Project

Chapter-3

DESCRIPTION OF THE PROPOSED PROJECT

3.0 DESCRIPTION OF THE PROPOSED PROJECT

3.1 TYPE AND CATEGORY OF THE PROJECT

The Dhaka Southern Power Generations Ltd. (DSPGL) has made a Power Purchase Agreement with its buyer, Bangladesh Power Development Board (BPDB) and obtained Environmental Site Clearance Certificate from Department of Environment (DoE) vide letter No.30.26.72.4.100.060513/admin/clearance/26; Date: 30.07.2013. The plant will consist of 3 units of highly efficient MAN HFO Generator sets and a steam co-generation system operated with waste heat from the HFO engines to supply to the national grid at Dhaka. The plant will be equipped with a FGD (Flue gas desulfurization) system to reduce SO_2 emission by about 90%.

There are no particularly sensitive ecological, cultural and archeological sites in the area. The plant will not involve any relocation of human settlement, as the project is situated on the purchased vacant land of private individuals based on willing sellers and buyer negotiations without any undue influence from the buyer. A declaration by the buyer (DSPGL) on this is given in annex-13 the land ownership documents showing land records before (i.e., by the sellers) and after the transfer (i.e., to DSPGL) are also given (referred to Khatians) in the annex-13. The area enjoys necessary infrastructure facilities, which include transport, electricity, telecommunication etc. For all construction activities for the plant, the provisions of Bangladesh National Building Code (BNBC) have been followed that include structural designs and seismicity tolerance. All the relevant social and environmental risks and potential impacts have been taken due care of as part of the assessment in compliance of the Performance Standards set by the World Bank besides following the guidelines set forth by DoE.

The basic data of the Dhaka Southern Power Generations Limited are furnished in Table-3.1

Table-3.1: Basic data on **Dhaka Southern Power Generations Limited:**

1. Name of the Project	Nababganj 55 MW Power Plant
2. Project Proponent	Tahzeib Alam Siddique
3. Project Location	Daulatpur, Nawabganj, Dhaka, Bangladesh
Corporate Office	House # 426, Flat #D, Road # 30, New DOHS, Mohakhali, Dhaka-1206
Main Sponsor	Doreen Power Generations and Systems Ltd. Rupali Engineers and Traders Ltd.
4. Type of Business	Power Generation
5. Raw Materials	The main raw material of the project is HFO (Furnace Oil)
6. By-product, if any	None
7. Net Plant Capacity	55 MW
8. Project Cost	BDT 3516.11 Million
9. Total Area of Land	7 Acres
10. Total Covered Area	6.98 Acres
11. Total Developed Land	7 Acres
12. Employment	Administration -15, Production - 47 and Environmental Management - 3 Total 65 Persons
13. Fuel Requirement	Heavy Fuel Oil (furnace oil), 68.80 million liter/year, Imported
14. Water Requirement	100m^3/day, Deep well

3.2 SITE DESCRIPTION

3.2.1 Location of the Project

The proposed power plant will be set up at Daulatpur, Nababganj, Dhaka, and in the land of REB. There is a school as well as a graveyard to the north-west & north-east side of the proposed project respectively. The access road from the Kailail Union road to the project is in between the graveyard and the High school playground. There are agricultural lands on the West side and south side of the project area. There are some scattered settlements at the north-east, east and south east of the project area near the road side. All infrastructure facilities like electricity, labour, telecommunication, etc. are available at the project site. The Proposed palton jetty including all infrastructures will be constructed at the bank of Dhaleshwari River which is situated at the north-east side of the proposed project. The location is well communicated by both road and river ways. The site covers an area of 7 acres of land. The location of the project is shown in different maps in Fig 3.1(a), 3.1(b) & 3.1(c). The satellite map of the project site is shown in figure 3.1 (d) & 3.1(e).The location map is shown in fig 3.1 (f) also. The Project layout plan is presented in Annexure – 1.

Fig: 3.1(a): Location of Dhaka Southern Power Generations Limited in South Asia with respect to Bangladesh

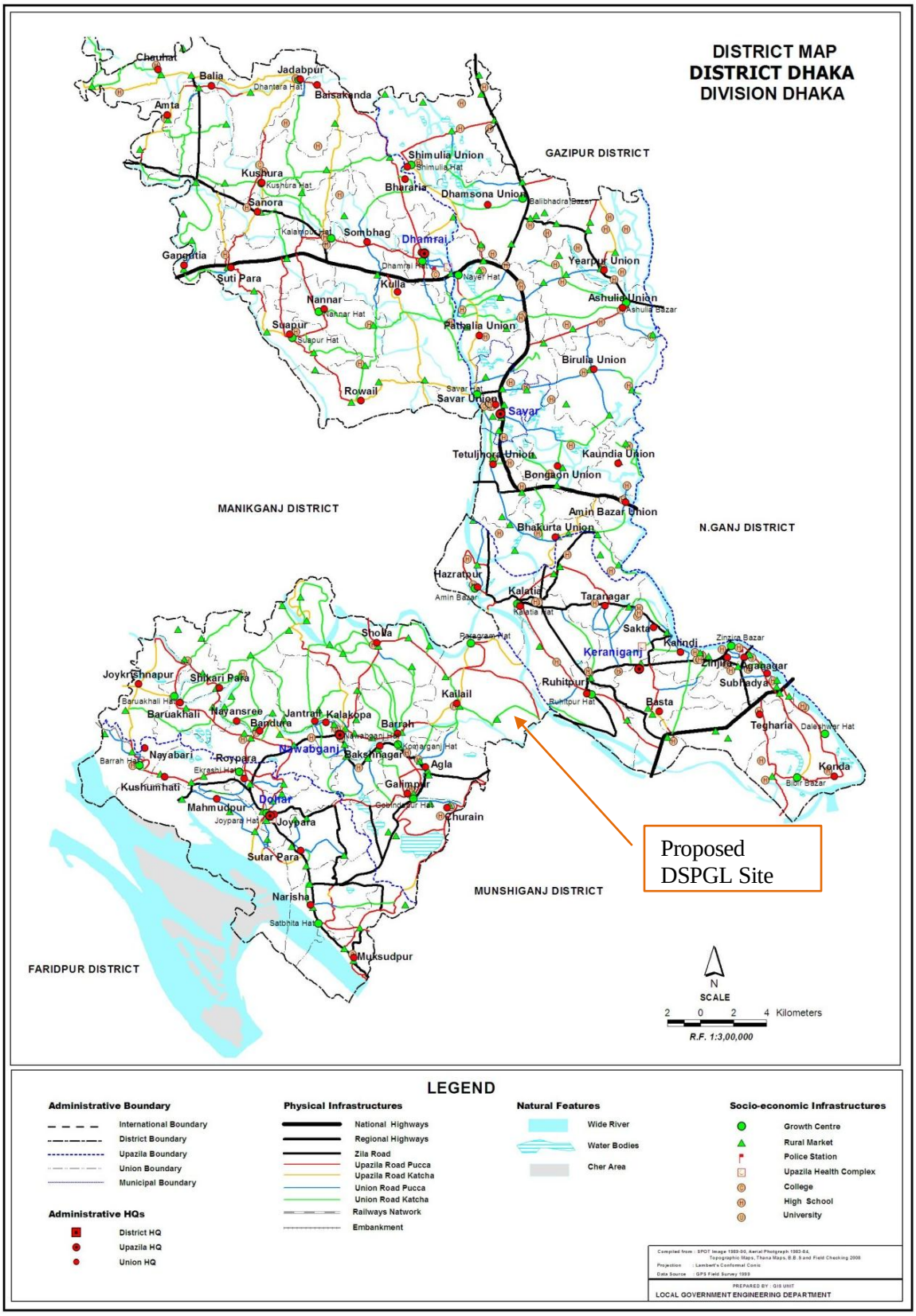


Fig: 3.1(b) Location of Dhaka Southern Power Generations Limited within Dhaka District

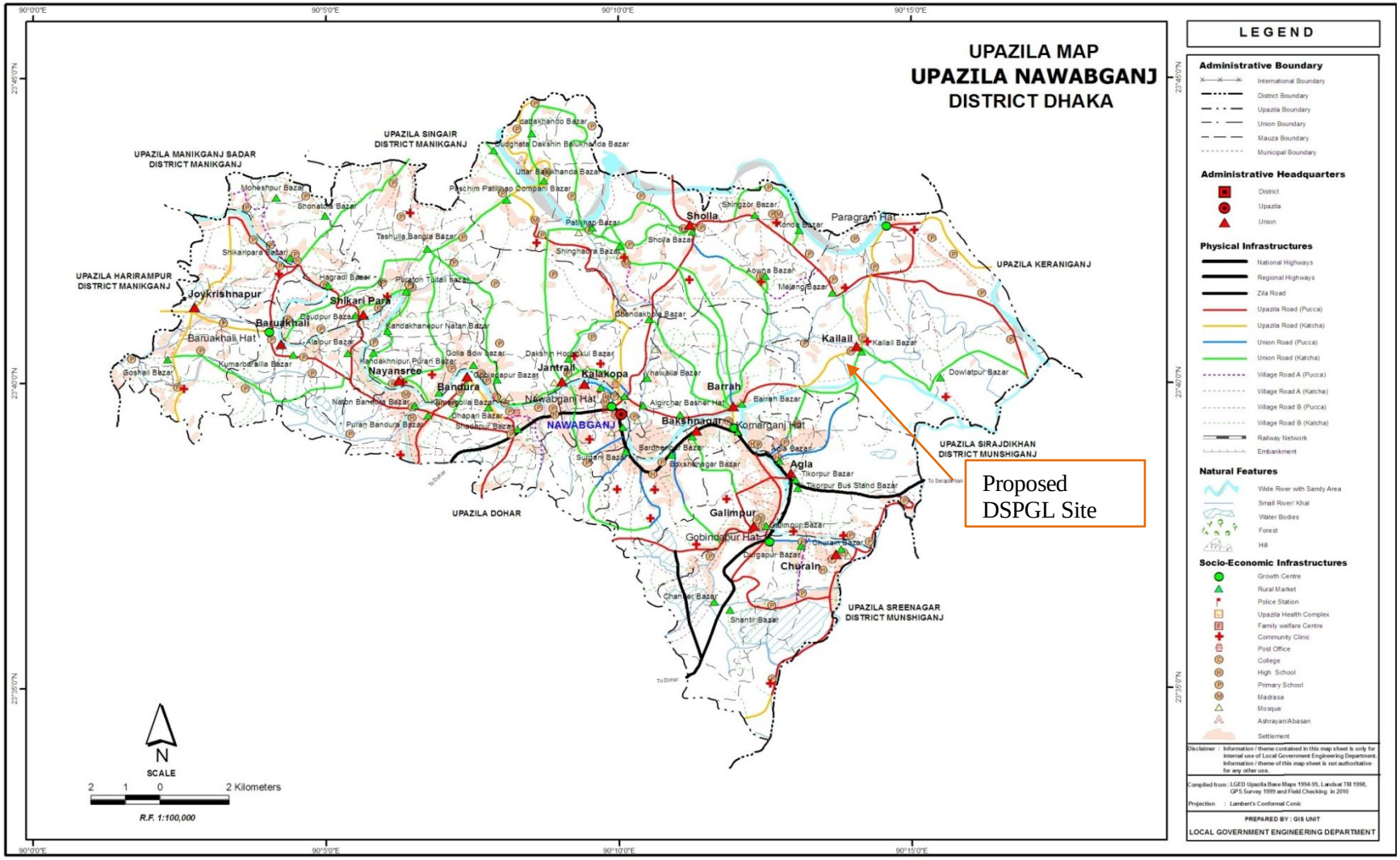


Fig: 3.1(c) Location of Dhaka Southern Power Generations Limited within Nawabganj Upazila

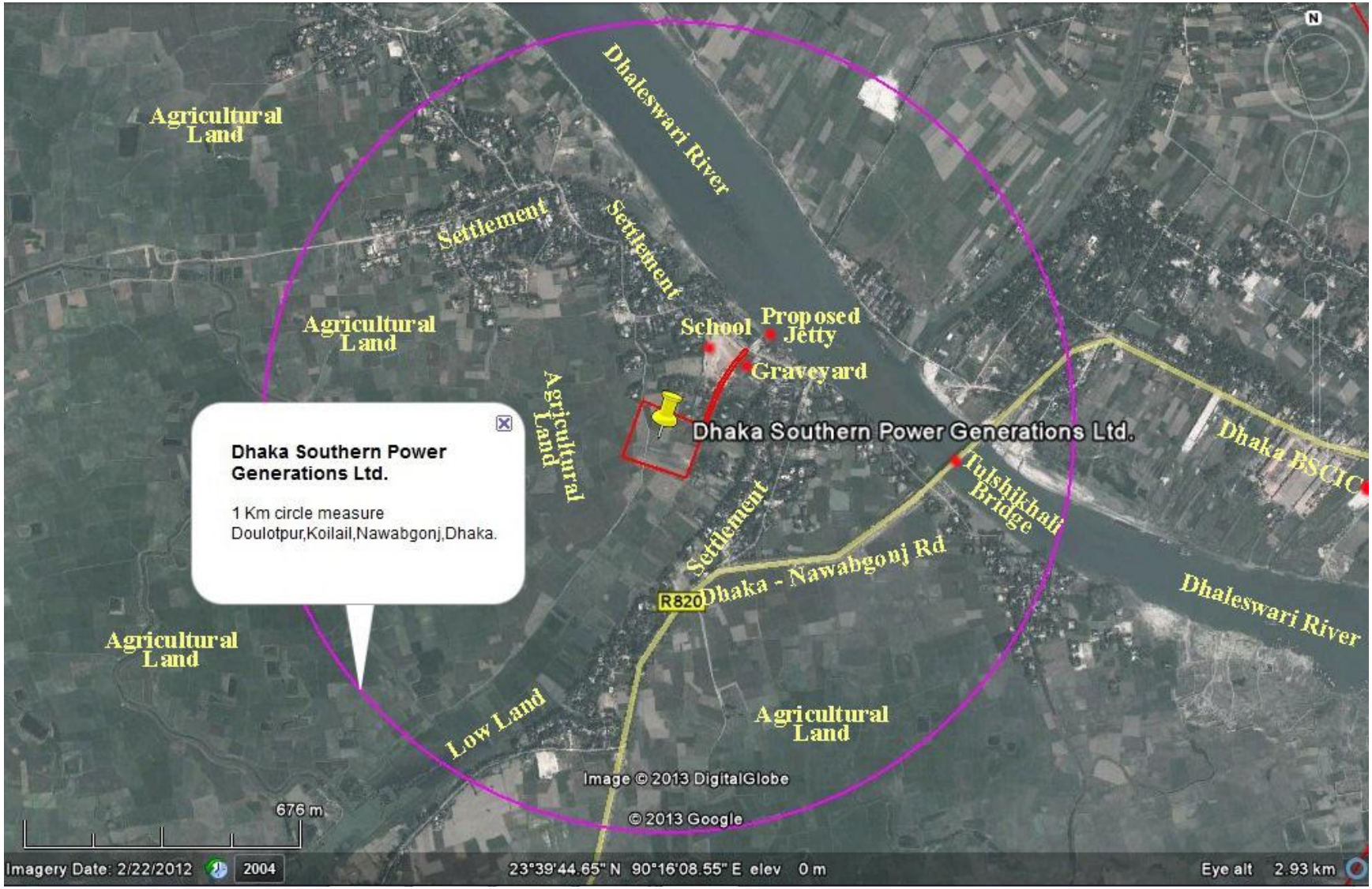


Fig: 3.1(d) Satellite Map of the Proposed Location of Dhaka Southern Power Generations Limited

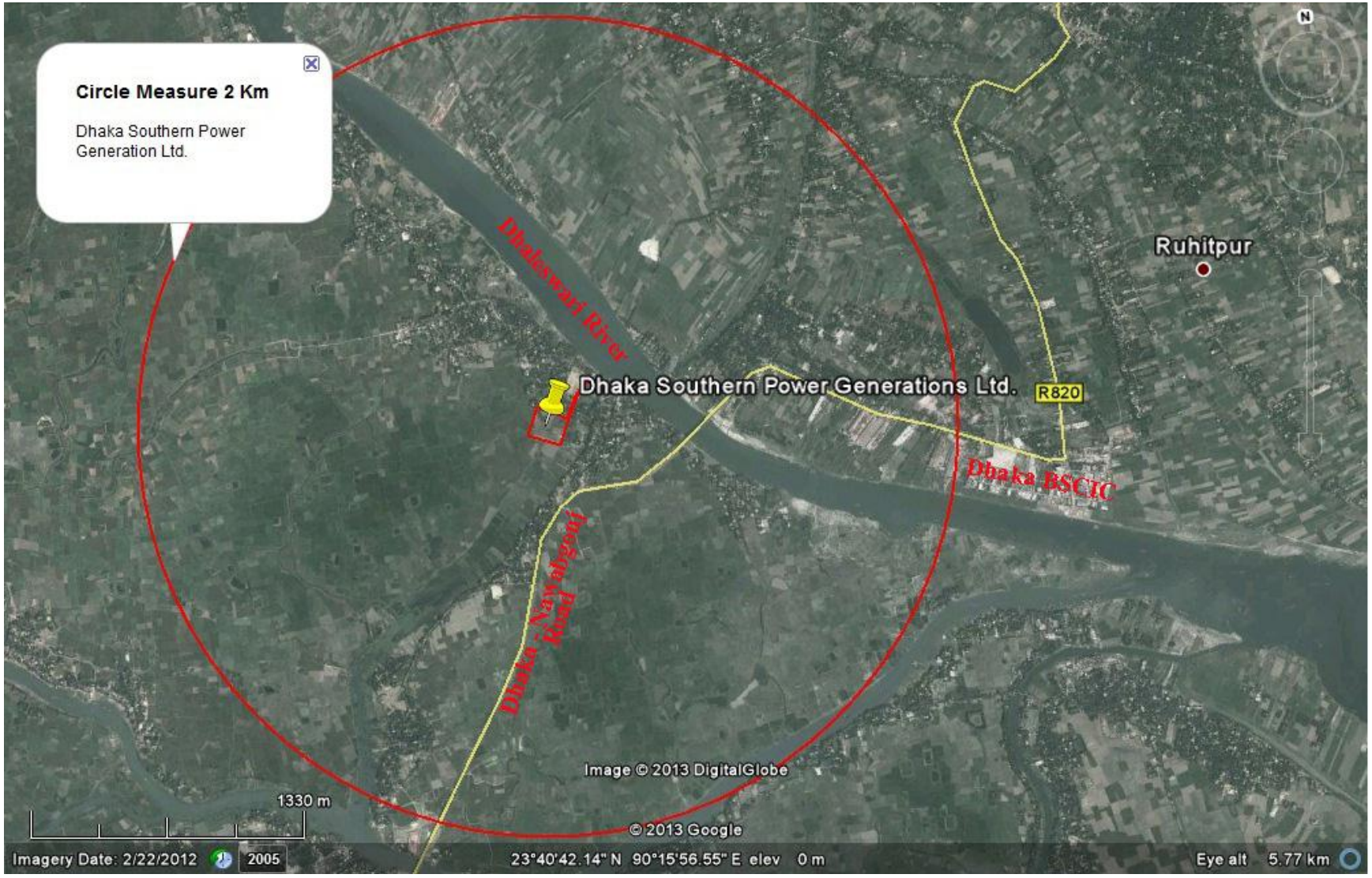


Fig: 3.1(e) 2 km Radius Satellite Map of the Proposed Location of Dhaka Southern Power Generations Limited

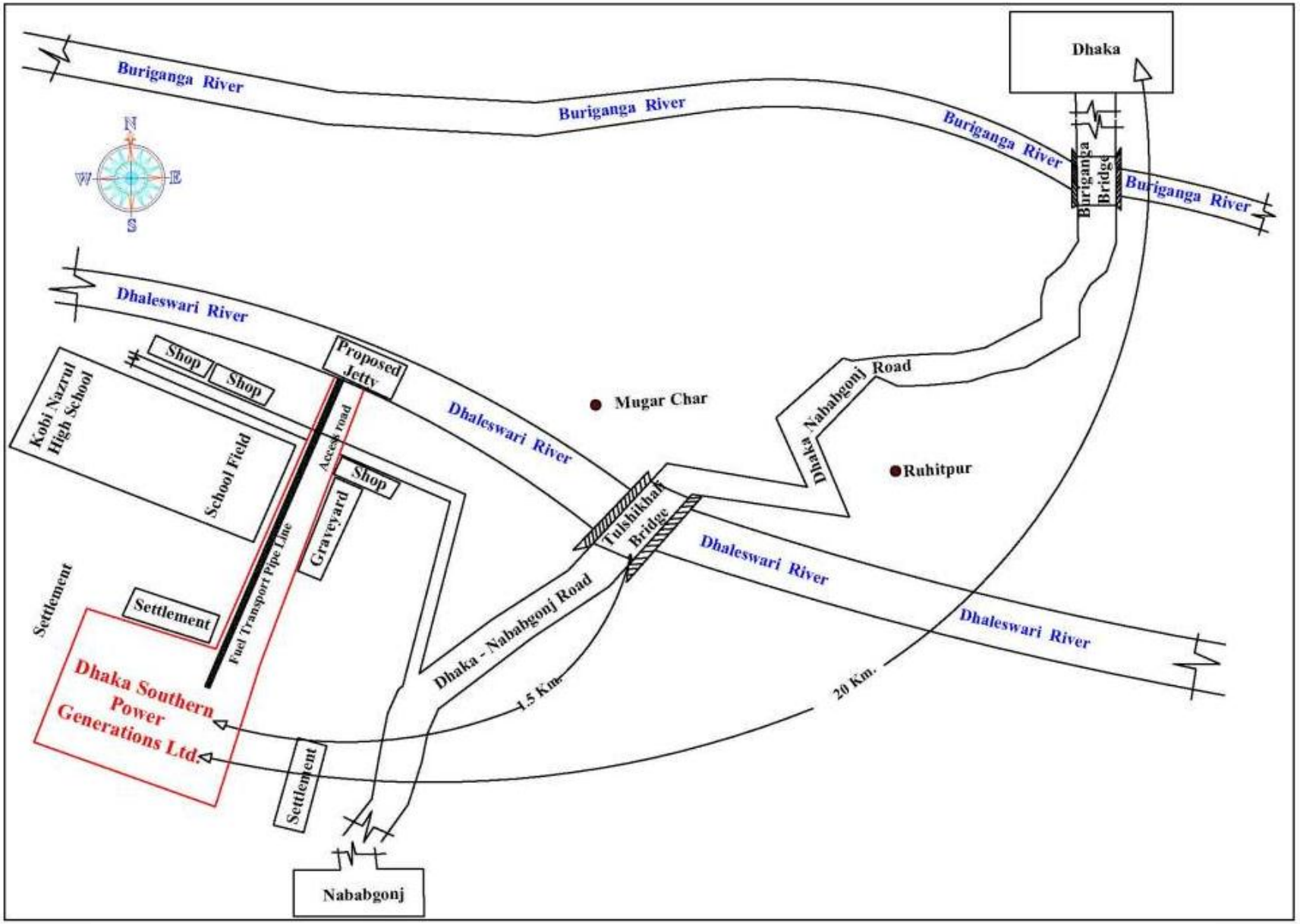
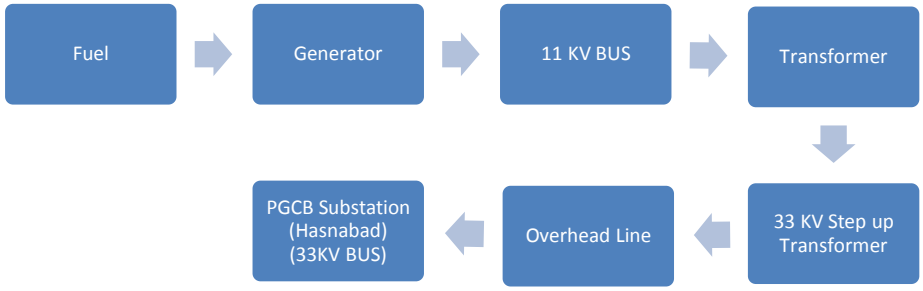


Fig: 3.1(f): Location Map of Dhaka Southern Power Generations Limited

3.2.2 Electrical Interconnection for power Evacuation

The DSPGL plant output evacuating power will be of 33KV from the plant's 33KV Sub-station, which will be hooked to the 33/132KV Hasnabad Sub-station of Bangladesh Power Development Board (BPDB) through a 4.4Km overhead transmission line with all other accessories (Breaker, Isolator etc.). The transmission will be brought through the side of the road side from the project to the Hasnabad sub station. So, there is no relocation of homestead needed. The IF will be connected to the Delivery Point by two no. of 33 kV lines (including switchyard) each capable of carrying 100% of the Net Energy Output of the generating plant. At 33 kV Outgoing Bus (from where interconnection line shall start), necessary circuit breaker including the associated 33 kV interconnection line will be required. The electrical interconnection transmission line would be constructed by DSPGL.

Electrical interconnection facility is shown in a flow diagram-



3.2.3 Fuel Transportation

DSPGL is responsible for fuel (HFO) receiving, handling and transportation up to the facility from the jetty of river Dhaleshwary. All arrangements required for the supply of liquid fuel to the facility including construction of jetty (if required), necessary arrangement, pipe line up to the storage facility along the road, fuel measuring system, internal fuel supply system, fuel heating and purification/treatment system as per requirement of the offered plant will be installed by the proponent at its own cost and responsibility. Maximum consumption of fuel is = 64,63,752 Lt/month. Fuel will be transported by Barge (flat bottom) with a capacity of 1500 ton and it will require maximum of 5 times unloading of a barge in a month. Detail information about the palton (jetty) has been attached in the annexure 20. Lighter vessel will be used for the transportation of fuel oil from mother vessel at Chittagong port outer anchorage to Power Plant jetty. The pipeline length from Jetty to Power Plant Storage is approx.-1159 feet, 12" Dia. and wall thickness- 10.4mm.

3.2.4 Topography of the Site & Surrounding Land

The proposed Dhaka Southern Power Generations Ltd. (DSPGL) plant will be set up at Daulatpur, Nawabganj, Dhaka. The proposed project site is located at mouza of Doulatpur, Union Kailail, Upazilla Nawabganj, Dhaka. The proposed project would be set up in the land of REB. The River Dhaleshwari, situated in the North and east side to the project. The location is well communicated by road and river ways. The site covers an area of 6.98 acres of land. The surrounding terrain is a low land seasonally flooded during rainy season. There is not much industrial set up with 5 km radius except the Keraniganj BSCIC which is situation at 3 km east to the project site. The entire area surrounding the project is almost rural in nature.

3.3 PROJECT ACTIVITY

3.3.1 Site Development & Construction

3.3.1.1 Site Preparation

Site preparation would comprise the partial land filling and compaction in around 7 acres of land prior to construction a 300mm thick carpet of crushed stone should be spread in the lay-down areas and on the working surface. All known underground services should be flagged up and all redundant services coming onto the site should be blanked off and removed.

3.3.1.2 Piling

The proposed power plant is being founded on piles. The piles could be bored, augured or driven and the type will depend upon the geotechnical data available. However given the close location of existing generating plant it is anticipated that the piles will be of a type which could be installed with the minimum of disturbance to existing equipment. This would imply bored or augured piles rather than driven types.

Design load tests should be made on test piles for design purposes (design piles). Design piles are normally loaded until the failure of the bearing soil as an aid to the pile design in similar conditions.

3.3.1.3 Foundations

Foundations should be designed to British Standard Code of Practice BS 8004 or equivalent Bangladesh National Building Code. The design of foundations for all structures and equipment are to be such that differential and total settlements or other movements should not exceed acceptable limits and ensure safe and maintenance free operation of the plant.

Detail design parameters for the civil works would be provided by the relevant consultant. The nature of the fill material and the construction techniques used should be such that the less heavily loaded equipment and the buildings may be founded on rafts or spread footings.

3.3.1.4 Roads

The roads should be designed to be capable of carrying all the vehicles likely to be used during construction and throughout the life of the plant including articulated vehicles and transporters used for the removal and replacement of major items of the plant.

Car parking and hard standing areas should be of similar construction to the roads. The road pavements should be of reinforced concrete and in conformity with relevant British or equivalent Bangladesh National Code of Practice.

Fig 3.2: Present Status of the Project Site

3.3.1.5 Drainage

It is recommended that the surface water and foul drainage systems should be separate and should be designed in accordance with BS EN 752 Parts 1 to 4 "Drain and sewer systems outside buildings". Manhole and chamber covers should be heavy duty throughout.

Surface Water Drainage

The capacity of the surface water drainage system should be sufficient to deal with a storm return period of 1 in 5 years. The surface water drainage should include all necessary gutters, down pipes, gullies, traps, catch pits, manholes etc. The quality of the discharge shall be acceptable in all respects to the local water and environmental authorities.

Foul Water Drainage

All sewage drainage should be taken to a septic tank. A septic tank is a long retention time tank where solids deposit out in an anaerobic bottom layer. The capacity of the septic tank is sufficient to cater for the normal and incidental load arising from the power station. The septic tank should be connected to a soak way by means of an overflow pipe whereby the liquid effluent can be drained.

3.3.1.6 Power Station Buildings

The various buildings comprising the works should have a common architectural concept in order to unify the various elements and should be suitable for the operating and climatic conditions at site. The design should make selective use of materials to produce a pleasing concept throughout and a working environment, which is safe, durable and functional.

The dimension of all the buildings should be such as to provide generous space for the safe installation and proper operation and maintenance of the plant and its equipment. In particular generous space should be provided immediately in front of, behind and beside all items of the plant.

In all rooms or buildings housing switchgear, a clear working space should be provided around switchboards of at least 1.0 m behind and in front of the fully withdrawn trucks.

It is recommend that the floors should be constructed in reinforced concrete and designed to accommodate all foreseeable static and dynamic loads. They should be provided with surface finish appropriate for their intended usage and properly drained

bounded areas should be provided wherever necessary to contain accidental spillage of oil or other harmful liquids.The design of all buildings must ensure that noise, vibration and temperature levels are within permissible limit.

3.3.1.7 Sub-station

Transformer compounds should be constructed with oil containment facilities. Compounds should each be provided with suitable fencing and a lockable access gate. Fences to transformer compounds and other electrical areas within the site boundary should be of 2.4 m minimum height.

The tank should be fitted with a suitable overflow system, air vents, access hatches, ladders, a sump and a means of emptying the tank.

3.3.1.8 Site Fencing

A security fence should be provided around the permanent boundary of the site that should be 3 m high above the site formation level.

Gates should be fabricated from galvanized steel and as a minimum provide the same level of security as the perimeter fence. All gates should be provided with suitable locking devices.

3.4 EQUIPMENT & PROCESS FLOW

3.4.1 Power Generation Method

The Dhaka Southern Power Generations Limited is an HFO based IPP power plant of installed capacity 57.9 MW. However, the declared capacity of the power plant is 55 MW as per the PPA with the Bangladesh Power Development Board.

The plant is powered by 3 engines from the world renowned MAN Company, each of capacity 19.3 MW. Besides, the plant will have a Co-generation unit consists of Superheated Steam boiler and steam turbine to produce 2.35 MW electricity. The 2.35 MW Cogeneration Steam Turbine Plant will have a Cooling Tower to supply water to the steam condensation unit. The flue gas coming out from the waste heat boiler will be passed through the Flue Gas De-sulpherisation Plant (FGD) to reduce the sulpher di-oxide emission through the stack.

A small portion of the produced electricity will be consumed by all electrically operated machinery and for lighting of the plant. All the system of the plant is being installed as per the design, drawing and guide lines by the Original Equipment Manufacturer (OEM) and complying the Standards as set by the OEM. The engines are started by High Pressure Air. The process flow chart of the Dhaka Southern Power Generations Limited is given in Fig 3.4

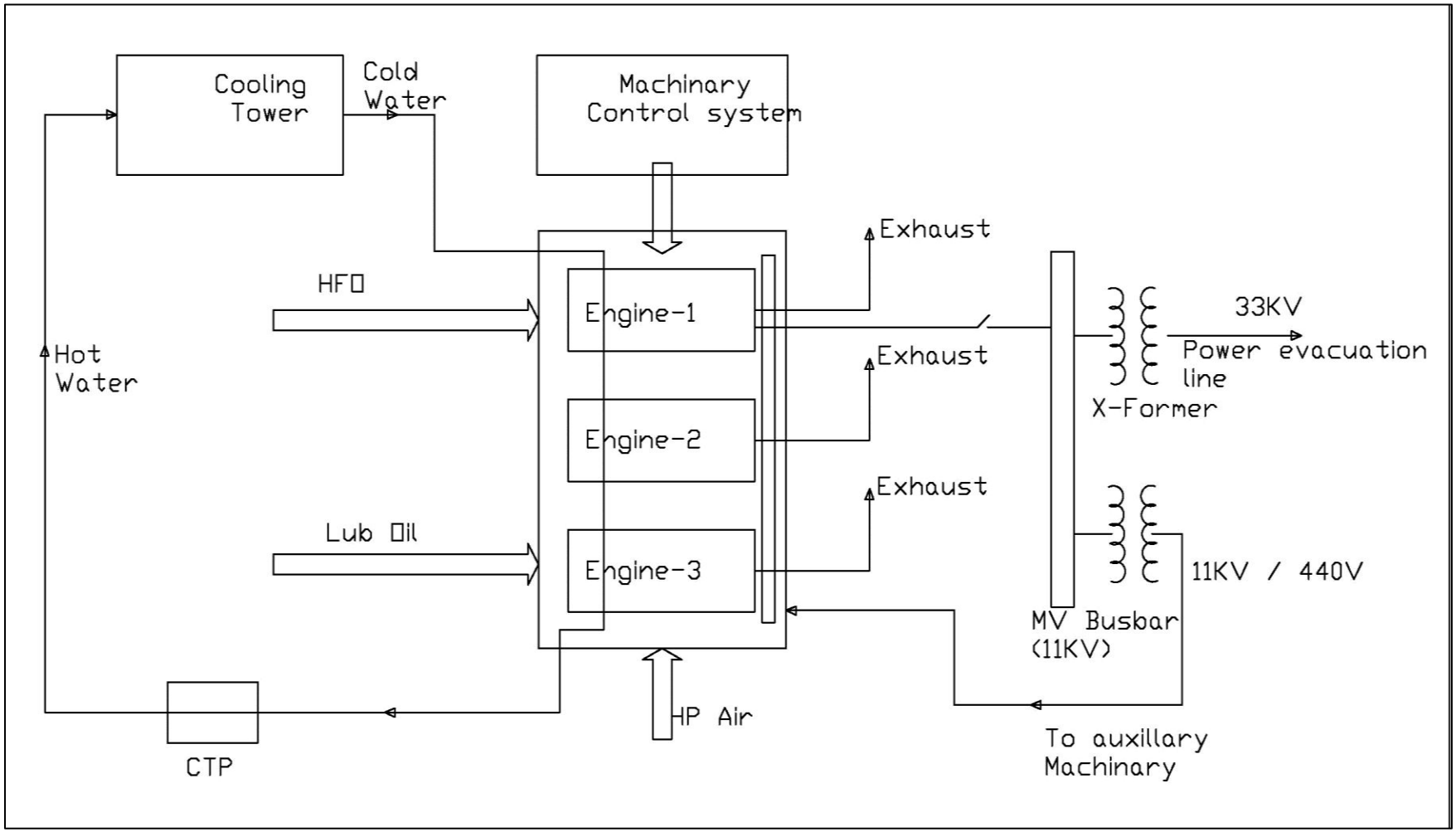


Fig 3.3: Process Flow Diagram of Dhaka Southern Power Generations Limited

The carefully designed forced ventilated Power House will contain the generating units and other auxiliary machinery. All MV and LV electrical controls will be from the Plant's Control Room through the MV and LV Switch Room.

The other supporting machineries are HP Air Compressors, Charge Air Filters, Engine Hall Ventilation Air Filters, Fuel Treatment Plant, Water Treatment Plant, Oily Water Treatment Plant, Auxiliary Boiler, Auxiliary Diesel Generator etc.

3.5 POWER GENERATION DETAILS

The proposed power plant will use imported Heavy Fuel Oil for the generation of electricity. This supplied fuel will be burnt in internal combustion engine for complete combustion; the generated pressure as a result of combustion will operate the generator sets by some rotating mechanism and will produce electricity.

3.5.1 Technical Data of Engine

The engine specifications of the HFO engine and 2.35 MW HFO engine exhaust gas secondary power plant engine are attached in the annexure-2 (a) & annexure-2 (b).

3.6 Fuel

3.6.1 Fuel Treatment

Liquid fuels vary substantially in hydrocarbon composition, physical properties and level of contaminants. Hence, treatment of the heavy fuel oil is mandatory. The imported heavy fuel oil would undergo proper treatment before feeding to the engines.

The major functions of a heavy fuel forwarding system are: pumping, heating, fuel selection, filtration, and metering. Heating requirements will vary depending on the viscosity of the fuel. However, heavy fuel oils may require heating to 135-160°C to reduce viscosity to an acceptable level.

3.6.1.1 HFO Purifier

HFO Purifier will be used to separate sludge and water content from HFO. The separated water and sludge will be properly treated.

3.6.1.2 Oily water Treatment

There will be an oily water separator which will trap waste oil from the oily water. The treated water will be drained properly.

3.6.2 Fuel Specifications

The fuel specification is provided in the annexure – 3

3.7 Water Purification System

There would be efficient water purification system for the proper treatment of water to be used in the cooling towers and the boilers. The required water would be the extracted from the ground by deep tube well. The raw water would be filtered through Multimedia filter; Iron filter & Reverse Osmosis filter respectively.

There will be closed loop cooling system in the power plant. The amount of make-up water for these cooling towers is about 28 ton per day which will be supplied from the filtered tank. Water will be pumped to the Reverse osmosis unit for second phase RO filtration for the boiler feed.

Chapter – 4
Baseline Environment

Chapter-4

BASELINE ENVIRONMENT

4.0 BASE LINE ENVIRONMENT

4.1 GENERAL CONSIDERATION

Baseline condition of environment states the present status of different components of environment in absence of the project. The main objective of examining the present environment is to provide an environmental baseline against which potential impacts from construction and operational phases of any project can be compared. A second important function of establishing a baseline for parameters such as air and water quality is to ensure that any problems arising from existing sources are not erroneously attributed to the project under study. In the present study the different environmental components examined for setting baseline conditions of the project area, are physico-chemical, biological and socio-economical. In physico-chemical component, parameters included are land, water quality, air quality, climate, and noise.

4.2 BOUNDING THE IMPACT AREA

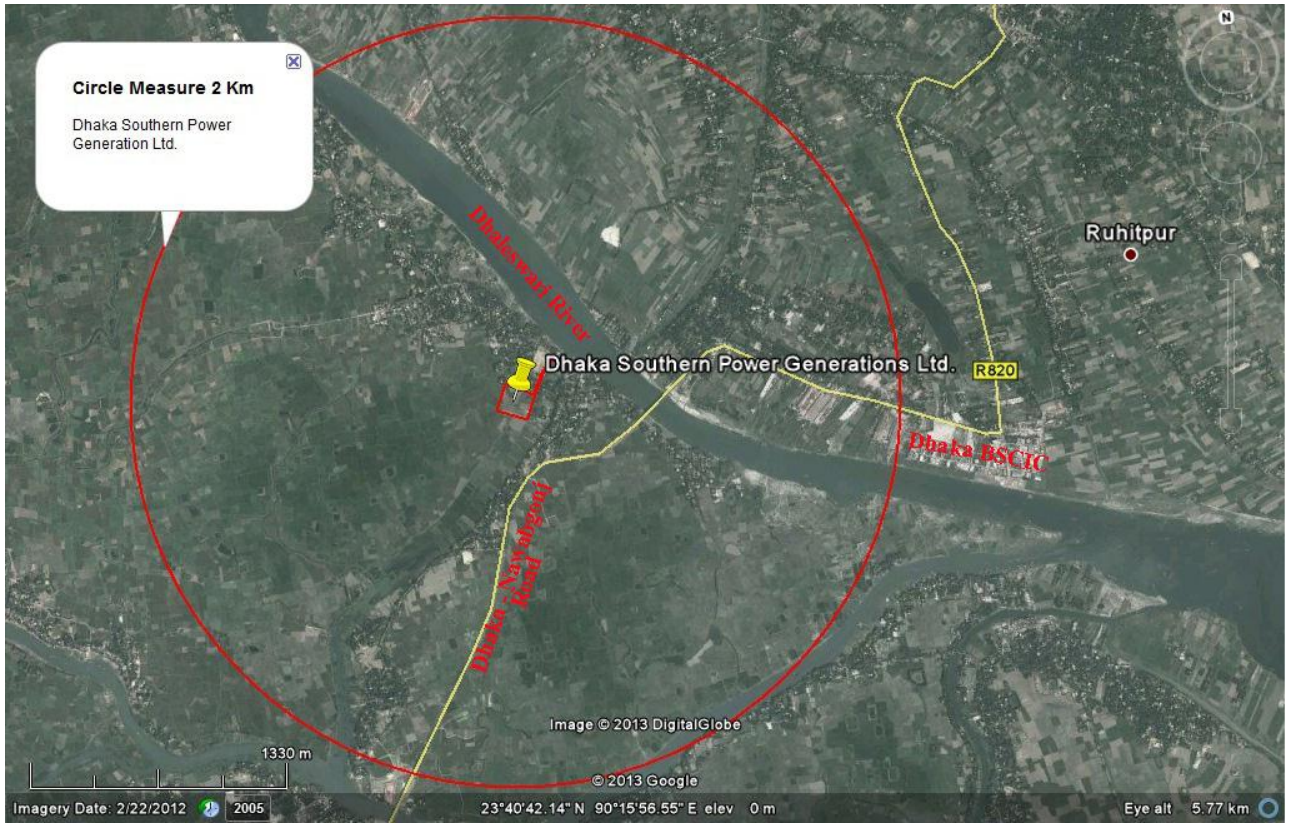


Figure 4.1: Study Area

The study area will cover the entire area of the project, which belongs to **DSPGL** project at Daulatpur, Nawabganj, Dhaka, Bangladesh. The River Dhaleshwari, situated in the North and east side adjacent to the project. For the ease of current ESIA study, the study area has been kept limited to the surrounding areas, which falls within the 2 Km radius of the proposed site. This almost covers the area falls under Nawabganj Upazila of Dhaka District. Primary and Secondary data has been generated and collected for conducting Baseline Study. Figure 4.1 above shows the study area.

4.3 CLIMATE

The climate of this region is tropical, with monsoons, characterized by a change of four seasons: pre-monsoon (March to May), monsoon (June to September), post-monsoon (October to November) and dry season (December to February). High air temperature is observed all throughout the year; daily air temperature variations are insignificant; air humidity is high with abounding rains. Typical parameters of the weather elements, as recorded for the period of last few years of observations (2006-2012) at Dhaka Meteorological Station 419230 (VGTJ) are presented in table 4.1 to 4.5 below.

4.3.1 Rainfall

The annual rainfall is about 2000mm and approximately 80% of it occurs during the monsoon. Average monthly rainfall during monsoon period varies between 300mm to 450mm. Maximum daily rainfalls during this period recorded in September 2007 is 668 mm.

The rainfall follows the general climate pattern with the highest rainfall in the summer month of June to September and minimum rainfall in the cooler and drier months of November to March. Table 4.2 presents average monthly rainfall for the period of last 67 years (1953-2009), average number of rainy days per month and average number of days per month when rainfall is greater than 10 mm. It is evident that extreme rainfall events occurred during the monsoon (June-September). Average monthly rainfall values for Dhaka area since 2006 are presented in Table -4.1.

Table - 4.1 Monthly Average Rainfall in the project area (2006- 2012)

Year	Rainfall in mm											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2012	10	1	37	269	137	175	226	-	-	-	-	-
2011	0	0	20	123	235	314	356	409	207	112	0	0
2010	0	48	22	37	177	308	167	340	169	174	0	81
2009	1	1	43	14	168	170	676	482	298	74	4	0
2008	23	56	45	91	205	577	563	319	279	227	0	0

2007	0	30	11	163	185	668	753	505	179	320	111	0
2006	0	0	0	181	185	326	331	167	663	61	5	0

Source: BMD

Table - 4.2 Monthly Average Rainfall in the project area (1953 - 2009)

Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. Rainfall (mm)	4.5	22.1	58.1	153.5	282.8	385.7	364.9	302	289.3	159.8	36.5	10.3
Days of Rain (Per Month)	1	2	4	8	12	17	20	17	14	8	2	1
Days of Rain > 10mm (Per month)	0	1	2	4	8	9	9	8	7	4	1	0

Source: ICWFM2011 (International Conference on Water & Flood Management, 2011)

4.3.2 Relative Humidity

As would be expected, relative humidity during the wet season is significantly higher than those occurring at other period of the year. This is well depicted by the data as shown in the **Table - 4.3** for relative humidity of Dhaka during the period 2007 – 2012 (till May).

Table -4.3 Average Monthly Relative Humidity of the Project Area in last 5 years

Humidity in %	Monthly Mean Humidity												
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
2007	68	68	54	69	70	81	84	80	80	78	77	78	73
2008	69	61	67	64	70	80	83	81	81	77	69	79	73
2009	72	55	53	66	72	74	80	82	81	73	66	69	70
2010	71	56	59	67	71	79	77	78	79	74	68	66	70
2011	69	54	57	64	76	80	79	82	77	73	67	73	70
2012	66	52	57	69	74	-	-	-	-	-	-	-	-

Source: BMD

4.3.3 Wind Speed

Monthly Prevailing Wind Speed and Direction in Knots of Dhaka for the period of 2007-2012 (till June) are presented in **Table - 4.4**.

Table - 4.4 Monthly Prevailing Wind Speed and Direction in Knots of Dhaka

Year	Month	wind Speed (Knots)	Wind Direction
2007	Jan	2.9	North-West
	Feb	3.1	North-West
	March	4.2	North-West
	April	3.8	South
	May	3.5	South
	June	3.1	South
	July	3.1	South
	Aug	3.1	South
	Sep	3.2	South
	Oct	4.1	North-East
	Nov	5.5	North-East
	Dec	2.9	North-West
2008	Jan	3.6	North
	Feb	3.2	North
	March	3.8	South
	April	3.4	South
	May	3.4	South
	June	3.3	South
	July	3.4	South
	Aug	2.8	South
	Sep	2.8	South
	Oct	9.6	North-East
	Nov	2.5	North-East
	Dec	3.3	West

2009	**Jan**	3.3	West
	Feb	4.1	West
	March	4.0	West
	April	4.1	South
	May	3.8	South
	June	3.1	South
	July	4.3	South-East
	Aug	2.8	South
	Sep	4.2	South-East
	Oct	2.3	East
	Nov	2.8	North
	Dec	2.4	North - West
2010	**Jan**	2.9	North - West
	Feb	3.3	West
	March	3.8	South
	April	4.1	South
	May	3.7	South
	June	3.0	South
	July	2.4	South
	Aug	2.2	South
	Sep	2.6	South-East
	Oct	2.0	North- East
	Nov	2.9	North
	Dec	2.4	North
2011	**Jan**	2.2	West
	Feb	2.4	West
	March	3.8	South
	April	2.4	South
	May	3.0	South
	June	2.7	South-East
	July	2.4	South-East
	Aug	2.4	South-East

	Sep	2.6	South-East
	Oct	2.0	North- West
	Nov	2.3	West
	Dec	2.1	North-West
Year	**Month**	**wind Speed (Knots)**	**Wind Direction**
2012	**Jan**	2.4	West
	Feb	3.0	West
	March	2.5	South
	April	2.6	South
	May	2.5	South
	June	3.0	South
	July	-	-
	Aug	-	-
	Sep	-	-
	Oct	-	-
	Nov	-	-
	Dec	-	-

Source: BMD

4.3.4 Ambient Air Temperature

The temperature of the country has the relationship with the period of rainfall. In general cool seasons coincide with the period of lowest rainfall. **Table 4.5 - Table 4.10** respectively shows the monthly average maximum and minimum temperature at Dhaka for the period 2007 -2012 (till March). During this period maximum average temperature of 39.6 degree Celsius was observed in April, 2009 where average minimum temperature was 8.2 degree Celsius in January, 2011. Rainfall pattern in the project area likely to be more or less similar that of Dhaka.

Table - 4.5 Monthly Ambient Temperature of the Project Area in 2007

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	15.6	28.8	9.6
Feb	19.2	30.8	12.6
March	23.2	36.7	15.0

April	26.7	35.9	18.1
May	29.3	37.5	22.3
June	28.5	35.9	22.0
July	28.5	34.8	23.4
Aug	29.3	35.9	24.2
Sep	28.3	34.9	24.5
Oct	26.8	35.6	19.5
Nov	23.1	31.8	16.8
Dec	17.4	28.2	11.3

Source: BMD

Table - 4.6 Monthly Ambient Temperature of the Project Area in 2008

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	16.7	29.0	10.5
Feb	18.0	30.6	10.8
March	24.3	34.6	16.5
April	27.0	36.9	19.6
May	27.9	36.7	20.3
June	28.4	35.4	222.5
July	28.8	34.0	24.6
Aug	28.6	36.0	23.6
Sep	28.7	34.8	24.4
Oct	26.3	34.8	18.0
Nov	22.1	32.3	16.3
Dec	19.1	29.0	13.0

Source: BMD

Table - 4.7 Monthly Ambient Temperature of the Project Area in 2009

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	17.0	28.1	11.1
Feb	20.4	33.9	12.2
March	23.9	36.0	15.8
April	27.2	39.6	20.4

May	27.6	37.8	21.6
June	29.8	36.5	22.6
July	29.6	35.7	24.4
Aug	28.9	34.3	24.3
Sep	29.3	35.3	24.5
Oct	26.5	35.8	20.6
Nov	22.2	33.9	15.2
Dec	17.3	29.0	11.4

Source: BMD

Table - 4.8 Monthly Ambient Temperature of the Project Area in 2010

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	14.5	29.0	9.6
Feb	19.8	34.2	12.0
March	25.6	37.3	18.4
April	28.3	37.9	20.8
May	28.8	36.9	21.3
June	28.8	35.8	23.2
July	29.6	35.1	25.3
Aug	29.5	35.1	25.0
Sep	28.8	34.0	24.8
Oct	26.9	35.7	21.5
Nov	23.1	33.2	16.6
Dec	17.8	29.7	11.0

Source: BMD

Table - 4.9 Monthly Ambient Temperature of the Project Area in 2011

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	14.2	27.8	8.2
Feb	19.8	31.0	13.0
March	24.0	34.5	16.0
April	26.4	35.8	20.2

May	27.6	35.3	21.3
June	29.1	36.0	23.2
July	29.2	35.4	23.9
Aug	29.0	35	24.5
Sep	29.0	36.2	23.7
Oct	27.4	34.5	22.0
Nov	21.9	32.4	17.2
Dec	16.8	30.0	11.0

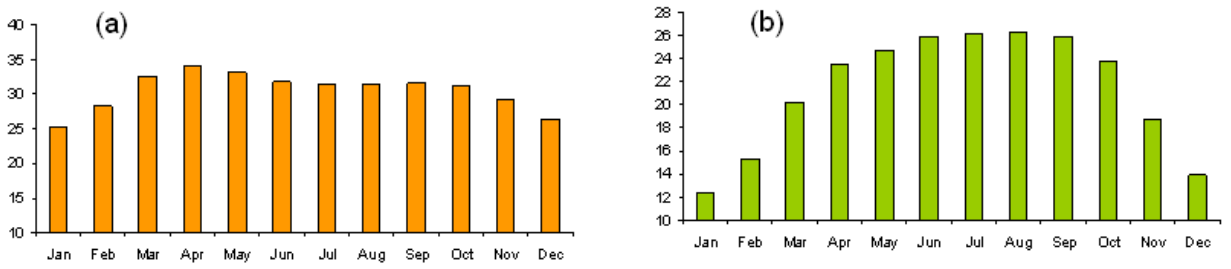
Source: BMD

Table - 4.10 Monthly Ambient Temperature of the Project Area in 2012

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	15.5	28.5	10.5
Feb	19.2	33.0	12.2
March	23.7	37.3	18.3
April	-	-	-
May	-		-
June	-	-	-
July	-	-	-
Aug	-	-	-
Sep	-	-	-
Oct	-	-	-
Nov	-	-	-
Dec	-	-	-

Source: BMD '-' means data missing

Characterization of air temperature in the project area is also made based on 56 years average air temperature which is presented in 2 graphical formats. Figure 4.2 (a) and 2(b) shows the mean monthly distribution of maximum and minimum temperature over Dhaka from 1953 to 2009, respectively.



Source: ICWFM2011 (International Conference on Water & Flood Management)

Figure-4.2: Monthly (a) maximum and (b) minimum temperature (°C) of Dhaka based on observation (1953-2009)

4.4 Hydrology

Surface Water of Project Area

Water supply of the Dhaka is largely dependent on ground water abstraction from underlying aquifer system. As other parts of the country this area also receives sufficient amount of rainfall and there is a good availability of ground water, which is being, used by hand pumps for drinking and domestic purposes. Most of the water bodies in the area are ponds and some of these ponds are generated due to excavation of earth. There are some low lying flood plain areas, which remain under water during flood period (July-October).

4.4.1 Water Quality

4.4.1.1 Surface Water

The Dhaleshwari River is the only surface water body adjacent to the project site. The river carries run-off water from adjoining areas, which might contain some pollutants. Water was collected from the river and analyzed in AECL Laboratory. The water quality of limited parameters of the river near the project site as analyzed is given below in Table 4.11.

Table-4.11: Surface Water quality (limited parameters) of the Dhaleshwari River

S.N.	Parameter	Concentration present	DoE (Bangladesh) Standard for Inland surface water
01	PH	6.7	6.0 – 9.0
02	TDS	288 mg/l	2100 mg/l
03	Suspended Solid	22 mg/l	150 mg/l
04	EC	610 µS/cm	1200 µS/cm

05	DO	7.7 mg/l	4.5-8.0 mg/l
06	BOD5 20o C	4.4 mg/l	50 mg/l
07	COD	14 mg/l	200 mg/l

Source: AECL Lab (sample collected on 01.08. 2013 and reporting on 06.08. 2013)

4.4.1.2 Ground Water

Ground water level exists at a moderate (Generally below 8.0 m) depth, which is being recharged mainly by infiltration of rainwater. The ground water zoning map is shown in fig 4.3. Ground water is the source of water for domestic use in this area. Usage of ground water for irrigation is limited here. The recharge capacity of the ground water level seems to be adequate. To determine quality of ground water, water sample was collected from a nearby tube well of the existing plant of the DSPGL and analyzed for different parameters. The results shows that all the parameters remain within the allowable limit of drinking water value as per as Environmental Quality Standards for Bangladesh. The parameters which have been analyzed during this study are presented below in Table 4.12 –

Table-4.12: Ground Water quality (limited parameters) of Project Site

S.N.	Parameter	Result	(DoE) Bangladesh Standard for Ground Water
01	Ph	7.3	6.0-9.0
02	Total Dissolved Solids	130 mg/l	1000 mg/l
03	Iron	0.40 mg/l	0.3-1.0 mg/l
04	Alkalinity	72 mg/l	-
05	Hardness	64 mg/l	(200-500) mg/l
06	Chloride	18 mg/l	(150-600) mg/l

Source: AECL Lab (sample collected on 01.08. 2013 and reporting on 06. 08. 2013)

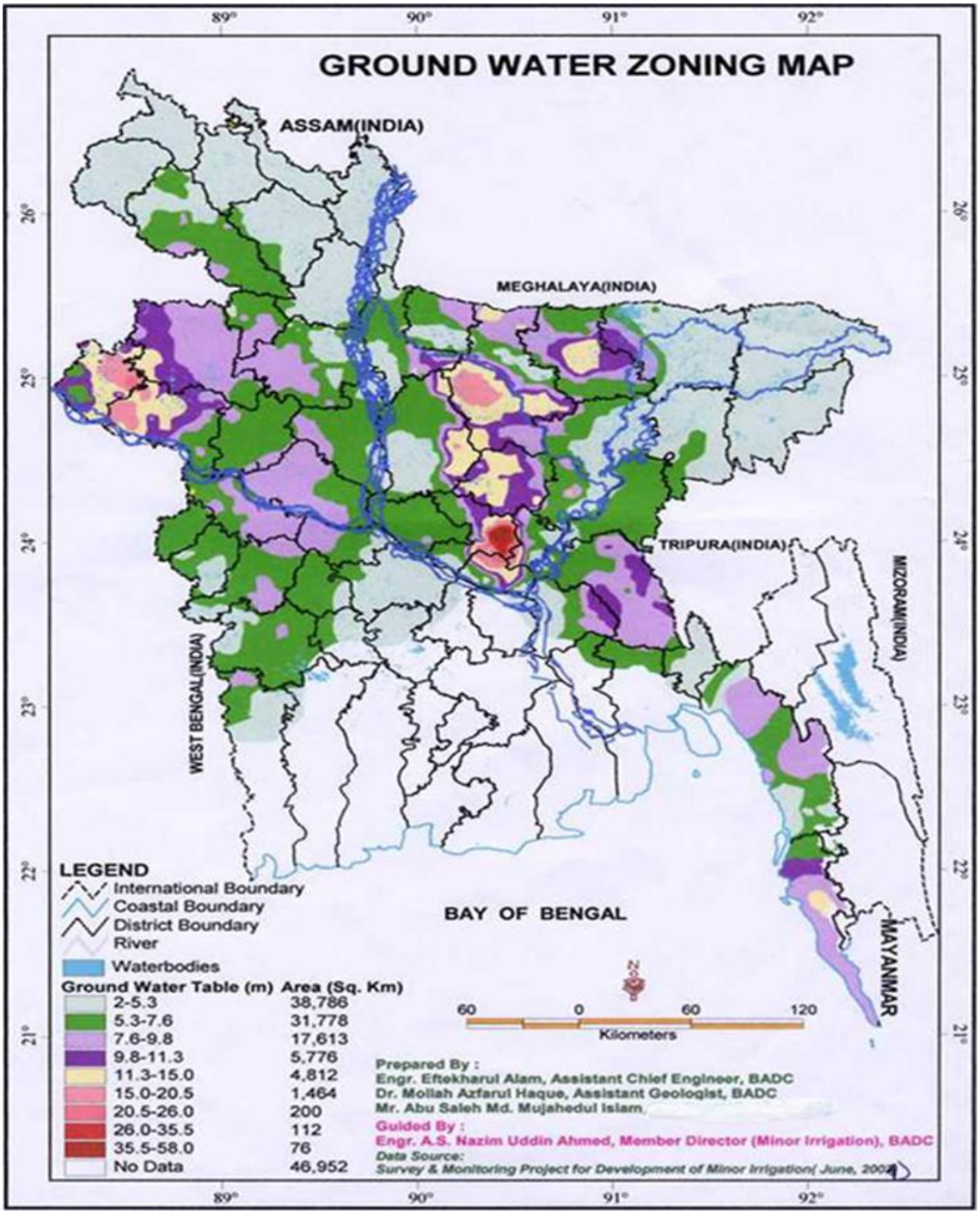


Fig. 4.3: Ground Water Zoning Map of Bangladesh

4.5 Air Quality

Air quality in the Dhaka City and its neighborhoods is deteriorating both from natural and manmade causes. It is one of the most dangerous and common kind of environmental pollution that is reported in most industrial towns and metropolitan city in Bangladesh. Major atmospheric pollution is caused by man induced activities like -

burning fossil fuels, industrial processors, construction works and agriculture, transportation industry. In the rural areas however the ambient air quality is relatively good. It is assumed that accepting the small areas near the urban growth centre air quality in the most of the area would be far below the Environmental Quality Standards of Bangladesh. It is necessary for ESIA to establish the baseline air quality specially the PM concentration to determine the air shed of the project area.

In six cities including Dhaka, ambient air quality parameters are monitored on a regular basis by the DOE using CAMS (Continuous Air Monitoring Stations). One of the CAMS is located at Narayanganj area which is not very similar air shed to the present power is located. Narayanganj is industrially populated and there are many power projects already have established. Nevertheless, we have presented the CAMPS air quality data in Table 4.13. The data for six criteria pollutants (i.e., pollutants regulated by law) for the four months' period during March 2013 to June 2013 are shown.

Table-4.13: Air Quality Data (Narayanganj CAMS, Dhaka)

Sl	Parameter	Unit	NNAQS	Period	Monthly Average Data				4 month's Average
					Mar 2013	Apr 2013	May 2013	Jun 2013	
1	PM2.5	µg/m3	65	24 hr	115.56	50.53	24.11	21.7	52.98
2	PM10	µg/m3	150	24 hr	235.18	132.66	64.90	77.4	127.54
3	SO2	Ppb	140	24 hr	22.80	8.59	5.12	2.87	9.85
4	NO2	Ppb	53	Annual	4.57	12.84	13.17	15.2	11.45
5	CO	Ppm	9	8 hr	0.65	0.25	N/A	0.37	-
6	O3	Ppb	80	8 hr	10.42	8.57	12.29	8.46	9.94

$PM_{2.5}$ - Fine ParticulateMatter (EAD<2.5µm)
PM_{10} - ParticulateMatter (EAD<10µm)
SO_2 - Sulfurdioxide
NO_X- Oxides of Nitrogen
CO- Carbone Mono-oxide
EAD- Effective Aerodynamic Diameter

The above data shows that the concentrations of $PM_{2.5}$ and PM_{10} are within the limit compared to the NAAQS. For the gaseous pollutants, the levels obtained are also within NAAQS. An air shed where NAAQS are within the limit is referred to as a non-degraded air shed as per the Environmental, Health & Safety guidelines (for Thermal power plant) of IFC/WB 2008.

As discussed earlier, since the Narayanganj district is industrially populated and the air quality of CAMP Narayanganj may not reflect the true air quality of the Nawabganj area or the project area. So, AECL has conducted a 24 hour average air quality monitoring

for 3 days to get an idea of the real air quality of the project area. The monitoring result of the air quality collected from the proposed plant site is given in Table 4.14. It shows that shows that the ambient air quality in terms of PM2.5, PM10, SPM, NOx and SO2 are considered to quite good and still has reasonable buffer/assimilation capacity to absorb air pollutants to a certain extent. These are within the prescribed limit of the National Air quality Standards.

Table - 4.14 Ambient Air Quality Analysis of the project area

SN	Description		Ambient Air Pollution Concentration in micro gram/cubic meter.				
		$PM_{2.5}$	PM_{10}	SPM	SO_2	NO_X	CO
	Method of analysis	Gravimetric	Gravimetric	Gravimetric	West-Geake	Jacob and Hochheiser	Indicator Tube
	Test Duration (Hours)	**24**	**24**	**24**	**24**	**24**	**24**
	Bangladesh (DoE) Standard for ambient Air	**65**	**150**	**200**	**365**	**100**	**10000**
	WHO /World Bank Standard	**25**	**50**	**NF**	**20**		**NF**
1	Test result (Concentration present) in Project West-North corner near boundary area. (Date :03/11/2013)	27	67	143	12	21	170
2	Test result (Concentration present) in Project West-North corner near boundary area. (Date :04/11/2013)	**31**	77	159	14	26	180
3	Test result (Concentration present) in Project West-North corner near boundary area. (Date :05/11/2013)	**25**	65	147	17	23	190
Remarks			Pollution source from normal activities, the weather was sunny and the wind direction was from the north-west to south-east corner.				

(Source: AECL Lab, sampling has been done by Respirable Dust Sampler & Fine particulate Sampler, Envirotech APM460BL & APM550).

Note:

1. *Fine Particulate Matter ($PM_{2.5}$).*
2. *Respirable Dust Content (PM10).*
3. *Suspended Particulate Matter (SPM).*
4. *Oxides of Nitrogen (NO_X).*
5. *Sulphur Di-Oxide (SO_2).*
6. *Carbone Mono-Oxide (CO).*

So, as per the Environmental, Health & Safety guidelines (for Thermal power plant) of IFC/WB 2008, the fuel quality standard for non-degraded air shed would be applicable in the present case. This would mean that for the plant (i.e. with power level > 50 MWth), the sulfur level in HFO has to be lower than 2% or there should have some mechanism in the plant to reduce the emission to this equivalent concentration if fuel with higher level sulfur is to be used. The plant will use 3.4% Sulfur HFO and will be equipped with a wet FGD (Flue Gas Desulfurization) plant which can remove >90% of SO_2 (details in Annex 9b). The resultant SO_2 emission will thus be equivalent to about 0.38% sulfur HFO use. The FGD plant will also remove substantial fraction of PM and NOx as it uses a wet scrubbing process.

4.6 Noise Level

The most sophisticated machineries will be installed in **Dhaka Southern Power Generations Limited,** which will produce little significant noise. It is suggested that the proponent should create a green belt around the project site, administrative building and other services buildings, which would reduce the noise level significantly. The ambient noise level data were collected from different sides of the project by noise level meter and they are given below in Table 4.15.

Table 4.15: Ambient Noise Quality Analysis

Sample Location	Location Coordinated : 23°40'12.91" N 90°16'55.28" E				***Project from North side (near boundary area)***			
Time of Experiments	*Day Time*					*Night Time*		
	06.00 To 09.00 am	*09.00 To 12.00 pm*	*12.00 To 03.00 pm*	*03.00 To 06.00 pm*	*06.00 To 09.00 pm*	*09.00 To 12.00 am*	*12.00 To 03.00 am*	*03.00 To 06.00 am*
Concentrations present (LA_{eq}) dBA.	*Max: 61.1 Avg: 47.41 Min: 39.19*	*Max: 66.13 Avg: 49.59 Min: 40.32*	*Max: 68.21 Avg: 56.13 Min: 41.67*	*Max: 66.11 Avg: 55.35 Min: 40.21*	*Max: 65.19 Avg: 54.97 Min: 39.17*	*Max: 62.11 Avg: 50.7 Min: 38.43*	*Max: 44.11 Avg: 41.2 Min: 38.55*	*Max: 46.21 Avg: 41.43 Min: 39.12*
Sample Location	Location Coordinated : 23°40'10.06" N 90°16'56.79" E				***Project from East side (near boundary area)***			
Time of Experiments	*Day Time*					*Night Time*		
	06.00 To 09.00 am	*09.00 To 12.00 pm*	*12.00 To 03.00 pm*	*03.00 To 06.00 pm*	*06.00 To 09.00 pm*	*09.00 To 12.00 am*	*12.00 To 03.00 am*	*03.00 To 06.00 am*
Concentrations present (LA_{eq}) dBA.	*Max: 59.12 Avg: 46.48 Min: 39.12*	*Max:66.19Avg: 53.27 Min: 39.19*	*Max: 69.21 Avg: 56.82 Min: 40.13*	*Max: 69.21 Avg: 56.1 Min: 40.21*	*Max: 62.16 Avg: 53.26 Min: 39.19*	*Max:60.39Avg: 49.42 Min: 38.55*	*Max: 47.31 Avg: 41.32 Min: 38.17*	*Max: 43.66 Avg: 40.48 Min: 38.14*
Sample Location	Location Coordinated :23°40'8.78" N 90°16'53.27" E				***Project from South side (near boundary area)***			
Time of Experiments	*Day Time*					*Night Time*		
	06.00 To 09.00 am	*9.00 To 12.00 pm*	*12.00 To 03.00 pm*	*03.00 To 06.00 pm*	*06.00 To 09.00 pm*	*09.00 To 12.00 am*	*12.00 To 03.00 am*	*03.00 To 06.00 am*
Concentrations present (LA_{eq}) dBA.	*Max: 60.12 Avg: 46.48 Min: 39.45*	*Max: 65.32 Avg: 52.57 Min: 40.17*	*Max: 68.43 Avg: 54.59 Min: 39.39*	*Max: 68.66 Avg: 55.53 Min: 40.69*	*Max: 63.17 Avg: 54.03 Min: 39.65*	*Max: 58.32 Avg: 46.65 Min: 38.32*	*Max: 46.21 Avg: 39.83 Min: 37.65*	*Max: 42.44 Avg: 39.76 Min: 37.25*
Sample Location	Location Coordinated : 23°40'11.99" N 90°16'51.31" E				***Project from West side (near boundary area)***			
Time of Experiments	*Day Time*					*Night Time*		
	06.00 To 09.00 am	*09.00 am To 12 pm*	*12.00 To 03.00 pm*	*03.00 To 06.00 pm*	*06.00 To 09.00 pm*	*09.00 To 12.00 am*	*12.00 To 03.00 am*	*03.00 To 06.00 am*
Concentrations present (LA_{eq}) dBA.	*Max: 58.65 Avg: 46.16 Min: 38.32*	*Max: 64.54 Avg: 55.95 Min: 39.43*	*Max: 67.22 Avg: 56.01 Min: 40.21*	*Max: 68.43 Avg: 56.55 Min: 40.17*	*Max: 68.29 Avg: 54.51 Min: 39.21*	*Max: 57.43 Avg: 48.22 Min: 38.12*	*Max: 44.32 Avg: 39.72 Min: 36.23*	*Max: 42.09 Avg: 41.2 Min: 36.21*
DoE (Bangladesh) Standard	**Day Time – 75 dBA & Night Time – 70 dBA (For Industrial Zone)**							
IFC/Int'l Standard	**70 dBA - Day & Night time (For Industrial/commercial Zone)**							
Remark	**Maximum noise source from vehicular/ship movement and human activities.**							

All units are in (LAeq) dBA
Source: AECL Lab (measured on 01.08. 2013 by Ansi type 2 Noise Level Meter

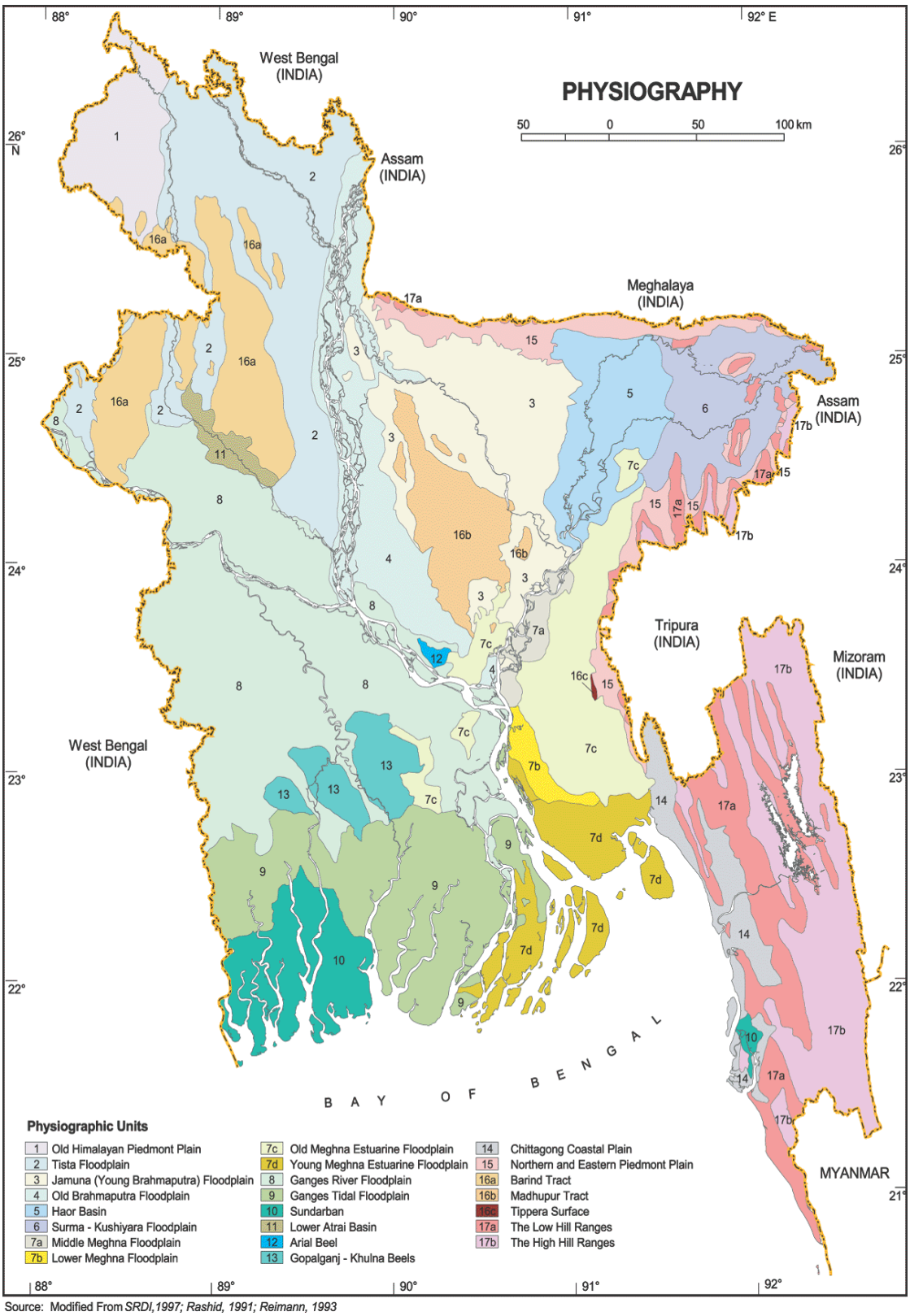
4.7 SOILS

Most of the area of Bangladesh is a vast, low-lying alluvial plain, sloping gently to the south and southeast. According to Bangladesh Agricultural research council's Agro-Ecological Zoning map of Bangladesh, the proposed project area falls in the Young Brahmaputra - Jamuna Floodplain. This region comprises of the area of Brahmaputra sediments. It has a complex relief of broad and narrow ridges, inter-ridge depressions, partially in filled cut-off channels and basins.

This area is occupied by permeable silt loam to silty clay loam soils on the ridges and impermeable clays in the basins which are neutral to slightly acidic in reaction. General soil types include predominantly Grey Floodplain soils. Organic matter content is low in ridges and moderate in basins. The physiographic map of Bangladesh is shown in Figure 4.4. Within this area, elevations are less than 7.276m above sea level, which is shown in Figure 4.5.

4.8 River:

The river Dhaleshwari is situated at the north-east side of the proposed project site. It starts off the Jamuna near the northwestern tip of Tangail District. After that it divides into two branches: the north branch retains the name Dhaleshwari and merges with the other branch, the Kaliganga River at the southern part of Manikganj District. Finally the merged flow meets the Shitalakshya River near Narayanganj District. This combined flow goes southwards to merge into the Meghna River. Average depth of river is 24 feet. The width of the river is 710feet in average. Different types of seasonal fishes are available in this river. For example: Chingri, Kal Bawoosh, Ayeer, Bowal, Icha, Tengra, GolishaTengra, Boal Pangash, Rui, Catla, Mrigel, Puti, Taki, Bain, Mola, Batasi etc. Different types of engine boats and Dingi Nauka (small boat) are most common here as water transportation in the river. Most of them are used for local business/trading purpose. The boat movements are limited between Sherumia Hat, Daulatpur, Saiyadpur, Kamalpur, Rajanagar, Shekher nagar, Moricha and Vangabita. The river width near the palton/jetty of DSPDL is 710 ft.



Source: Modified From *SRDI,1997; Rashid, 1991; Reimann, 1993*

Fig. 4.4: Physiographic Map of Bangladesh

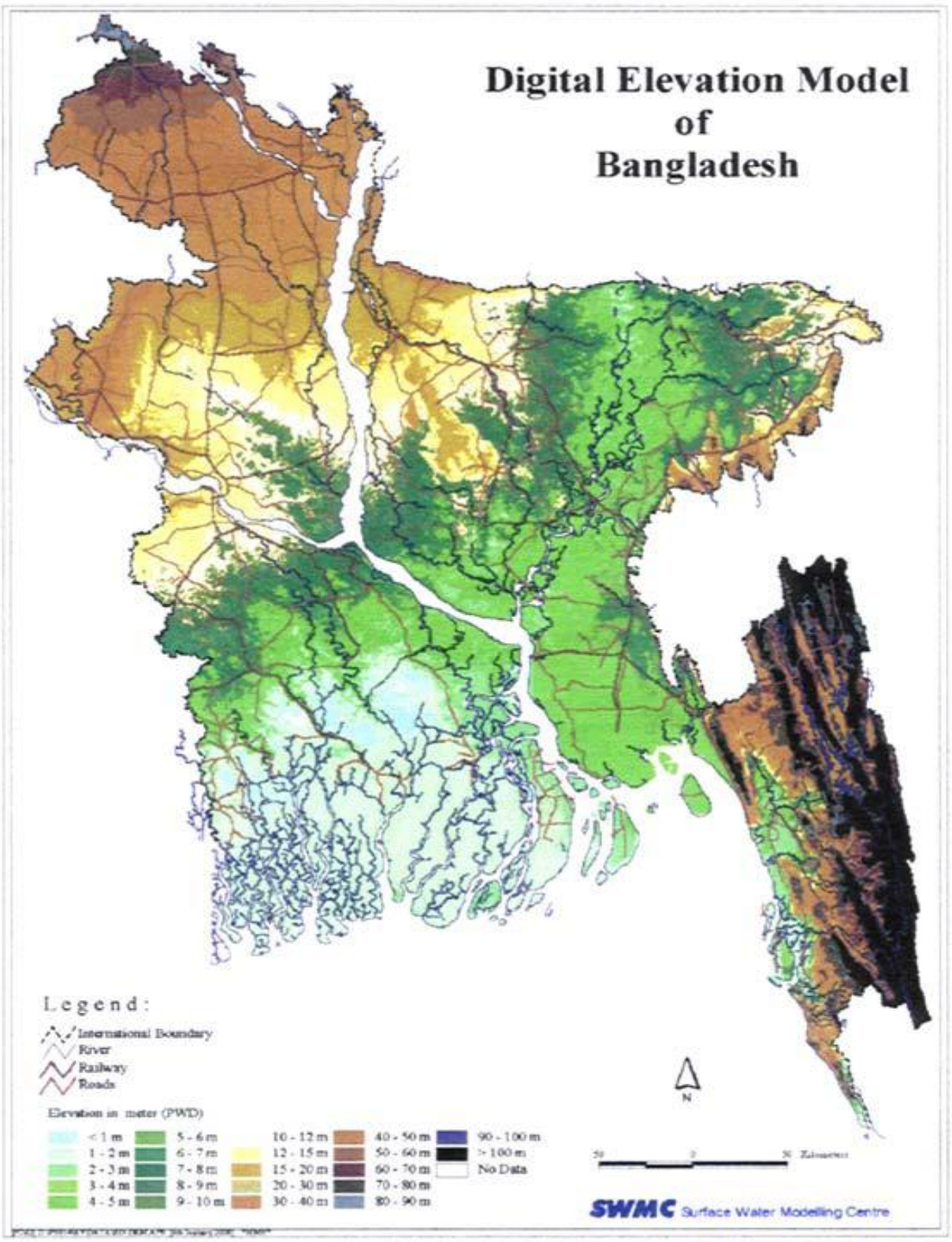


Fig. 4.5: Digital Elevation Model of Bangladesh

4.9 SEISMICITY

Bangladesh, a densely populated country in South Asia, is located in the north-eastern part of the Indian sub-continent at the head of the Bay of Bengal. Tectonically, Bangladesh lies in the north-eastern Indian plate near the edge of the Indian craton and at the junction of three tectonic plates – the Indian plate, the Eurasian plate and the Burmese micro plate. These form two boundaries where plates converge– the India-Eurasia plate boundary to the north forming the Himalaya Arc and the India-Burma plate boundary to the east forming the Burma Arc (Fig. 4.6).

Active faults of regional scale capable of generating moderate to great earthquakes are present in and around Bangladesh. These include the Dauki fault, about 300 km long trending east-west and located along the southern edge of Shillong Plateau (Meghalaya- Bangladesh border), the 150 km long Madhupur fault trending north-south situated between Madhupur Tract and Jamuna flood plain, Assam-Sylhet fault, about 300 km long trending north east southwest located in the southern Surma basin and the Chittagong-Myanmar plate boundary fault, about 800 km long runs parallel to Chittagong-Myanmar coast (Fig. 4.7).

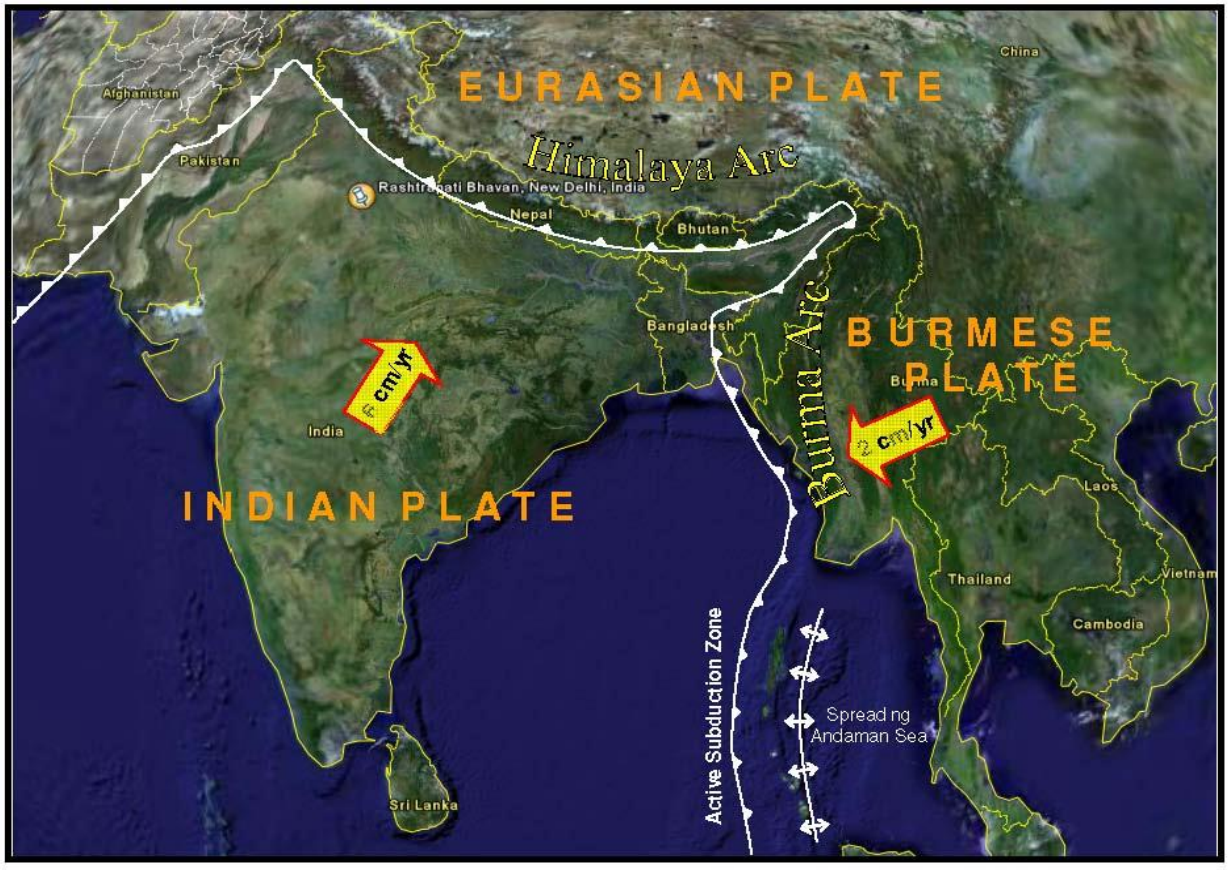


Fig. 4.6: Regional tectonic setup of Bangladesh with respect to plate configuration

The Chittagong- Myanmar plate boundary continues south to Sumatra where it ruptured

in the disastrous 26 December 2004 Mw 9.3 earthquake (Steckler et al. 2008). These faults are the surface expression of fault systems that underlie the northern and eastern parts of Bangladesh. Another tectonic element, the 'Himalayan Arc' is characterized by three well defined fault systems (HFT, MBT and MCT) that are 2500 km long stretching from northwest syntaxial bend in Pakistan in the west to northeast syntaxial bend in Assam in the east. It poses a great threat to Bangladesh as significant damaging historical earthquakes have occurred in this seismic belt (Bilham et al., 2001; Mukhopadhyay et al., 2004 and Mullick et al., 2009). The tectonic set-up and the plate motions together place Bangladesh potentially vulnerable to earthquake.

Dhaka is situated in the central part of the country on the bank of the Buriganga River and at the southern tip of the Madhupur Tract dating back to the Pleistocene age. The Madhupur Tract is an area of recent uplift within the delta and the surface of the tract is in general higher on the west, sloping very gently eastward to disappear beneath younger sediments (Fergusson, 1863; Morgan and McIntire, 1956). Dhaka is surrounded by the old Brahmaputra floodplain in the north and east, by the Ganges-Meghna flood plain in the south and by the Jamuna flood plain in the west. Dhaka is slightly elevated above the surrounding floodplains and represents mostly flat land with minor undulations. Topographically Dhaka is of low relief with many low depressions. According to Alam (1988), the Madhupur Tract is structurally controlled. The Pleistocene sediments of Madhupur Tract have been affected by numerous episodes of faulting. These faults are probably the branch out surface faults from the low dipping western extension of Burma Arc detachment fault. Dhaka lies within 50 to 500 km distances from the seismogenic faults and sits on the Burma Arc detachment fault.

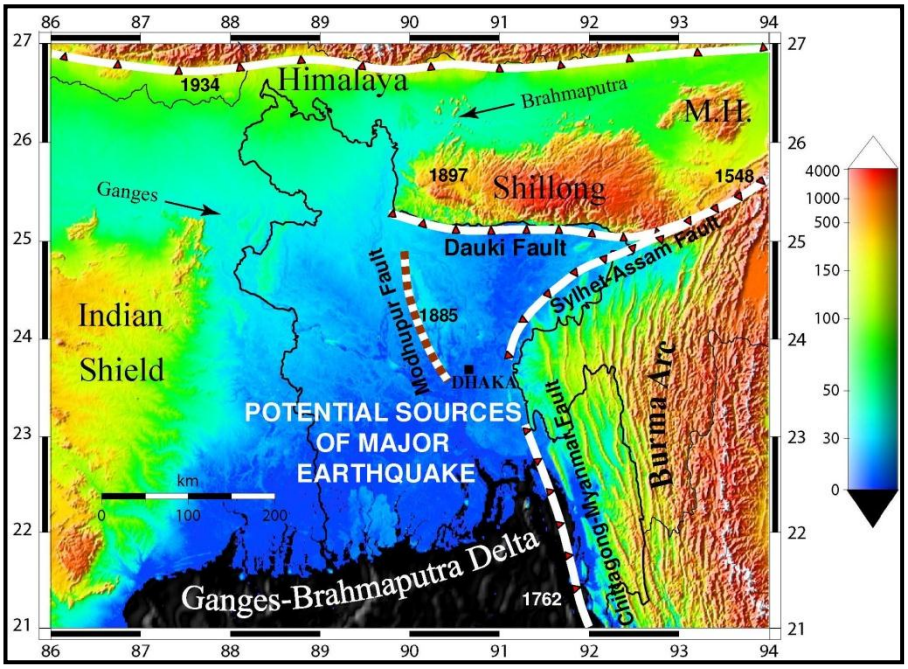


Fig. 4.7: Digital Elevation Model (DEM) of Bangladesh and surroundings showing geological faults – potential sources of major earthquakes in Bangladesh.

On the basis of distribution of earthquake epicenters and morphotectonic behaviour of different tectonic blocks Bangladesh has been divided into three generalized seismic zones (fig 4.8). Zone-II comprising the central part of Bangladesh represents the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur Tracts, and the western extension of the folded belt. The zone II consists of the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur and the western extension of the folded belt and the Bask coefficient for this zone is 0.05. Nawabganj area within the vicinity of Dhaka falls in seismic zone II of the seismic zoning map of Bangladesh.

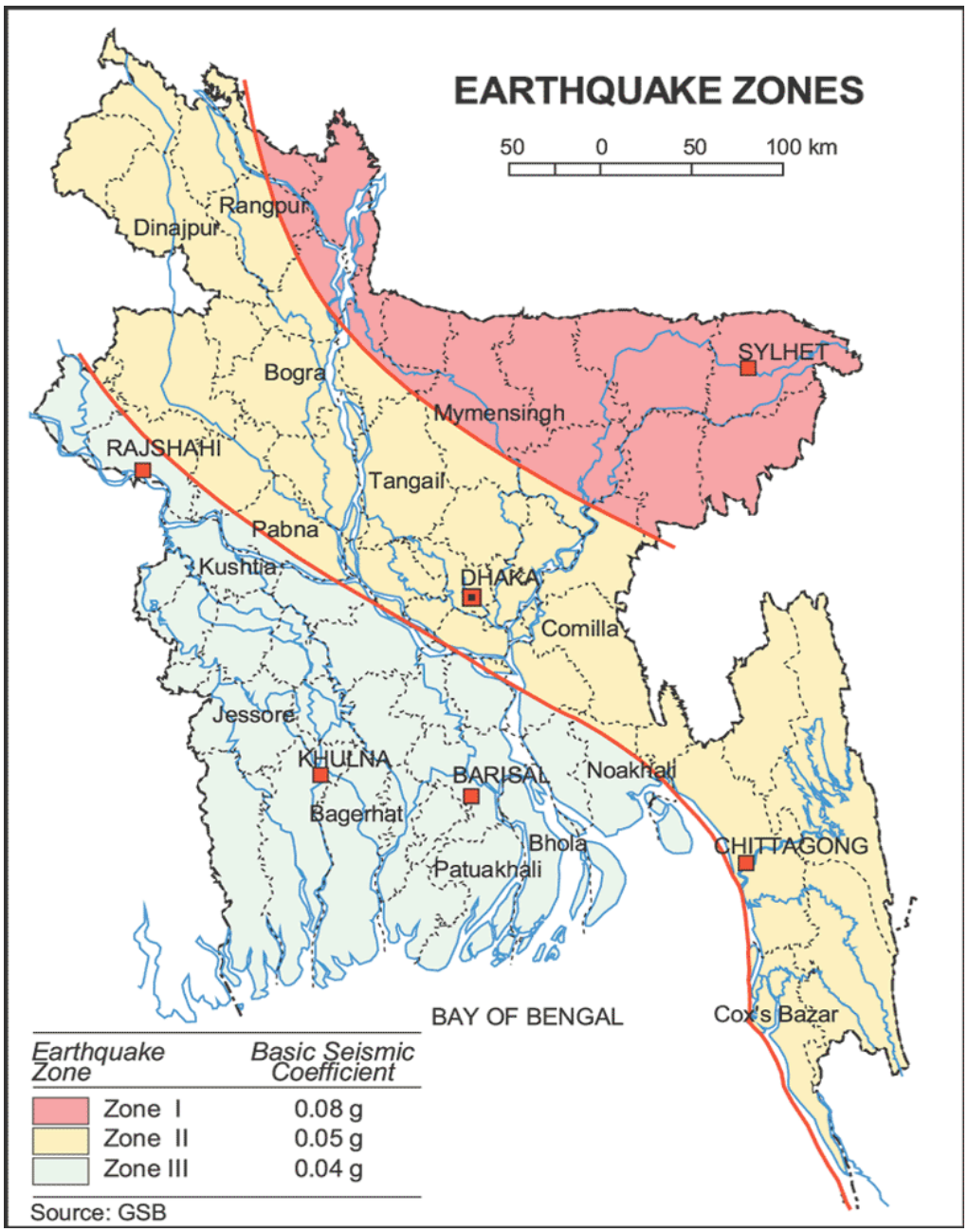


Fig 4.8: Earthquake Zoning Map of Bangladesh

Table 4.16: Seismic Zonation of Bangladesh

Zoning	Area Mercalli Scale	Modified
I	North and eastern regions of Bangladesh (Seismically most active)	IX
II	Lalmai, Barind, Madhupur Tracts, Dhaka, Comilla, Noakhali and western part of Chittagong Folded belt.	VIII
III	Khulna division S-E Bangladesh (Seismically relatively quiet)	VII

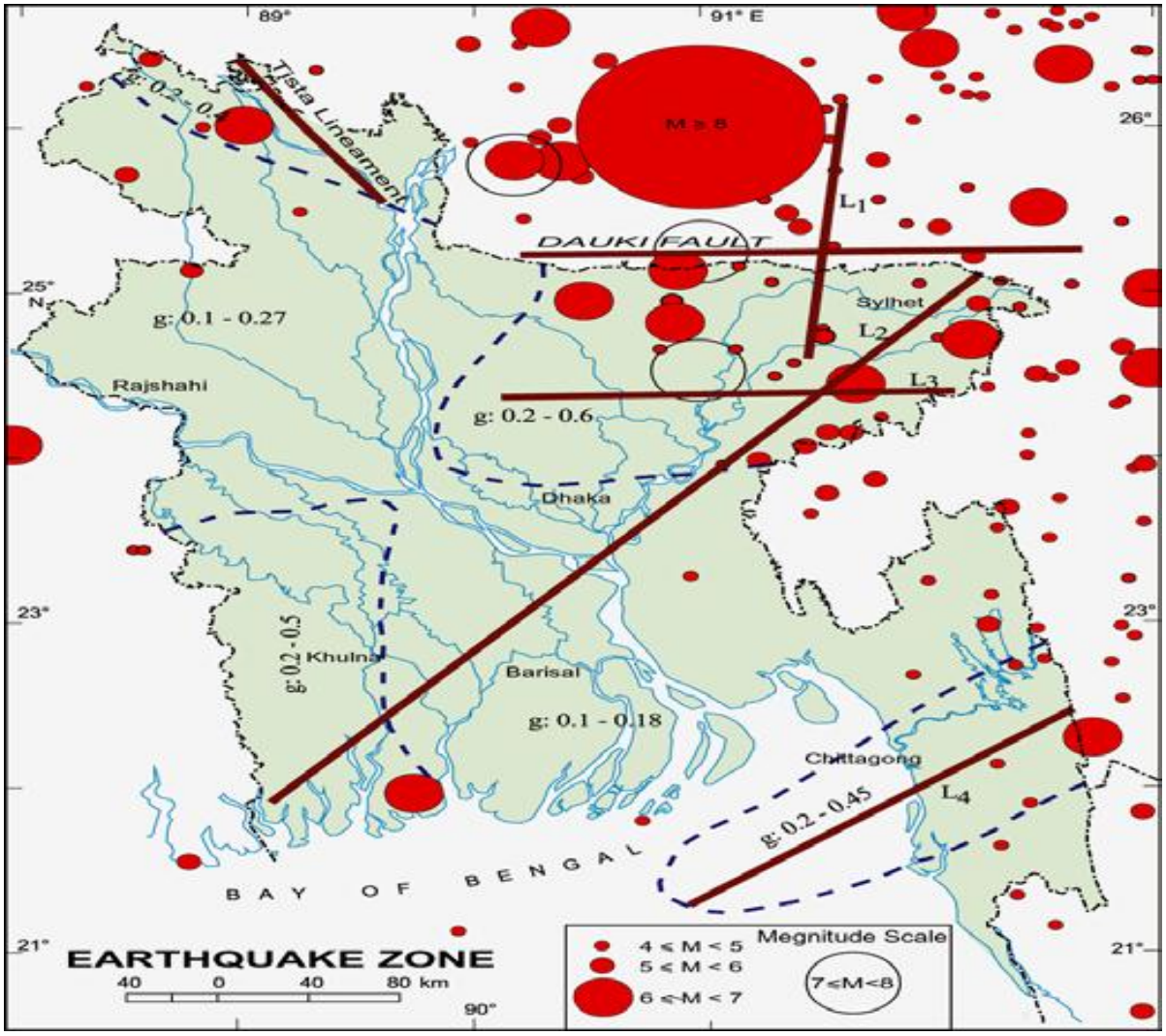


Fig. 4.9: Seismic Activity of Bangladesh

Dhaka suffered ground shaking of the order III to VIII on the Modified Mercalli (MM) scale from both teleseismic (distant) and local earthquakes during historic and recent

times. Among all the earthquakes that Dhaka has suffered from, the earthquakes of 1762, 1812, 1865, 1885 and 1897 were the most severe earthquakes in recent recorded history. The following descriptions summarize the earthquake history that affected Dhaka.

Table 4.17: Major earthquake affect in Dhaka Division

1548 Earthquake – Assam
The first known earthquake in Bangladesh was a "terrible one" and destroyed both Sylhet and Chittagong in 1548 (Rizvi, 1970; Iyengar, et al., 1999; Banglapedia , 2003), The details of the earthquake and the damage are not available but it opened numerous ground fissures and caused liquefaction in Assam, Sylhet, Tripura and in the Meghna floodplains. It is assumed from the descriptions in the reports that the 1548 earthquake epicenter was somewhere in Assam or Nagaland. Though no reports were made on the affects of this earthquake in Dhaka, it can nevertheless be well imagined that the intensity was V to VI in Dhaka.
1642 Earthquake – Assam
This earthquake was more severe than the 1548 earthquake (Rizvi, 1970). It probably occurred in the Assam-Sylhet region, but might have shaken Dhaka with moderate intensity.
1762 Earthquake – Chittagong
The earthquake of 1762 was very destructive and violent. It was felt all over Bengal and Arakan and it originated somewhere along the Chittagong-Myanmar coast on 2 April. It damaged vast areas of Dhaka, Chittagong and Myanmar (Oldham, 1883: Rizvi, 1969: Martin and Szeliga, 2010). Rizvi (1969) writes: "The earthquake on April 2, 1762 proved very violent at Dhaka and along the eastern bank of Meghna as far as Chittagong. At Dhaka the rivers and jhils were agitated, and raised high above their usual levels, leaving, when they receded, their banks were strewn with dead fish. The shocks were accompanied by subterranean hollow noises and were so severe that a number of houses were thrown down by which 500 persons, it is said, lost their lives". Based on the degree of damage of the ground surface, its aerial extent and comparing with the 2004 Sumatra earthquake, the magnitude of the 1762 earthquake was 8.5+ on the Richter scale. The intensity of this earthquake in Dhaka was MM VI.
1775 Earthquake
Very little is known about this earthquake. This earthquake was severe in Dhaka with no loss of life (Rizvi, 1969, Banglapedia, 2003).

1787 Earthquake – Sirajganj
The earthquake of 1787 changed the course of the rivers and the ground shaking at the epicentral region was probably MM X. No report was available of the effect of this earthquake in Dhaka. However, from the level of physiographic changes at Sirajganj and Dhaka being 100 km away to the southeast, it may be said that the ground shaking intensity in Dhaka was MM VI to VII.
1812 Earthquake – Dhaka
In 1812 two earthquakes visited Dhaka—on 10April and 11 May. The epicenters of these earthquakes are unknown, but might have been close to Dhaka. The earthquakes jolted Dhaka violently and damaged a number of houses and several buildings at Tejgoan (Rizvi, 1969). The degree of ground shaking had a MM intensity of VIII.
1822 Earthquake – Kishoreganj
An earthquake of magnitude 7.1 on the Richter scale jolted Dhaka and other parts of Bangladesh on 3 April 1822 at approximately 10:30 local time with severe damage reports coming in from Mymensingh (Martin and Szeliga, 2010). The epicenter of the earthquake was located about 70 km northeast of Dhaka near Kishoreganj. The tremor was followed by three minor aftershocks. The ground shaking in Dhaka was believed to be VI on MM intensity scale.
1842 Earthquake – Rajshahi
A major earthquake occurred on 11 November 1842 with magnitude Mw 7.3 shook most of Bangladesh, including Dhaka (Martin and Szeliga, 2010). The maximum damage was reported from Pabna. The epicenter of the earthquake was located 190 km west-northwest of Dhaka near Rajshahi. The intensity of ground shaking in Dhaka was MM V.
1845 Earthquake – Sirajganj
Dhaka experienced three strong earthquakes on 23 July, 26 July and 6 August 1845. All three tremors were felt strongly in Bengal and lower Assam (Martin and Szeliga, 2010). The first quake occurred at approximately 4:30 am local time on 23 July and had a magnitude of 5.9. This was followed by a second tremor at approximately 2:00 am local time on 26 July that had a magnitude of 6.1. The third one was the strongest (Mw 7.1) and it occurred on 6 August at approximately 11:30 pm local time. The epicenters of the first two were centered on Sirajganj about 100 km northwest of Dhaka. The third quake was 265 km north of Dhaka located in lower Assam. No damaged at Dhaka was reported from these earthquakes. The ground shaking intensity at Dhaka was MM V to VI.

1846 Earthquake – Mymensingh

A strong earthquake was felt in Dhaka on 18 October 1846 at 2:00 pm local time. The earthquake was preceded by three foreshocks on 16 October (11:10 am) and 17 October (6:10 am, 11:20 am). Buildings were destroyed in Muktagacha and Sherpur while in Mymensingh many structures, including the mosque, the church and many government buildings were damaged. Several prisoners were injured by falling debris at the jail in Mymensingh (Martin and Szeliga, 2010). The epicenter of the tremor was located 150 km north of Dhaka near Phulpur of Mymensingh. The earthquake had a magnitude of 6.2 on the Richter scale. Though no reports of damage were available for Dhaka, it shook the city with MM intensity VI.

1865 Earthquake – Chittagong

Dhaka was strongly jolted and plaster was reported to be dislodged from buildings from the earthquake of 1865 that occurred on 14 December at approximately at 6:45 pm local time (Martin and Szeliga, 2010). Reports of damage published in the print media (Bengal Hurkaru, 1865, December 18- December 22; Englishman, 1865, December 16- January 4) suggest the epicenter was probably in Chittagong. Several aftershocks were felt until 18 December. Another earthquake, triggered in north Bengal on 19 December at approximately 9:30 pm local time, also shook Dhaka severely. An eyewitness in Dhaka noted, “It nearly threw us off our editorial chair” (Englishman, 1865, December 16- January 4). The MM intensity for both the earthquakes was believed to be VI to VII.

1885 Earthquake – Bengal

This earthquake, known as the Bengal Earthquake, occurred on 14 July 1885, and is one of the most seven earthquakes. The earthquake was followed by eleven aftershocks during the period 21 July to 5 September 1885 (Middlemiss, 1885). Though no exact figures for the casualties in Dhaka caused by this earthquake are available, it was truly one of the major earthquakes in Bangladesh. The quake hit at 6:25 am local time and was centered just 50 km northwest of Dhaka near Manikganj. It is believed to have occurred on the Madhupur fault. The earthquake had a magnitude 7 on the Richter scale. Middlemiss (1885) notes, “Taking its rise in Bengal, this earthquake of the 14th July was felt with violence throughout the province. It extended westwards into Chota Nagpur and Behar, northwards into Sikkim and Bhutan, and eastwards into Assam, Manipur and Myanmar. The area over which it was sensibly felt may be roughly laid down as 2,30,400 square miles. An irregular ellipse drawn through Daltongunge (in Palamow), Durbhanga (in Behar), Darjeeling, Sibsagar, Manipur and Chittagong will give the external boundary of that area. Within this, again, another irregular figure may be drawn through Calcutta, Sitarampur, Monghir, Purnea, Siligori, the Garo hills, Chattack and Barisal, which will enclose an area over which the shock was felt with such considerable violence as to shake loose objects, rattle windows, and produce small cracks in double-storied houses. Finally, we have another figure within this

bounded by Rampur, Bogra, Sherpur (Maimensing district), Mymensing, Dhaka and Pabna, where destruction to buildings is greatest and loss of life occurred".

1897 Earthquake – Great Indian

This earthquake is known as the Great Indian Earthquake and was triggered on 12 June 1897 at 17:11 BST. It is one of the most powerful and destructive earthquakes in recorded history. The quake was located in the western part of the Shillong Plateau about 200 km north of Dhaka. It probably originated from the reactivation of Dauki fault, (Szeliga et al., 2010), although Bilham and England (2001) place it on the Oldham fault on the north side of the Shillong Plateau. The magnitude is estimated from its surface effects and their spatial distribution suggests it was 8.7 on the Richter scale. The shock was preceded by a rumbling underground noise which lasted for about 3 minutes (Johnson, 1988). The actual earthquake lasted about two and a half minutes in Shillong. This noise was compared with the tremendous rumbling noise like a thousand ships' engines thumping away in the midst of a storm at sea. The shocks were so severe and prolonged that most buildings were leveled to the ground (Moore, 1910). The earthquake left an area of 3,90,000 sq.km. in ruins and was felt over 6,50,000 sq.km. From theMyanmar to Delhi.Alarge number of ground fissures and vents were observed. The epicentral area, including parts of Bangladesh, witnessed many secondary effects like ejection of water and sand, rotation of pillars, rise in river height, and liquefaction of soils and sinking of houses. Hundreds of aftershocks—some very heavy and some light—were felt in Dhaka over a period of two months. At Bordwar tea estate, a week after the great shock, the surface of a glass of water standing on a table was in a constant state of tremor.At Tura, a hanging lamp was kept constantly on the swing for three days. At least 1,626 people were killed. Extensive damage from shaking and liquefaction occurred in Assam, Meghalay and Bangladesh (Oldham, 1899; Ambraseys and Bilham, 2003). The great earthquake of 1897 did much damage in Dhaka city, but luckily it caused comparatively little loss of life. Ground fissures and sand veins were also occurred at many places in the city. The earthquake intensity at Dhaka was VIII+ on MM scale. Shaheen Medical Hall, a temple known as Nazir's Math, Shahbagh, and the house occupied by Mrs. Stansbury – all collapsed and five persons were killed, including two foreigners, beneath the ruins, while nine other houses, including the residences of the Commissioner, the Collector, the Judge, and the Civil Surgeon, were rendered uninhabitable. The amount of damage to buildings published in the print media was different from the government statement.

1918 Earthquake – Srimangal

Often referred to as the Srimangal earthquake, this massive quake was centred 70 km southeast of Mymensingh and 100 km northeast of Dhaka near Kishorganj. It was preceded by a series of light to moderate foreshocks. The earthquake occurred at 4:22:07 pm local time and had a magnitude 7.6 on the Richter scale. Its depth of focus was 14 km. The earthquake was strongly felt throughout Bangladesh and the degree of ground shaking in Dhaka was MM VII. The earthquake caused

considerable damage to buildings in Dhaka.

1923 Earthquake – Meghalaya

A major earthquake with magnitude Ms 7.1 occurred on 9 September 1923 at 22:33:42 BST. The epicenter was located 180 km north-northeast of Dhaka in southern Meghalaya near the Bangladesh-India border. The earthquake causes heavy damage at Mymensingh and was felt all over Bangladesh with aMM intensity VI at Dhaka.At least 50 people were killed in the Mymensingh district in northern Bangladesh. Damage occurred in Mymensingh and to a lesser extent at Agartala, Guwahati and Kolkata.

1930 Earthquake – Dubri

This earthquake is known as the Dubri earthquake. It was triggered on the early morning of 2 July 1930 at 03:53:34.4 BST with aftershocks of magnitude 6. The epicenter was located 230 km north of Dhaka in northwestern Shillong Plateau near Dabigiri, Meghalaya. The earthquake was felt widely in Bangladesh with MM intensity V+ at Dhaka.

1934 Earthquake – Bihar-Nepal

This is a well-known Bihar-Nepal earthquake that occurred on 15 January 1934 at 14:43:25 BST and caused widespread damage in Bihar and Nepal. At least 8,519 people were killed in Nepal (Pandey and Molnar, 1988) and 7,253 deaths were reported in adjoining parts of India (Dunn et al., 1939). The epicenter was in eastern Nepal close to Bihar-Nepal border and had magnitude 8.4 on the Richter scale. The epicentral distance was 500 km northwest of Dhaka. The tremor was felt all over Bangladesh with MM intensity VI in Dhaka.

1943 Earthquake – Assam

This earthquake occurred on 10 October 1943 at 23:23:17 BST. A major earthquake shook northeast India and had a magnitude of 7.2 on the Richter scale. The epicenter was centred in Hojai, Assam, 365 km northeast of Dhaka. Little is known about this tremor as it occurred during World War II when the threat of Japanese aggression on the eastern border of British India was extremely high. It was widely felt in Bangladesh and northeastern India. Also moderately felt in Nepal, southern Tibet and in parts of Myanmar (Ambraseys and Douglas, 2004). The felt intensity at Dhaka was believed to be MM V to VI.

1950 Earthquake – Assam

This tremor is often referred to as the 1950Assam Earthquake and was the sixth largest earthquake of the 20th century. It had a magnitude of 8.4 on the Richter scale and struck a relatively sparsely populated region in Arunachal Pradesh near the Indo- Chinese border. The epicentral distance from Dhaka was 800 km

northeast. The earthquake triggered on 15 August 1950 at 20:09:28.5 BST and felt all over Bangladesh with MM intensity IV at Dhaka. Water bodies in Dhaka remained in a state of agitation for an hour due to the effect of long period seismic waves from this distant earthquake.

1954 Earthquake – Monipur-Myanmar Border

Dhaka experienced shock from a major earthquake that occurred on 22 March 1954 at 00:12:17 BST. The epicenter of the tremor was centered in northern Myanmar near Monipur-Myanmar border, 480 km east-northeast of Dhaka. The earthquake had a magnitude estimated Ms 7.7. It was felt widely in Bangladesh with MM intensity V in Dhaka. Many city dwellers awoke and ran out in panic. No damages were reported but seismic seiches were observed in water bodies at Dhaka.

1977 Earthquake – Bangladesh-Myanmar Border

A moderate earthquake occurred on 12May 1977 at 18:20:00 BST with magnitude of 5.7 on the Richter scale that jolted Dhaka with MM intensity III. The epicenter of the quake was located 340 km southeast of Dhaka near Bangladesh-Myanmar border with focal depth of 40 km. It was strongly felt at Bandarban where people attending a political rally rushed outdoors in panic. Many buildings in Chittagong developed cracks and numerous people were injured, some after jumping from buildings.

1988 Earthquake – Bihar-Nepal

Many people in Dhaka were awakened in the early hours of 21 August 1988 at 05:09:09.56 BST by the shaking of high rise buildings from a strong earthquake. This earthquake occurred in eastern Nepal bordering Bihar, about 510 km northwest of Dhaka. The earthquake had a magnitude of 7.8 with focal depth of 57 km that killed 998 people and caused severe damage to buildings in Nepal and Bihar. The tremor was felt in most parts of Bangladesh. Seismic seiches were also observed in many water bodies that capsized numerous boats including a ferry on the Jamuna River killing two people and leaving nearly thirty missing (Bangladesh Observer, August 22, 1988). The felt intensity at Dhaka was MMV.

2001 Earthquake – Dhaka

The residents of Dhaka city experienced two consecutive shocks in a second. The first shock was due to the arrival of P-wave followed by the arrival of S-wave as second shock. This was an earthquake triggered at the southern periphery of the city. The earthquake occurred on 19 December 2001 at 1:54:07.96 pm local time. The epicenter was centred 11 km south of Curzon Hall across the Burigonga River at Kalakandi. The earthquake had magnitude estimated 4.5 on the Richter scale and had hypocentral depth of about 10 km. The duration of shaking was 21 seconds. The earthquake was felt at Narayanganj, Munshiganj, Chittagong,

Comilla, Gazipur, Laxmipur, Rajshahi and as far as Rangpur. Strong tremors were felt (MM V-VI) in Dhaka city, and many people rushed out of their homes and offices in panic.

2003 Earthquake – Borkol

Known as the Borkol earthquake, occurred in the early morning of 27 July 2003 at 5:18:17.96 am local time. This quake killed three people, injured 25 people and damaged about 500 buildings in Chittagong and the Chittagong Hill Tracts. Power supply to some areas was cut as a transformer exploded at the Modunaghat Grid Sub-station in Hathazari, Chittagong. The epicenter was situated 217 km southeast of Dhaka at the eastern bank of Kaptai reservoir. It had a magnitude measured Mw 5.7. Dhaka shook with MM intensity IV. Many people were awakened, especially residents of upper floors of high rise buildings.

2004 Earthquake – Sumatra

Known as the Sumatra earthquake that initiated on the morning of 26 December 2004 at 06:58:53 BST off the west coast of north Sumatra. It had a magnitude measured Mw 9.3 with focal depth of 30 km. It was one of the deadliest natural disasters in recorded history, having generated devastating tsunamis that struck along the coasts of most landmasses bordering the Indian Ocean, killed about 2,30,000 people in fourteen countries including 2 people in coastal Bangladesh. The epicentral distance was 2,350 km south of Dhaka, but the rupture propagated northward for 1,200 km reaching much closer to Bangladesh. The tremor was felt all over Bangladesh.

2008 Earthquake – Manikganj

A minor earthquake jolted Dhaka and surroundings on the evening of 20 March 2008 at 7:15:51.35 pm local time and created considerable panic among the city dwellers. The earthquake had a magnitude measured 3.8 on the Richter scale with focal depth of 35 km (NEIC, DUEO). The epicenter was situated in Manikganj 41 km west-northwest of DUEO. It was believed to be originated from the Madhupur fault. The Bengal Earthquake of 1885 had also occurred in the same region.

2008 Earthquake – Mymensingh

Known as Mymensingh earthquake, this temblor occurred in the middle of the night of 27 July 2008. The epicentre was located 12 km northeast of Mymensingh city and 120 km north of Dhaka. It had a magnitude estimated 5.1 on the Richter scale and a focal depth of 17 km (NEIC). Apart from Mymensingh where the earthquake caused panic, tremors from this earthquake were felt in many parts of the Dhaka. The ground shaking was MM V at Dhaka.

2008 Earthquake – Chandpur
A light earthquake with couple of aftershocks jolted Dhaka on the evening of 20 September 2008 just before Iftar. It caused tremendous panic among the city dwellers. The epicenter was 50 km southeast of Dhaka near Kachua of Chandpur. The magnitude was 4.5 on the Richter scale with a focal depth of 10 km (NEIC, DUEO). The tremor was strongly felt in Dhaka with MM intensity V.
2009 Earthquake – Bhutan
Known as eastern Bhutan earthquake. A strong earthquake occurred on the day of Eid-ul-Fitr, 21 September 2009 at 14:53:06 BST. The epicenter was situated in eastern Bhutan, 410 km northeast of Dhaka. It originated from the Main Central Thrust (MCT). This distant quake had a magnitude Mw 6.1, but shook most of Bangladesh including Dhaka while people were celebrating Eid-ul-Fitr. The ground shaking at Dhaka was MM V. People at upper floors of high rise buildings were panicked; some came out of their houses and offices in fear. Small and light objects fell down.
2009 Earthquake – Bay of Bengal
The residents of Dhaka woke up at midnight of 10 August 2009 and many ran out of their houses in fear. A major earthquake that occurred on early 11 August 2009 at 01:55:35.61 BST rocked Bangladesh. The epicenter was located in Bay of Bengal between north Andaman Island and Myanmar coast, 1100 km south southeast of Dhaka. The earthquake was originated from a 300 km long seismic gap of active subduction zone of Indian and Burmese plates between the locations of the 2004 Sumatra and 1762 Chittagong earthquakes. It had a magnitude Mw 7.5 with focal depth of 4 km (NEIC). The quake was strongly felt in most parts of Bangladesh including Dhaka. Residents of upper floors in high rise buildings woke up. Many people panicked and ran out of their houses for safety (The New Nation, 12August 2009; The Independent, 12 August 2009). A tsunami warning was issued for Bangladesh coast but withdrawn after few hours (The Independent, 12 August 2009). However, no casualty or damage was reported. The intensity of ground shaking at Dhaka was MM V.

4.10 BIOLOGICAL RESOURCES

Flora and Fauna

General Consideration

Forests, pasture lands, rivers, surface water and other water bodies, etc. are the most important natural ecosystems. They are the foundation on which conservation of

biological diversity depends. Biological diversity, which refers to genetic variation as well as to the diversity of human populations and ecosystems, is a resource that belongs not only to regions and to nations but also to all of humankind. Although it is a renewable resource, it can be irreversibly destroyed. Future uses of this resource (medicine, plant breeding. etc.) cannot be foreseen at present, although they will certainly be extensive in scope, and they even are crucial to the survival of humankind.

It is extremely rare to encounter completely natural areas nowadays. On the other hand, both extensive and local use of natural flora and fauna can be regarded as normal occurrences in natural ecosystems. Although the transition from hunting and gathering to settle agriculture in established agro-ecological zones is complete almost everywhere, traditional forms of resource use continue to play an important role in the lives of rural populations. Current pressure due to increase production and extend the area of land under cultivation is leading to more intensive use of remaining predominantly natural areas. This results in environmental stress and rapid loss of biological diversity, as well as permanent conversion of land to agricultural use.

Opening up natural areas in order to exploit their resources with modern technology frequently leads to additional forms of resource use. For example, forests opened up to commercial forestry are more exposed to uncontrolled over exploitation, as well as being subjected to ecological stress by migrants who practice agriculture.

Both extensive resource use over large areas and selective, intensive use of every favorable site can severely damage an ecosystem. Small-scale operations preservation of remaining natural areas and resource use in harmony with nature are important if the resources of a region are to be managed in an ecologically appropriate manner. Proper monitoring is needed in order to obtain reliable information about significant changes in an ecosystem.

Every region needs areas set aside to preserve ecological balance (nature reserves, of natural vegetation, fallow land) in order to conserve its biological diversity. The form, extent and location of these areas must be carefully evaluated in each individual case.
Because many different products in predominantly natural areas are not traded in great volume and do not appear in statistics on trade, their immediate value to the local population is often underestimated. The use of such areas is often of great economic importance to the poorer segments of rural populations. Intense exploitation of such areas is therefore usually accompanied by corresponding social consequences and social costs, even when it appears reasonable on economic grounds.

Many predominantly natural areas are of environmental and economic value beyond their own borders. Forests, for instance, guarantee safe and regular supplies of water because they protect headwaters. The protective function of forests is often recognized only after its neglect has produced negative consequences (deforestation that leads to

erosion, landslides, sedimentation in reservoirs, floods). Intensification of resource use in harmony with nature should be based primarily on indigenous knowledge and modes of production established in the local culture. There is a need to undertake scientific studies in this area since information based on such studies is presently lacking. Locally established responsibility for conservation of natural resources requires appropriate local rights of use. These rights must be regulated by grass-roots organizations.

Regarding the ecological setting of the area has been already mentioned, the area in mostly high and wet ecosystem with forest and other forms of greenery quite at abundance. There had been extensive field survey during the study to assess and also quantify to a certain extent the flora and fauna richness. These concentrated among others, on the wildlife (reptiles, amphibians, mammals and birds), separately on fishes and a floral species (Grass, shrubs, timber/fuel wood trees and fruit trees). Findings of the survey have been presented in Table 4.18 to Table 4.20, respectively in the following pages.

As this is obvious from the above-mentioned tables, the area is quite rich in flora and fauna. However, many of those are quite common for different other areas in Bangladesh. The already existing industries in the study area not just brought, some of the utility services, but have also provided with a different look of infrastructure setting in the area. This is still not something, which can be called aesthetically unacceptable or directly detrimental to the floral growth of the area. However, the industrial activities along with their discharges may prove quite detrimental to both flora and fauna in the area eventually, provided no appropriate corrective measures are taken.

Flora

The proposed project is in a rural setting with greenery. This includes homesteads, horticulture, roadside plantation, natural vegetation, and agricultural crops. Besides highland (elevated) afforestation and homesteads, the remaining area is mostly lowland and generally interconnected with certain manmade barriers and kacha roads here and there.

Due to roadside plantations and certain homestead forests, the area is rich with floral diversities. Different fruit, fuel wood trees along with various shrubs are abundant. Among the trees, the most widely available ones are Shilkoroi, fulkoroi, Mehagani, Shimul, etc. Also there are some fruit trees such as Mango, Coconut, Jackfruit, Battle nut, guava etc.

Aquatic flora is divided into three major types - tree, shrub and herb. Aquatic floral species grow in rivers, canals, ditches, seasonal wetland and low lying agricultural lands in submerged, free-floating, or rooted floating states. Common aquatic floral species in

the study areas include Water hyacinth - Eichhorniacrassipes, Khudipana - Lemnaperpusilla, and Kalmi - Ipomoea aquatica.

Fauna

Fishes

Fish is still reasonably available in the area, given the overall and increasing scarcity of fish in the country. Small fishes, which are very popular also in overall Bangladesh, are available and caught and used widely, particularly during early monsoon and pre-winter season. Among reptiles, narrow headed soft-shell turtle deserves special mention. Among birds, Bok, Salik, Finge etc. deserve special mention.

The fishes include catfishes (Magur and Shing), major carps (Katla, Rui and Mrigal), minor carps (Puti), other (Tengra, Boal, Mola, Taki, Shol). Also prawn, particularly the popular small prawns, locally known as Ichha, Wildlife, and Reptile. The common types of reptiles are found in the area, water snake, house lizard, soft-shell, turtle etc.

Amphibians

Mostly Toads and frogs- two species are prominent.

Mammals

These include fruit bat, Squirrel, field and house mousses, and flying fox. No major mammal species of national significance are present in this area.

Birds

A number of those are including common kingfishers, House crow, House sparrow, little fern etc.

Table 4.18: Faunal Species in the project area.

Scientific Name	English Name	Local Name
Reptiles		
Enhudrisenhydris	Smooth Water Snake	PainnyaShap/ Huriya
Hemidactylus	House Lizard	GodaTikTiki
NajanajaKaouthia	Narrwo headed Softshell Turtee	ChitraKatchap
Chitraindicad		
Amphibians		
Bafomelanostictus	Common Toad	Bang
RanaCyanophyctis	Skipper Frog	Bang

Mammals		
Callosciurus sp.	Squirrel	Kat Biral
Cynopterusspinex	Short nosed fruit Bat	Badur
Funumbaluspennanti	Squirrel	Kat Biral
Herpestes Auropuncatus	Mongoose	Bheji
Musbooduga	Field Mouse	Idur
Musmusculus	House Mouse	NengtiIdur
Pteropusgiganteus	Gaint Flying Fox	BoroBadur
Birds		
Alcedoatthis	Common Kingfisher	Machranga
Copsychussaularis	Robin	Doel
Corvussplendens	House Crow	Kak
Egrettaalbe	Great Egret	BoroBak
Egrettagazetta	Small Egret	ChhotoBak
Dirrurusadsimilies	Black Drongo	Fingry
Passer domesticus	House Sparrow	Choroi

Table 4.19: Floral Species in the Study Area

English Name	Scientific Name	Local Name	Main Name
Grass			
Grass	Spontaneum Saccharum Cynodondactylon	Khar Gash (KaichiKash, Dubla etc.)	Fuel/Covering Soil Binder
Trees			
Lichi	Lichichinensis	Lichu	Fruit
Mango	Mangiferaindica	Aam	Fruit, Timber
Date Palm	Phoenix	Khejur	Fruit, Timber
Balck Berry	sylvestrisSyzygiumc	Jam	Brown sugar
Jackrfuit	uminiheterophyllus	Khatal	Fruit, Timber
Coconut	Cocosnucifera	Narikel	Fruit, Timber
Papya	Carica Papaya	Pape	Fruit, Fuel
Gauva	Psidiumguajva	Piara	Fruit
Banana	Musa Sepientum	Kala	Fruit Fuel
Wood Tree (Timber/Fuel wood)	Shorea Robusta	Shilkoroi	Fuel, Timber
Mehagani, Shal, Shilkoroi, Shimul	AlbiziaproceraSalm aliamalabaricum	Silk cotton	Fuel, Timber Fuel, Pillow

English Name	Scientific Name	Local Name	Main Name
Aquatic Flora (Herb)	Eichhorniacrassipes	Kachuripana	Herb
	Lemnaperpusilla	Khudipana	Herb
	Ipomoea aquatica	Kalmi	Herb

Table 4.20: Fish Species in the Study Area

Fish Group	Scientific Name	Local Name
Prawn	Macrobrachiummalcolmsoni	Icha
Cat Fish	Mystusvittatus	Tengra
	Mystusvittatus	GolishaTengra
	Wallagoattu	BoalPangash
Major Carps	Labeorohita	Rui
	Catlacatla	Catla
	Cirrhinusmrigala	Mrigel
Minor Carps	Puntiussophore	Puti
Snakehead	Channapunctatus	Taki
Eel	Mastacembelusarmatus	Bain
Others	Amblypharyngodonmola	Mola
	Pscudeutropicusatberinoides	Batasi

Figure 4.10 Water Hyacinth near the proposed project site

Fig 4.11: Terrestrial flora (tree) close to the project site

Fig 4.12: Terrestrial flora (herb) close to the project site

Fig 4.13: Terrestrial fauna close to the project site

Fig 4.14: Aquatic fauna close to the project site

4.11 Socioeconomic Baseline Description

As part of the Environmental & Social Impact Assessment (ESIA) of the proposed Power Plant project, an environmental baseline study was carried out in areas surrounding the project site i.e. Daulatpur village. This has been done on the basis of several surveys around the locality as well as Nawabganj Upazila Profile. Bangladesh Bureau of Statistics (BBS),Banglapedia, concerned books and periodicals were also consulted.

4.11.1 Administrative Areas

Nawabganj Upazila is in the Dhaka district with an area of 244.81 sq km, Singair upazila on the north, Dohar upazila on the south, Keraniganj, Sirajdikhan and Sreenagar upazilas on the east, Harirampur and Manikganj Sadar upazilas on the west. The main rivers are Dhaleshwari, Ichamati and Kaliganga. The Upazila consists of 14 union parishads, 178 mouzas and 305 villages.

4.11.1.1 Land Use

Total cultivable land is 18208.01 hectares. Among them fallow land is 6272.76 hectares; single crop 47.5%, double crop 37.8% and treble crop land 14.7%.

4.11.2 Demographic Characteristics of the Project Area

4.11.2.1 Population

Total population as per Nawabganj Upazila Complex within the project area is 269189 of which 49.31% are male and 50.69% are female. The project site is situated in Daulatpur village and according to the Koilail union, the population of Daulatpur village is about 4200 of which about 50% is male and 38% is female with 12% population of Under 18 Year.

4.11.2.2 Household

The number of household of Nawabganj Upazila is 47411. Majority of housing in this area are of pacca, semi-pacca, semi-permanent building i.e. walls made of 5 inch brick works and corrugated iron roof. In case of Daulatpur the number of household is about 1050; 38.67% of the households are pacca, 50% semi-pacca and 11.33% kacha. The homestead areas are relatively medium.

4.11.2.3 Literacy

According to the Banglapedia the study area has an average literacy rate of 54.4%.The literacy rate among the town people is 63.1% and in Doulatpur village it is less than 50%. Literacy rate among the male and female population in the study area is 56.4% and 52.6 % respectively.

4.11.3 Utility Services in the Project Area

4.11.3.1 Sources of Drinking Water

Tube well is the main source of drinking water for the people in the study area. Only

district headquarters and some Upazila headquarters are provided with piped water supplied from the Department of Public Health Engineering (DPHE). Safe drinking water is not available to many of the households of the area. These residents depend on wells, pond as their source of drinking water.

4.11.3.2 Electricity

Electricity in rural Bangladesh is still a relatively scarce commodity, which many households cannot afford even if available at their locality. But in case of Doulatpur village about 85% of the households in the project areahas the electricity facility provided by REB.

4.11.3.3 Health & Hygiene

District Hospitals and Upazila Health Complexes are located at each district and Upazila of the project area. There are also a large number of private clinics located in each district town, which are within a few kilometers from the project area. But such kinds of health facilities are totally unavailable in Daulatpur village where the site is situated. About 38.69 % of the people uses sanitary toilets in the study area while 44.1 % use slab latrine. Only 55.9 % of the population uses katcha or other types of latrine. Moreover, 5.41% of households do not have latrine facilities The hygiene condition of the study area is better/worse than other areas of the country.

4.11.3.4 Waste Disposal

There are some facilities for garbage or hazardous waste dumping in each municipality area of the district. Such facilities are also available in the project area.

4.11.3.5 Emergency Services

There is one firefighting station located at both Ruhitpur & Nawabganj Upazila. Since the firefighting station at Ruhitpur is closer to Daulatpur village; this firefighting station response to the firefighting emergency services required in the village.This firefighting station is about 4 km away from Daulatpur village.

4.11.4 Occupation and Source of Income of Population

As in other parts of the country, the majority of the population (22.10%) in Nawabganj Upazila is engaged in agriculture followed by services including transport, handloom, etc. (18.54%), agricultural labourers (13.27%), business (12.20%), industries and other daily wages (4.5%), Weaving (4.37%) and fishing (2.90%). Traditionally the people of the project area are engaged in various types of business. Due to changing of the economic trend the people are being engaged in agriculture, service in the industries

and self-employment. In Daulatpur village, 35% people are engaged in agriculture & 22% agricultural labourers; 11% people are wage laboureres and about 12% of service holders are found. About 5% of the population is engaged in fishing. Apart from these about 9% of the people is working as expatriate (immigrant) mostly in European countries and 6% is in some other professions. Fig 4.15 is presents the occupation in Daulatpur.

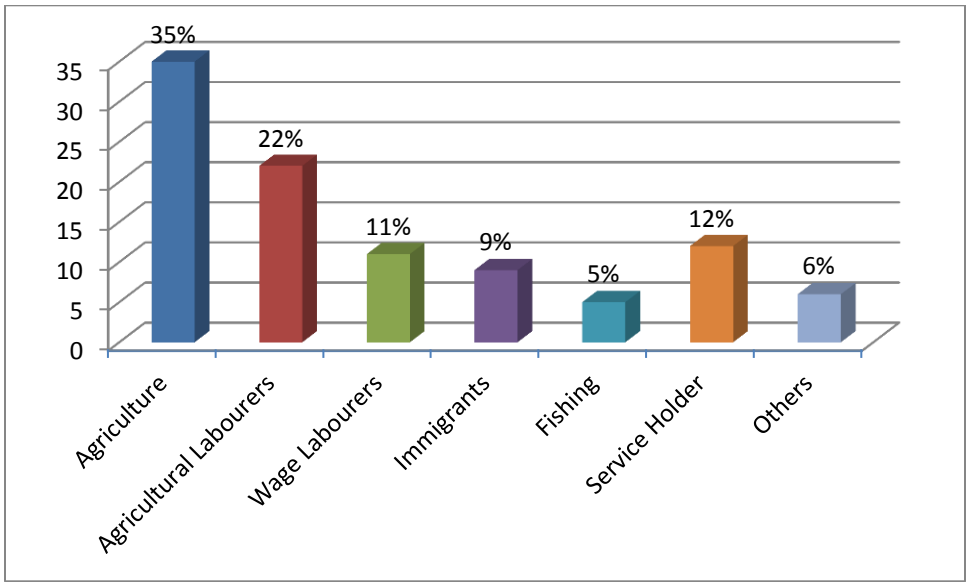


Fig 4.15: Occupation stats in Daulatpur

4.11.5 Ethnic and Religious composition of the Population in the Project Area

The majority of the population in the Nawabganj Upazila is Muslim (>77%) followed by Hindus (20.74%), Christian (2.04%), Buddhist (0.01%) and others 0.01%. In Daulatpur about 85% of the population is Muslim, about 10% of the population is Hindu and rest of the population is Buddhist &Christian. There is no indigenous people in the project area.

4.11.6 Archaeological Heritage and Relics

Bagmara Math and the remnants of the residence of Zamindar Khelaram Dada are the worth mentioning local archaeological heritages in this area. No archeological heritage or such is found in the Kailail union or Daulatpur village.

Chapter 5
Potential Impacts of the Proposed Project

Chapter-5

POTENTIAL IMPACTS OF THE PROPOSED PROJECT

5.0 POTENTIAL IMPACTS OF THE PROPOSED PROJECT

5.1 GENERAL CONSIDERATIONS

In case for most industrial projects, potential negative impacts sometime could be far more numerous than beneficial impacts. The regional and national economic benefits associated with the implementation of any development project are considered to fall outside the scope of an ESIA, and therefore not considered here. However, it is generally expected that these long-term benefits will ultimately trickle down to the local population and will make a contribution to an improvement in the quality of life.

Likewise, the indirect benefits of strengthening of technical capabilities of local persons through association with foreign experts and other training elements that may form part of a project have been considered to fall outside the scope of ESIA.

5.2 SCOPING OF IMPACTS

The potential impacts due to implementation of Project are identified by using simple checklists. This method is described below:

5.2.1 Checklist

Checklist is comprehensive lists of environmental effects and impacts indicator designed to stimulate the analysts to think broadly about possible consequences of contemplated actions (Munn, 1979). **Table 5.1** represents the checklists developed for the present plant. In this checklist, actions, which may affect at the various stages of the project activities, are listed and the degrees of Significant Environmental Impacts (SEIs) are shown. The terms none, minor, moderate and major are used in the checklists to evaluate the magnitude of SEIs. In the checklist, both the construction and operational phases of the proposed development are considered separately in order to distinguish the short term and long-term impacts. As can be observed from the checklists, major environmental components, which will be adversely affected by activities of the project, are air, noise & water quality and socio-economic environment. All these impacts will arise in operation phase of the project. It should be noted that identification indicated in the Checklist relates to the significant level of impact.

Table 5.1: Checklists of Dhaka Southern Power Generations Limited

Project Phase	Action Affecting Environmental Resources & Values	SEIs without Mitigation Measures				Type		Comments
		None	Minor	Medium	Major	Adverse	Beneficial	
Plant Location	Land value depreciation	x						No land value changes anticipated
	Loss of and displacement from homestead land	x						No loss of and displacement from homesteads land; no impact
	Loss of and displacement from agricultural land	x						Loss of and displacement from Agricultural land will not occur; no impact
	Damage to nearby operation	x						No impact anticipated
	Disruption to drainage pattern		x			x		Land development may create problems in local drainage pattern, minor impact
	Inadequacy of buffer zone		x			x		Buffer strip is absent
	Encroachment into precious ecological	x						No precious ecological issues; no impact
Construction Stage	Run off erosion		x			x		Filling would create runoff erosion during rainy season
	Worker accident		x			x		Irregularly may occur in construction period
	Sanitation diseases hazard			x		x		Concentration of labor force create un-hygienic condition
	Noise/vibration hazard		x			x		Piling/equipment installations create noise

Project Phase	Action Affecting Environmental Resources & Values	SEIs without Mitigation Measures				Type		Comments
		None	Minor	Medium	Major	Adverse	Beneficial	
	Traffic congestion		x			x		Carrying of construction materials will create traffic congestion
	Blockage of wildlife passage	x						No wildlife in the area; no impact
	Employment			x			x	Major employment opportunity during construction
Operation Stage	Pollution from liquid discharge			x				Oily liquid waste may generate due to handling of HFO, medium impact
	Pollution from solid waste		x			x		No significant solid waste; minor impact
	Air quality				x	x		Air pollution from stack emission, major impact
	Occupational health hazard			x		x		Inherently will occur, medium impact
	Odor hazard	x						No obnoxious odor will be generated; no significant impact
	Traffic congestion	x						No traffic congestion: no impact
	Noise hazard				x	x		Heavy noise generation is expected; major impact.
	Employment				x		x	Major Employment opportunity during operation

Chapter 6

Prediction and Evaluation of Impacts

Chapter-6

PREDICTION AND EVALUATION OF IMPACTS

6.0 EVALUATION OF IMPACTS

6.1 GENERAL CONSIDERATIONS

The Impacts, which are likely to be occurred in the different phases of the project, are identified in section 5.0. In this section, evaluation of these impacts was done mentioning their origin and characteristics along with their possible mitigation/enhancing measures. At the end of each sub section, status of residual impact is also mentioned.

6.2. ADVERSE IMPACTS AND MITIGATION

6.2.1 Impact due to Project Location/Pre-construction Phase

6.2.1.1 Land Acquisition

Impact Origin

As discussed earlier the Proposed Project will require about 7.00 acres of land. Land acquisition could affect the environment and peoples by the following ways

i. Loss of Homestead land
ii. Loss of Agricultural Land
iii. Cultural, historical and Aesthetic Loss
iv. Loss of sensible places
v. Corruption and partiality during acquisition and Reacquisition process, etc.

Mitigation Measures

The proposed project didn't require any relocation of homestead and land acquisition as the proposed plant would be set up in the land of Rural Electrification Board (REB). The entire land was fallow & vacant land in the project site. There is no homestead land falls inside the proposed project site. There was no cultural, historical and aesthetic interest in the project land and no loss of sensible place. So the above mentioned impacts are negligible.

6.2.1.2 Loss and Displacement from Agricultural Land

Impact Origin

The land was flat, low land. Only one crop (Aman season) in a year as well as some seasonal vegetables were cultivated on that land since the land was not so fertile. So, there was little loss of agricultural land hence agricultural product in the country.

Mitigation Measures

Compensation for the affected land parcels has been paid at market price by the REB through Deputy Commissioner, Dhaka. During acquisition process people were consulted in group about the price and procedure of payment of compensation. During sand filling and other physical works of the project in 2013 the affected people and other stakeholders were again consulted about nature of the project, potential impacts and mitigation measures, project benefits, etc. All of the affected people expressed satisfaction on the price of land. There is no arbitration or grievance on the land price or any other issues as yet from the local people. On the contrary the project authority (DSPGL) has filled the playground of the Kazi Nazrul Islam High School by their own cost to facilitate the students and local people and remove water logging during monsoon. The land use map has been attached in annexure- 5.

6.2.1.3 Disruption of Earth Surface

Impact Origin

As mentioned earlier that land filling would be required to develop the site to provide protection against flood. The land development process is done by sand filling through dredging pipes. The sand is collected from the river Dhaleshwari. The dredged sand is carried out to the required area for filling. This average depth of land filling is about 12 ft. from its original level which doesn't disrupt the natural surface of earth and obstruct the natural drainage system of the area.

Mitigation Measure

According to the plan, **Dhaka Southern Power Generations Limited** will not create any water logging and drainage problem as the DSPGL authority collects the soil to develop the area by carried sand from river Dhaleswari. Cross drainage works should be constructed to bypass the surface water and other discharges. A land development map has been attached in the annexure-6.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented. Residual impact will be very insignificant.

6.2.1.4 Change in Landscape

Impact Origin

A landscape is a subjective concept that cannot be precisely quantified. However, in general, any project when not designed considering the local landscape, then it creates visual intrusion to the people. The proposed project may change the local landscape to some extent.

Mitigation Measure

Any built up part of the plant should be designed considering key criteria of landscape like coherence, readability, hierarchy and stability. It is understood that **Dhaka Southern Power Generations Limited** will have a modern architectural view, which does not provide any significant visual intrusion. One simple way by which the altered green area can be turned into its original visual quality is the plantation of trees around the project area. The greenery layout plan shown in the annexure-4 indicates the tree plantation around the project site.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.2 Impacts during Construction

6.2.2.1 Disruption of Earth surface-Site preparation and Clearing and Earthworks

Impact Origin

Each development project more or less requires site preparation. The preparation works generally done during constriction stages includes

- Biomass Removal
- Biomass Disposal
- Property removal
- Construction of access road
- Cut and fill operation
- Soil Export and Import
- Drainage works etc.

The impacts generally arise from the above activities are as follows:

- Noise
- Fugitive dust
- Runoff and flooding
- Soil erosion: Land erosion along the uncovered space due to soil removal and excavation.
- Water Pollution through runoff and sedimentation
- Social concerns
- Infrastructure disruption
- Safety Concerns

However the proposed site is of the nature that it will cause negligible impacts in the pre-construction stages. The site will require some land filling. The proposed site has no homestead land so impact from property removal activities is negligible.

Mitigation Measures

Cutting and filling operation should be kept minimum. The proponent should ensure construction of proper drainage facility. Regular water sprinkle should be used to minimize fugitive dust emission. Safe working procedures should be ensured by the contractor. Undertaking construction work during dry seasons. The heavy equipment should be operated at day time.

6.2.2.2 Impacts on Air Environment

Impact Origin

The air quality in the project area may slightly deteriorate for the time being during construction. The major construction activities from which air emission mostly dust emission may occur are;

- Poorly paved service lane;
- Ground excavation;
- Delivery of building materials to site;
- Handling and mixing of cement

Poorly Paved Service

The access road to the proposed project should be perfectly paved. Dust nuisance from unpaved or partly paved road is of concern because:-

- There will be increased traffic driving in and out of the proposed site to deliver construction material;
- If soil moisture content becomes very low; it could create increasing quantity of loose particulate matter on road surface;
- There could be no or little vegetation cover to act as dust trap.

Ground Excavation

Site preparation in readiness for construction work may require vegetation clearance stripping off of overburden material, ground leveling and compaction. These activities will open-up the ground to wind action and thus potentially resulting in dust generation. This is because:-

- Vegetation clearance will directly expose the ground to agents of erosion;
- Stripping off of overburden material will loosen soil aggregates thus making them easily susceptible to wind action;

- Removal of tree stumps and roots will weaken soil bounding and thus can easily be blown by wind

Delivery of Building Materials to Site

Construction materials such as building blocks, cement, sand, steel bars, stone/brick chips will be bulky and thus will require to be delivered on site by a fleet of trucks driving in and out of the construction site. During this exercise dust is likely to be generated from the following:-

- Handling of cement which is dusty by nature of the way it is;
- Handling of sand, stone/brick chips may contain loose dust particles;
- Site clearing of area of holding ballast , building blocks and sand will expose the site to wind action;

Handling and Mixing of Cement

The powdery nature of cement will be a potential source of dust especially during handling and mixing it with other materials such as sand and gravel. Cement dust will likely be of concern during:-

- Opening-up of cement bags and empting the cement in order to mix with other construction material;
- During loading and offloading of cement.

6.2.2.2.1 Potential Environmental Impacts of Dust

Dust produced will potentially negatively affect the following:

1) Employees generally construction workers;
2) Immediate neighbors and general public; and
3) Vegetation.

1. Effects of Dust to Employees

Cement dust can affect plant employers in the following way

- ✓ Eye irritation;
- ✓ Skin irritation;
- ✓ Impairment of normal sweating of the skin as it blocks pores on the skin;
- ✓ Chocking of the throat;
- ✓ Respiratory difficulties;
- ✓ Difficulty in breathing;
- ✓ Potential course of chest complication and ailment.

2. Dust Impacts to Immediate Neighbors and General Public

- ✓ Reduced visibility; emission of high particulate matter to the environment will reduce local visibility;
- ✓ Continuous exposure of people to dust will likely affect one's eye sight that can potentially result in an outbreak of eye infection;
- ✓ Chest related aliment; continuous exposure of people to dust will likely result in chest complications and respiratory disorders.

3. Dust Impacts to Vegetation

- ✓ Dust settling on plant leaf surface will block leaves stoma hence interfering with normal respiration of the plants;
- ✓ Dust settling on plants will reduce the evapo-transpiration of plants and animals such as butterflies, caterpillars, grasshoppers who feed of foliage will be affected as the dust settled on foliage will render the foliage unpalatable;
- ✓ Heavy dust settling on plant matter will impair on normal growth of the plant; and
- ✓ Heavy dust settled on plants will choke and kill plants.

6.2.2.2.2 Proposed Mitigation Measures

Following mitigation measures are proposed to minimize the air pollution during the construction stage:-

- ✓ The Project Proponent should ensure the complete paving of the service road
- ✓ Regular sprinkling of water to be done on open surface and dust grounds until paving is done;
- ✓ Transport of materials in tarpaulin- covered trucks
- ✓ The sand and other such dispersible material will be stored at site for minimum working period.
- ✓ Removal of soil/mud from trucks and other appliances prior to leaving the project area.
- ✓ Storage of top-soil in a safe space and creation of top-soil on filled land utilizing this preserved soil
- ✓ Selective cutting of trees in the site should be carried out. Only trees which on exact proposed position of the building should be cleared any other vegetation outside proposed building position should be maintained;
- ✓ Plantation of trees in the construction yard as quickly as possible. Any open area should be planted with appropriate vegetation (trees, flowers and grasses) ;
- ✓ Project management and contractor to enforce strict use of personal protective clothing;
- ✓ Complains of dust related ailments among employees and neighbours to be given access to medical attention.
- ✓ The equipment design will be chosen for least suspension of dust/sand into atmosphere.
- ✓ The construction activity will be carried out during day time only.

The emissions are temporary and not expected to contribute significantly to the ambient air quality and will be within prescribed limits for rural residential regions by National Ambient Air Quality Standards.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.2.3 Impacts on Acoustic Environment

Noise is likely to be generated from the following activities/areas:

- ❖ During ground preparation;
- ❖ During assembly of building materials on site;
- ❖ During construction of the various components of the proposed power plant.

A brief elaboration of each of the potential source/cause of noise is as follows:-

Ground Preparation

Ground preparation is another activity that will potentially result in noise nuisance. Activities of ground preparation that are likely to result in noise nuisance include:-

- ✓ Use of heavy machinery such as excavators, caterpillars in ground excavation will be a source of noise nuisance; and
- ✓ Transportation of excavated earth material from site by use of dump trucks will result in noise nuisance. The noise will be mainly from the trucks.

Assembly of Building Materials

Building materials to be used in construct site will first be gathered and assembled on site. These include building blocks, timber, steel bars, sand, gravel, cement. Possible courses of noise nuisance when assembling construction material on site include:-

- Offloading of building materials on site especially steel bars, gravel and building blocks can result in noise;
- Trucks ferrying in building materials can be a source of noise;
- Employees involved in offloading of building material can be a source of noise.

Construction of the Various Components of the Proposed Power Plant

Construction of the civil work structures for the proposed power plant will be labour intensive. This will involve engaging a large workforce, also during construction some machines and equipment will be in use. Possible sources of noise during construction work may include the following:-

- Loud talking, shouting and conversation among employees;
- Noise from equipment such as cement mixers;
- Noise from machines such as welding machines and wood working machines;
- Increased machine and equipment activity on site.

6.2.2.3.1 Potential Environmental Impacts of Noise

Impacts of noise will potentially affect the following:-

a. Immediate neighbors; and
b. Employees.

a. Impacts of Noise to Immediate Neighbors

- ✓ Continuous exposure of neighbors to noise nuisance may result in noise induced hearing lose;
- ✓ Noise nuisance may reduce concentration of neighbors in their private matters.

b. Noise Impacts to Employees

- ✓ High noise level will force employees to shout laud when communicating to one another;
- ✓ Exposure of employees to high noise level (above 85dB) continuous for 8hours per day may result in noise induced haring lose;
- ✓ Exposure of ear to peak sound level instantaneously may result to deafness.

6.2.2.3.2 Proposed Mitigation Measures for Noise Nuisance Management

- ✓ Noisy construction works to be limited to daytime hours
- ✓ Immediate neighbors to be notified in writing on the date of commencement of construction work at least one month in advance;
- ✓ All employees likely to be exposed to ear noise to be provide with ear protectors;
- ✓ The project Proponent and contractors to ensure strict enforcement on user of ear protectors;
- ✓ Where applicable and possible exceptionally noisy machines to be fitted with noise reduction devices;
- ✓ Any employee who may complain about ear related pain and or complication while at work to access medical attention at the expense of the contractor or project proponent;
- ✓ Fitting noise machines with noise reduction devices;
- ✓ Providing suitable hearing protection to all workers exposed to noise levels above 85dB(A);

The noise impacts will be local; limited to the premises and very short – term.

6.2.2.4 Sanitation Hazard & Drinking water

Impact Origin

The health of the project personnel, construction workers and laborers living at the base camp could be impacted if arrangement of sanitation and drinking water is not ensured adequately and properly. During construction stage, lot of local labors will work and hence they would generate considerable amount of human waste. These are the potential source for spread of diseases, as various insects will play dominating role in the spread of diseases. There are chances for the spread of water borne diseases also.

Mitigation Measures

Proper sanitation system should be provided and at the same time, regular, proper and safe disposal of human waste should be ensured. Contractors and workers should obey appropriate means of waste removal and sanitation measures. Adequate number of toilets and bathrooms should be made for the workers, and proper disposal system of sewage waste should be implemented for sanitation purpose and the workers should be aware to practice those facilities.

The project activities shall make higher demand on the local utilities and service facilities particularly potable water, health and sanitary facilities. There should be sufficient number of tube-wells for drinking purpose.

Residual Impact

If, the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.2.5 Overland Drainage and Impact on Surface Water

The potential impacts on local hydrology are principally those of altered patterns as a result of onside construction and earthwork activities. The proposed project will affect natural drainage, surface and ground water quality if not managed the construction works properly. There could be Siltation of water system or drainage from uncovered piles of soil

Proposed Mitigation Measures

- Surface drainage shall be controlled to divert surface runoff away from the construction area;
- Laying barrier net;
- Undertaking construction work during dry seasons**;**
- Completed areas should be restored/re-vegetated as soon as practicable;
- Temporary silt-trap or digging of pond toward siltation prevention;
- Stockpiling of spoil soil at a safe distance from the drainage system;

- Utilizing spoil soil in land-fill;
- Strict supervision should be maintained to avoid blockage of natural creeks during the construction period, and;
- Containment of sanitary waste should be adequately disposed off to avoid surface and ground water contamination;
- Making provision for temporary disposal of wastes inside construction yard and disposal of solid wastes in an appropriate manner;
- Adequate provision has to be retained for the treatment and disposal of cuttings, drilling fluids and other chemicals and lube oil wastes generated during drilling, testing and commissioning stage;

6.2.2.6 Social acceptability of Construction workers to the host communities

The differences in the cultures of workers (in case hiring is required) and local community may create some problems. In the rural area, the local people especially the religiously conservative section of the community will not accept the foreign workers in general.

Mitigation measures

The project proponent and his organization have practice of working with the workers of different cultures. It is recommended to aware the foreign or culturally different workers (if any) about the social & religious adaptability in the area so that they could maintain those when they will have in touch with local community.

6.2.2.7 Accidents or Occupational Health Hazard

Impact Origin

Under controlled situation, accident is not expected. However, occasionally it occurs during construction works. Accident may occur during earth cutting, casting, construction works and installation of heavy machinery. The protection of head, eye, ear, and hand, foot of the workers, laborers and project personnel could be affected if proper and adequate arrangement is not ensured.

Mitigation Measures

The workers should be provided quality PPE (Personal Protective Equipment), safety goggles, and other necessaries. It would be ensured that the workers will use the PPE at work site. Regular monitoring on occupational health and safety issues will be carried out.

6.2.2.8 Increase in Vehicular Traffic in the Area

Increase in vehicular traffic in the area is likely to be experience during construction phase of the power plant. During the construction phase, increase in vehicular traffic in the area is likely to be because of-

- Trucks ferrying construction material to site;
- Trucks ferrying waste material from site; and
- Ferrying in of construction tools and equipment.

6.2.2.8.1 Potential Negative Environmental Impacts Likely to Result From Increased Vehicular Traffic in the Area

- ✓ Possible traffic congestion of local roads and lanes;
- ✓ Possible of occasional experience of delays on the said local roads;
- ✓ Increased number of vehicles on local roads will result in increased wear and tear of local roads thus reducing lifespan of affected roads;
- ✓ Cost of maintaining local roads will increase;
- ✓ Pedestrians and cyclists using local roads will have to exercise more care with increase of vehicular traffic on the said roads; and
- ✓ There will be an increase of exhaust emission from vehicles, which will pollute local atmospheric air.

6.2.2.8.2 Proposed Mitigation Measures to Mitigate Increase in Vehicular Traffic in the Area

The following measures can be put in place to mitigate possible negative impacts likely to result from increase in vehicular traffic in the area:

- ✓ Management to provide for adequate internal parking, for all vehicles coming to the plant premises;
- ✓ Management to pave the dilapidated service road with tarmac or more durable material;
- ✓ All users of said roads to always observe traffic rules this will give pedestrians and cyclist their space and safety while using the road; and
- ✓ Marking/signs of the roads and directions to be clearly done.

6.2.2.9 Impact due to HFO Transportation

Impact Origin

Spillage of HFO and possible contamination of Dhalewsari water is the possible impact which is to be avoided. DSPGL is responsible for fuel receiving, handling and transportation of HFO from the river jetty to up to the facility. All arrangements required for the supply of liquid fuel to the facility including construction of jetty, necessary arrangements including spill proof transfer system, pipe line up to the storage facility, fuel measuring system, internal fuel supply system, fuel heating and purification/treatment system as per requirement of the offered plant will be installed by the proponent at its own cost and responsibility. The pipeline length from Jetty to Power Plant Storage is approximately 400 meters.

Mitigation measures

Lighter vessel of 1500MT capacity will unload the HFO to the DSPGL jetty 4-5 times a month. This little activity will not affect the normal water transport movement in the river Dhaleshwary as well as the aquatic life. The DSPGL HFO transfer and storage facilities will be designed so that there is no chance for spillage of HFO and mixing of the HFO with surface water body. The unloading area at plant site should have hard standing floor with sealed drainage ended up to oil water separator. The HFO storage tanks should be double skinned and have secondary containment 110% bigger than the storage capacity so that the HFO could be retained in the containment area in case of any emergency failure.

6.2.2.10 Impact due to Transmission line construction

Impact Origin

The project will construct 4.40 km transmission line from the project site to Hasnabad Power Station, Keraniganj. This 4.40 km transmission line follows the LGED road and RHD road. According to the DSPGL, private land will not be used for transmission line. Along the LGED road and RHD road 04 residential and 54 commercial establishments are found close to the road. So, the transmission line will not affect any of these structures. Physical displacement will not be required due to the project interventions.

Mitigation measures

Since the transmission line will not relocate any settlement and will be laid through the road side of LGED & RHD, there would not create any negative impact to the surrounding environment.

6.2.3 Impact during Operation Stage

Operation of the project may potentially affect quality of life, air, noise, water, land and flora, fauna and human by increase in air, noise and water pollution, increase in hazardous waste generation, pollution from spillage/surface runoff, disturbance to flora and fauna, by loss of trees resulting from increased assess, increase in land values, threatening agriculture, etc. Environmental issues during the operational phase primarily include the following:

- Air emission (Significant)
- Noise generation (Significant)
- Hazardous waste generation (Minor)
- Water use and waste water discharge (Minor)
- Health and Safety

An in-depth analysis of each of the potential negative impacts is as follows.

6.2.3.1 Impact on Air quality

Impact Origin

Emission from the engine and generator stack may affect the ambient air quality. Unburned gases from the engine operation may affect the air quality. The situation aggravates when the fuel (here HFO) contains high percentage of impurities like sulfur, water, metals, MCR (micro carbon residue) etc. The high temperature of flue gases also impacts the air quality in terms of thermal pollution. The combustion of heavy fuels for power Generation inevitably results in emission of particulate and gaseous pollutants to the atmosphere. As the proposed power plants would be fired with Heavy fuel oil, the air pollutants emitted by the power plant will be Particulate matter, carbon monoxide, nitrogen oxides and sulfur dioxide.

Sulfur dioxide (SO_2) Emissions from the power plant

SO_2 is a colorless gas. It smells like burnt matches. It can be oxidized to Sulfur trioxide, which in the presence of water vapor is readily transformed to Sulfuric acid mist. SO_2 can be oxidized to form acid aerosols. SO_2 is a precursor to Sulfates, which are one of the main components of respirable particles in the atmosphere.

Health Effects

Health effects caused by exposure to high levels of SO_2 include breathing problems, respiratory illness, changes in the lung's defenses, and worsening respiratory and cardiovascular disease. People with asthma or chronic lung or heart disease are the most sensitive to SO_2. It also damages trees and crops. SO_2, along with nitrogen oxides, are the main precursors of acid rain. This contributes to the acidification of lakes and streams, accelerated corrosion of buildings and reduced visibility. SO_2 also causes formation of microscopic acid aerosols, which have serious health implications as well as contributing to climate change.

Nitrogen Oxides (NOx) Emissions from the Proposed Plant

Nitrogen gas, normally relatively inert (nonreactive), comprises about 78% of the air. At high temperatures and under certain other conditions it can combine with oxygen in the air, forming several different gaseous compounds collectively called oxides of nitrogen (NO_x). Nitric oxide (NO) and nitrogen dioxide (NO_2 - the criteria pollutant) are the two most important. Major source of nitrogen oxides in the proposed power plant include the fuel combustion in power plants.

The engine emission data from the HFO generator shows that NOx emission from each engine will be below 1480 mg/Nm3 (15% O_2), which is lower than the IFC/WB guideline; NOx emission limit for liquid fuel-fired reciprocating engine power plants

located in non-degraded air shed is 1850 mg/Nm3 (15%O_2) as the compression ignition, bore size diameter is 480 mm (≥ 400 mm).

Health Effects

Certain members of this group of pollutants, especially nitrogen dioxide (NO_2), are known to be highly toxic to various animals as well as to humans. High levels may be fatal, while lower levels affect the delicate structure of lung tissue. In experimental animals this leads to a lung disease that resembles emphysema in humans. As with ozone, long-term exposure to nitrogen oxides makes animals more susceptible to respiratory infections. Nitrogen dioxide exposure lowers the resistance of animals to such diseases as pneumonia and influenza. Humans exposed to high concentrations suffer lung irritation and potentially lung damage. Increased respiratory disease has been associated with lower level exposures.

The human health effects of exposure to nitrogen oxides, such as nitrogen dioxide, are similar to those of ozone. These effects may include:

- Short-term exposure at concentrations greater than 3 parts per million (ppm) can measurably decrease lung function.
- Concentrations less than 3 ppm can irritate lungs.
- Concentrations as low as 0.1 ppm cause lung irritation and measurable decreases in lung function in asthmatics.
- Long-term lower level exposures can destroy lung tissue, leading to emphysema.

Children may also be especially sensitive to the effects of nitrogen oxides.

Other Effects

Oxides of nitrogen also can:

- Seriously injure vegetation at certain concentrations. Effects include:
  - Bleaching or killing plant tissue.
  - Causing leaves to fall.
  - Reducing growth rate.
- Deteriorate fabrics and fade dyes.
- Corrode metals (due to nitrate salts formed from nitrogen oxides).
- Reduce visibility.

Oxides of nitrogen, in the presence of sunlight, can also react with hydrocarbons, forming photochemical oxidants. Also, NO_x is a precursor to acidic precipitation, which may affect both terrestrial and aquatic ecosystems.

Particulate Matter

Amount of PM emission can be substantial from HFO plants, which is generally estimated as 1.50 g/kWH[1]. With this level of emission, the emission from the plant will be 22.92 gm/sec. The project area is located in rural area where the quality of air shed is moderately good. So, this small contribution of PM to the local air shed will not be very significant. Moreover, the plant would have a Flue Gas De-sulpharisation (FGD) in the plant will also substantially (>50%) reduce PM emission as it uses a wet scrubbing process. Nevertheless, the PM issue has been examined by the emission modelling to evaluate the PM10 dispersion to the surrounding project area.

Carbon monoxide and carbon dioxide Emissions from the Proposed Plant

Carbon monoxide is generated when incomplete combustion takes place. The emission of carbon dioxide depends on the fuel burn and the carbon content in the fuel. The proposed power station is a heavy fuel oil fired modern design with optimum designed cycle efficiency in order to maximize the MW output and less consumption of fuel and water, CO & CO_2 emission per unit of fuel burnt will be smaller amount compare to other power stations. The ambient CO level is low (table 4.14) and compression ignition engines use excess air for combustion. So, CO emission is low and it no mitigation is required.

Mitigation Measures

A. Engine Emission

SO_2 Emission

The emissions of SO_2 are dependent on the sulfur content of the fuel. The project authority will use HFO with approximated sulfur content of 3.4% which is above the allowable limit of IFC/WB Environmental Health & Safety Guideline 2008, is 2% or less Sulfur content for the SO_2 emission of liquid fuel oil power plant in non-degraded air shed. There is no standard set in the Bangladesh ECR 1997 for the SO_2 emission for the liquid fuel fired power station. So we should consider the standard of IFC/WB guideline in this situation. The project will have a Flue Gas de-sulfurization plant (FGD) to reduce the sulfur emission (more than 90%). With this level of emission, the estimated SO_2 emission at the final exhaust will be equivalent to HFO with 0.38% Sulfur content. So, the SO_2 emission level at the final exhaust would be lower than the requirement of IFC/WB standard.

The detail of the Flue Gas De-Sulfurization (FGD) plant has been discussed in the Chap-7.

[1] US EPA-420-R-09-007: Technical support document (2009)

NOx Emission

The engine emission data from the HFO generator shows that NOx emission from each engine will be below 1480 mg/Nm3 (15% O_2), which is within the allowable limit of the IFC/WB guideline. NOx emission guideline for liquid fuel-fired reciprocating engine power plants located in non-degraded air shed is 1850 mg/Nm3 (15%O_2) as the compression ignition, bore size diameter is 480 mm (≥ 400 mm). There is no standard set in the Bangladesh ECR 1997 for the NOx emission for the liquid fuel fired power station. So we should consider the standard of IFC/WB in this situation. The Flue Gas de-sulfurization plant (FGD) will also reduce the NOx content of the exhaust as it uses a wet scrubbing process and NOx is soluble in water. The ambient NO_2 level is low (table 4.14) and considering small contribution to cumulative emission in the air shed, the NOx level is not expected to exceed the NAAQS.

B. Ambient air quality

An effect on ambient air quality has been assessed based on air emission dispersion modeling. In this study, the PM10, SO_2 and NOx emissions for the reciprocating HFO engine system discharged through stack were modeled to obtain maximum possible downward ground concentration. USEPA AERMOD view version 8.0.5 model was used to estimate the emission concentration from the plant. The exhaust specifications and stack parameters for the proposed reciprocating HFO engine are used as input to AERMOD model. The individual engine stack data was used as point source of PM10, SO_2 & NOx emissions and the results are the summation of 3 emission sources. The parameters and corresponding values are summarized in the table 6.1 below:

Table 6.1: Exhaust specifications and model input data (for one engine emission)

Parameters	Values
Stack height (m)	32
Stack inside diameter (m)	4.5
Stack exit velocity (m/s)	
Exhaust temperature (K)	(194.9+273) = 464.9
Exhaust flow rate (m^3/sec)	14.22
NOx emission rate as NO_2 (gm/sec)	10.01
SO_2 emission rate (gm/sec)	49.33
PM emission rate (gm/sec)	7.64
Ambient temperature (K)	273

*calculations have been attached in annexure -12

The model assumes the stack tip downwash with receptors on flat terrain and no flagpole receptor heights. The PM10, NOx and SO_2 concentration contour have been analyzed separately with 500 m interval with a radius of 5000m from the point source.

NO_2 concentration:

The NO_2 concentration contour of 24 hour and annual average of have been analyzed. The maximum of 24 hour concentration of NO_2 (30-50 µg/m^3) has been predicted at a radius of 200m north & south and 1000m north & south to the project. The concentrations are found below 10-30 µg/m^3 within 1000m north & south and around up to 5000 to the other sides. The maximum annual concentration of NO2 has been detected as 3-5 µg/m^3 at 500m around the project side and the concentrations are within 0.5-3 µg/m^3 on the either sides up to 5000m from the project.

There is no IFC/WHO and Bangladesh standard set for 24 hour concentration for NOx. The maximum yearly concentration of NOx have been detected (max 5 µg/m^3) well below the IFC/WHO and Bangladesh standard at all sides at any radius around the project.

SO_2 concentration:

The SO_2 concentration contour of 24 hour and annual average of have been analyzed. The maximum of 24 hour concentration of SO_2 (100-300 µg/m^3) has been predicted at a radius of 500m north & south and 2000m northwest & northeast to the project, whereas the concentrations are within 50-100 µg/m^3 at a radius of 500-1000m north & south and up to 5000m to the other sides. The maximum annual concentration of SO2 has been detected as 20-50 µg/m^3 at 500m around the project site, whereas the concentrations are within 5-20 µg/m^3 on the either sides at around 1000 m north & south and up to 5000m at the other sides to the project. The plant would have a FGD, in which the emission level for SO_2 will further be reduced by 90% and thus will come down to 10-30 µg/m^3 (24 hour average) and 0.20-0.50 µg/m^3 (annual average) respectively.

There is no IFC/WHO annual standard set for SO_2 for ambient air quality, the 24 hour concentration of SO_2 have been found (10-30 µg/m^3) below the IFC/WHO standard (20 µg/m^3) and also below the Bangladesh standard (24 hour average 365 µg/m^3 and annual average 80 µg/m^3) at all sides of the proposed project after installing the FGD.

PM10 concentration:

The PM10 concentration contour of 24 hour and annual average of have been analyzed. The maximum of 24 hour concentration of PM10 (10-40 µg/m^3) has been predicted at a radius of 200-500m north & south and up to 5000m east & west to the project site. The concentrations are found below 10 µg/m^3 at the other sides of the project site beyond 500m. The maximum annual concentration of PM10 has been detected as 3-8 µg/m^3 at 500m around the project side and the concentrations are below 3 µg/m^3 at all the sides which is coming down to 0.3 µg/m^3 from 500m 5000m surrounding the project.

The IFC/WHO and Bangladesh standards for 24 hour PM10 concentrations are (50 µg/m^3 and 150 µg/m^3 respectively) and annual concentrations (max 20 µg/m^3 and 50

µg/m^3 respectively). The 24 hour and annual PM10 concentrations have been found below Bangladesh and IFC/WB standard at all the sides of the project. Further, on installing FGD, it will also substantially reduce PM emission (>50%) as it uses a wet scrubbing process.

Air quality near School

There is a school located at 220m northeast to the project site, where there is chance of air pollution contribution from the project. The following table shows from the modelling contour that all the parameters near the school area have been found within the Bangladesh and IFC/WB limit.

Radius in m		100	200	300	400	500
PM10 Conc (µg/m^3)	24 hour	10-40	10-40	6-10	6-10	6-10
	Annual	3-5	3-5	1-3	0.8-1	0.5-0.8
NO2 Conc (µg/m^3)	24 hour	10-30	10-30	10-30	10-30	10-30
	Annual	1-3	1-3	1-3	1-3	1-3
SO2 Conc (µg/m^3)	24 hour	10-30	10-30	8-10	8-10	5-6
	Annual	1-2	1-2	0.7-0.1	0.5-0.7	0.5-0.7

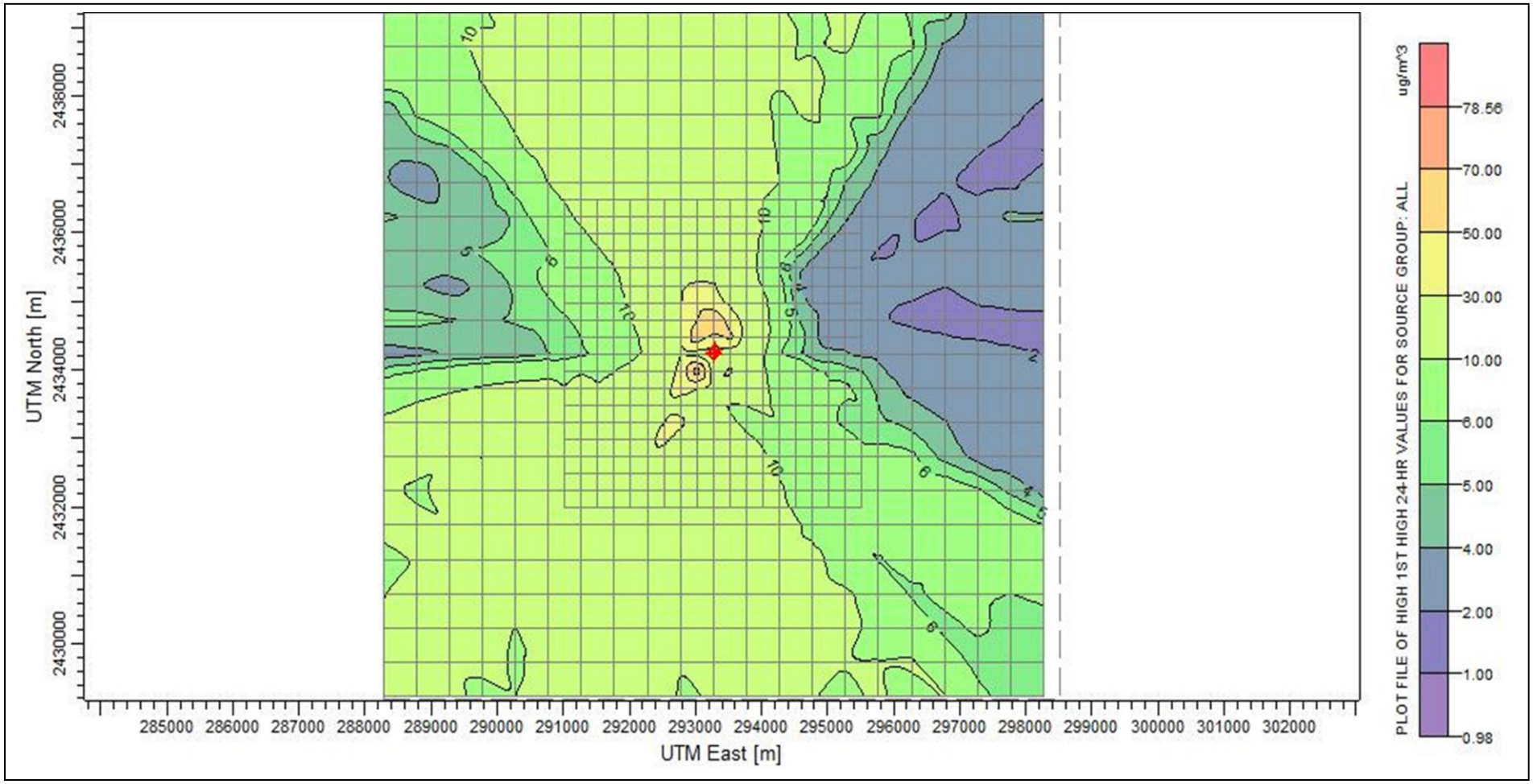
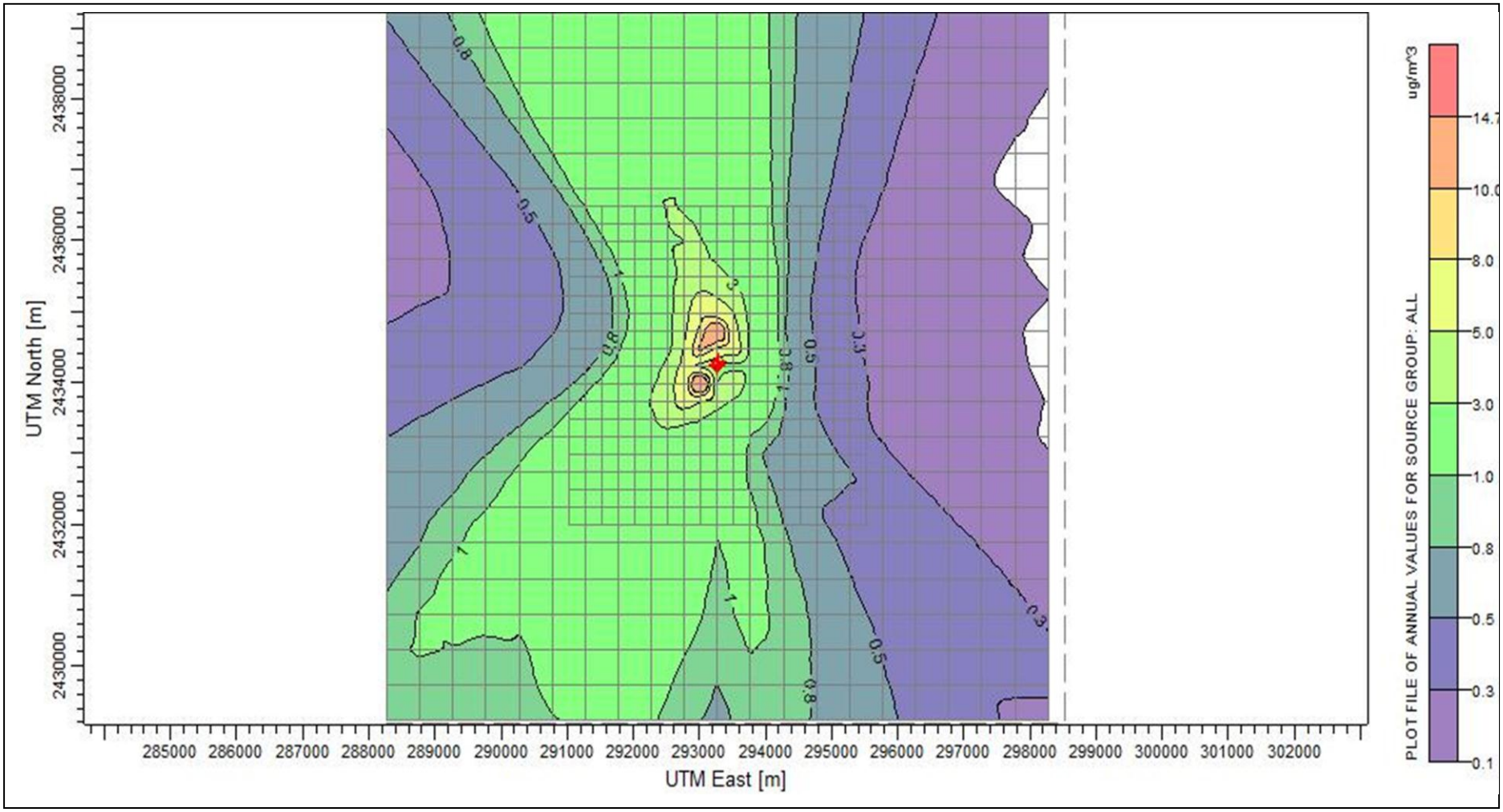


Figure 6.1: Emission contour map showing the NOx concentration (24 hour average) at 5000m surrounding the project location



6.2: Emission contour map showing the NO2 concentration (Annual average) at 5000m surrounding the project location

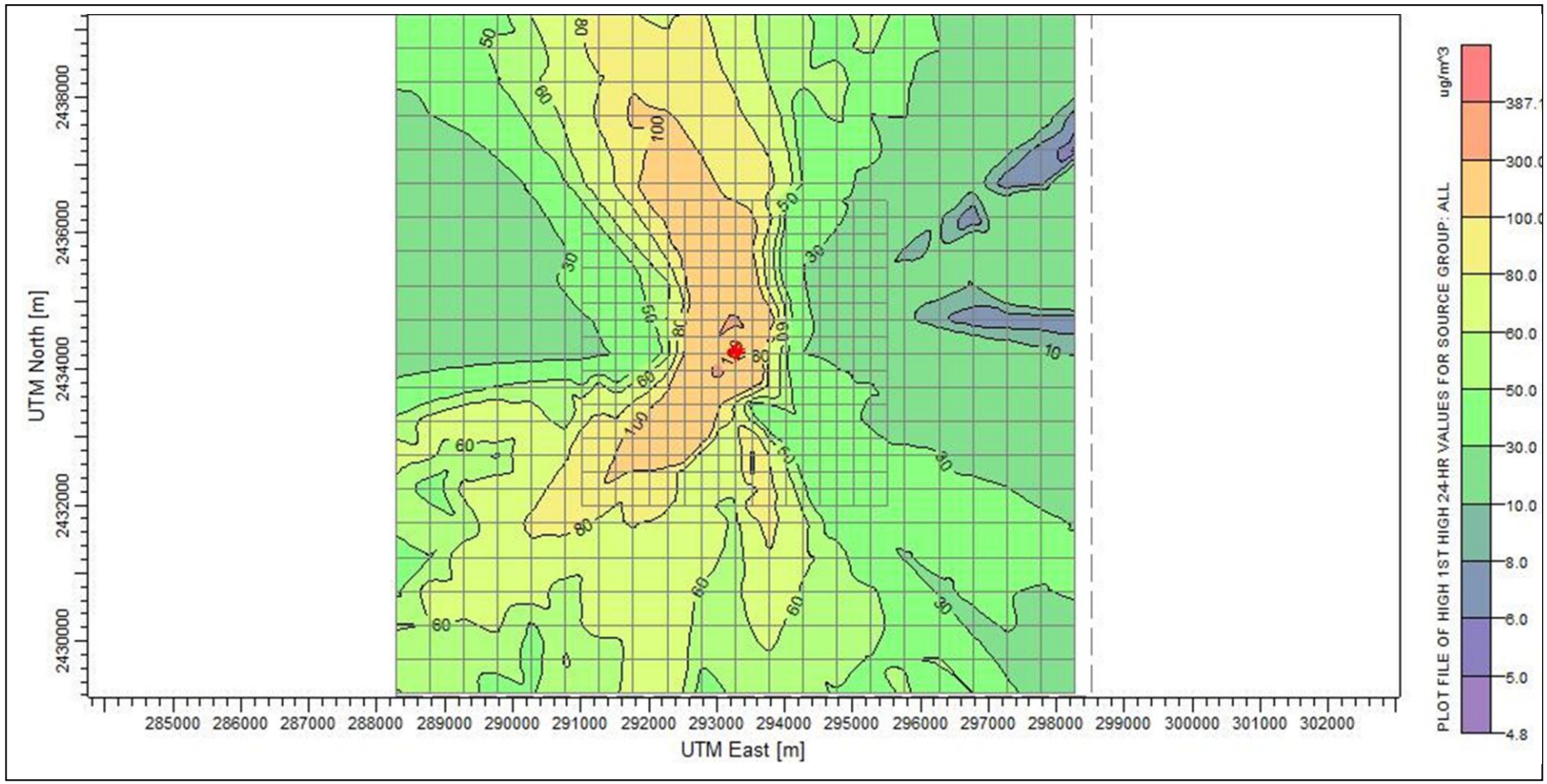


Figure 6.3: Emission contour map showing the SO2 concentration (24 hour average) at 5000m surrounding the project location

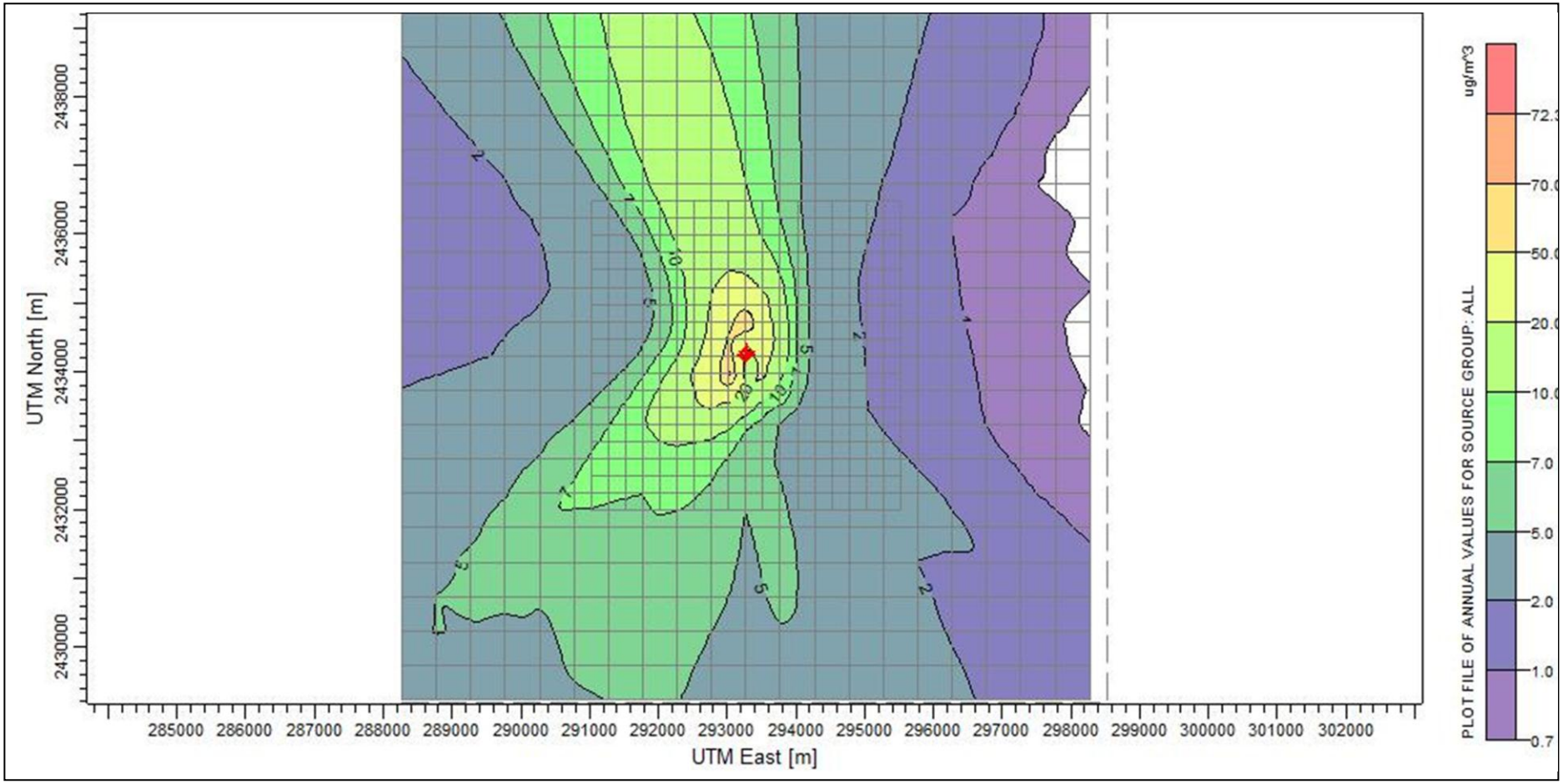


Figure 6.4: Emission contour map showing the SO2 concentration (Annual average) at 5000m surrounding the project location

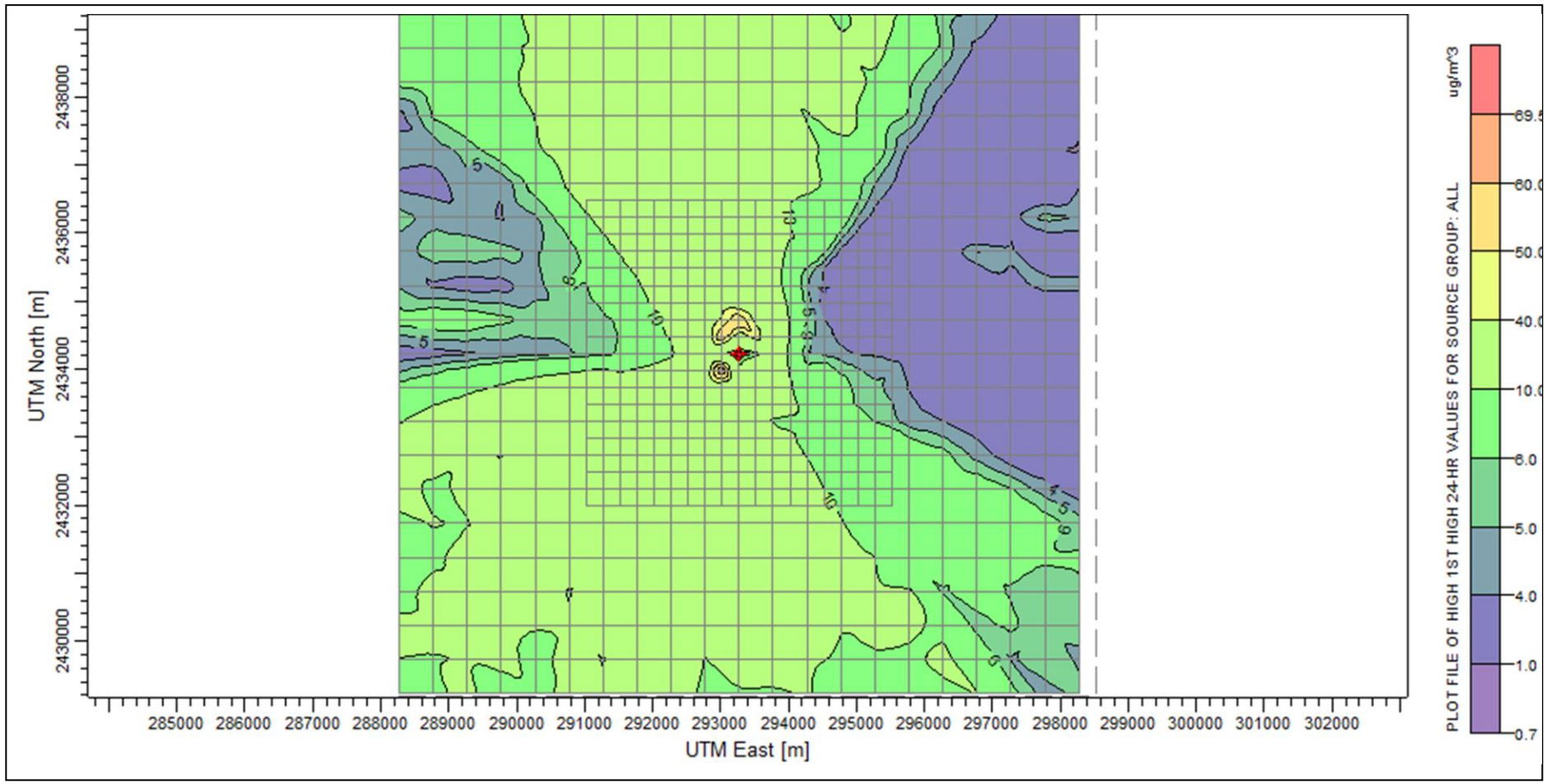


Figure 6.5: Emission contour map showing the PM10 concentration (24 hour average) at 5000m surrounding the project location

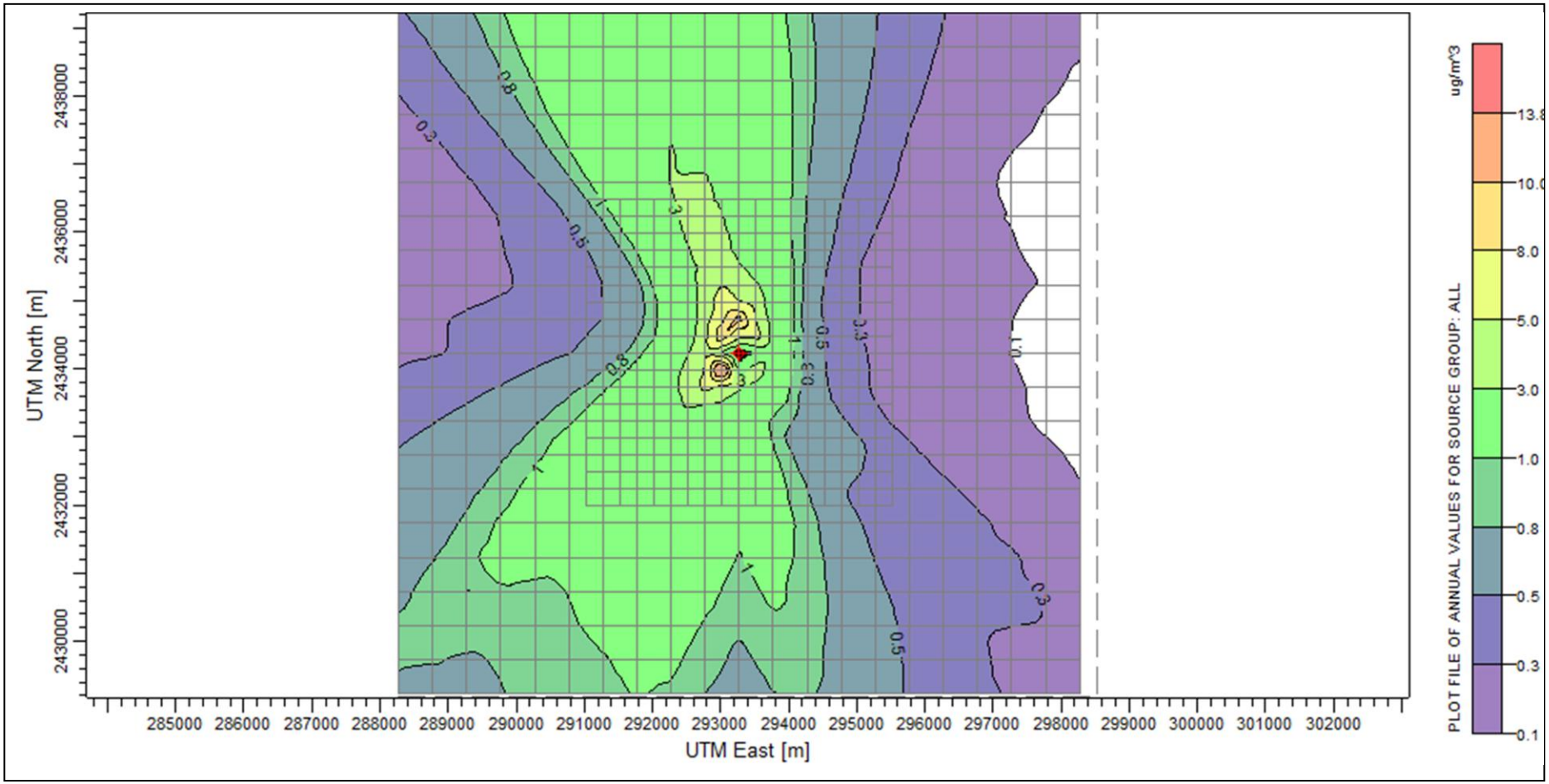


Figure 6.6: Emission contour map showing the PM10 concentration (annual average) at 5000m surrounding the project location

From the Table 4.14, it is evident that the area falls under non degraded air shed (IFC/WB definition) and after taking all above mitigation measures, the DSPGL will contribute very negligible amount of air emission (NOx, SO_2 & PM) to the surrounding pollution comparing to the air existing emission source in the study area.

For the well dispersion of the hot air from the generator, the project authority will construct a 32 m high stack from the ground level. The stack would be connected with a silencer to prevent the noise from the engine. The stack heights have been designed to facilitate undisturbed and free dispersion of the emitted air pollutants. Exhaust gas sample extraction facilities shall be installed for emission monitoring on each stack.

The detail emission modeling report has been attached as annexure 10.

Residual Impact

It is clear from above study that the project proponent will adopt necessary options suitable to their needs meeting the national standards. Adoption of measures set out above is not expected to provide total mitigation, because no machine works at 100% efficiency. After adopting proper mitigation measures to maintain national/international standards, **Dhaka Southern Power Generations Ltd.** will emit some residual pollutants, which can affect the environment in the long run. On the other hand, There is no industry in located in the vicinity of the plant (1 km radius) area, emits air meeting the national requirement as **Dhaka Southern Power Generations Ltd.** The cumulative residual pollutants can create an adverse situation in the ambient air quality. So, this situation can be overcome by determining the exact level of treatment and maintaining it by following the management plan properly, which is required to maintain the normal ambient air quality of the area.

6.2.3.2 Impact due to Liquid Discharge

Impact Origin

The Proposed power plant will not create any process liquid from the production process. The power plant will have closed loop water cooling system for the main reciprocating engine cooling system (220 cu.m/hour) and in the waste heat steam turbine condensation unit (280 cu.m/hour). Where small amount of water will be required as makeup water only which is approximately 75 cu.m/hour. In addition, small amount of water will also be used for occupational floor, equipment washing and for domestic purposes. This wash water will not contain significant amount of pollution, which may impact the surface water quality.

Mitigation Measures

The cooling water will be used in a close loop system having no discharge. Some make up water would be added (approximately 75 cu.m/hour) to the system. The domestic liquid waste will be disposed through a septic tank with a soak pit. The project will have

planned drainage system to discharge the surface runoff. The surface drainage network would be connected with an interceptor prior to discharge through natural water. The interceptor will trap all oily matter present in the water.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.3.3 Impact due to Solid Waste

Impact Origin

The operation of the plant itself would not generate any solid waste. Solid waste generated by the people working at the proposed site is paper, cartoons, bags, boxes, office wastes, pallets, empty drums etc. along with negligible quantity of domestic waste. There will have waste Air filters and waste rugs be generated occasionally which need to be properly disposed.

Mitigation Measures

All solid waste will be segregated properly. Some solid waste has secondary demand and sold to the secondary dealers. Other solid wastes will be disposed to the safe places carefully. The air filters and waste rugs should be collected in a safe place and should be disposed to the land fill.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.3.4 Impact due to HFO and Lubricating Oil

Impact Origin

The proposed project will be operated by HFO, so, there is HFO preheating and treatment system in the project before feeding the HFO to the engine. This will end up with some oily sludge & water. Moreover, the project will use lubricating oil in the engine cooling system from where insignificant amount of used lubricating oil would be generated from the plant. The generated waste oil will be stored in a sealed tank.

Mitigation Measures

The oil storage of the project (fresh and used) should be done on hard standing floor and roofing with a secondary containment facility of 110% bigger than the allowable maximum storage capacity. The oily water sludge would be treated by Pure Bilge Oily

water cleaning system, where clean water would be discharged with the oil content below Bangladesh national standard (below 10 mg/l) and sludge thus collected and the waste lubricating oil will be supplied /sold to the venders for recycling. These vendors or the Lube Oil Re-cycling facilities should be approved by DoE. As there is no chance of mixing and disposal of oil onto land or water, so there is no mitigating measure to be suggested.

Detail on oil water separation has been attached in Annexure-11

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.3.5 Noise and Vibration Impacts

Impact Origin

A. Engine room noise:

The generator room will have internal noise level of around 107 dBA at 1m distance from each reciprocating engine and the steam turbine noise is 90 dBA, the combined noise effect from the 3 engines & turbines can be found by applying the formula of ($\sum L = 10. \text{Log}_{10} (10^{L1/10} + 10^{L2/10})$ dBA, in which the equivalent noise will be 112 dBA from all engines & turbines, which will be minimized by sophisticated acoustic power house building design so as to minimize the noise emission up to standard.

B. External noise emission:

The individual reciprocating engine stack will emit a noise level of 65 dBA after providing the silencer (25 dBA abatement from the steam turbine exhaust).

Mitigation Measures

A. Engine room noise abatement:

Necessary noise abatement measures will be taken as required avoiding adverse noise & vibration impact on the neighborhood. In particular, significant noisy components such as the generators and turbines are enclosed in buildings acoustically designed, providing **Styrofoam filler of 100 mm width in between 150 mm thick brick walls both side** (sandwich type) of the Styrofoam filter around the power house building. The following are the noise abatement capacity of the material which would be used for noise abatement for the engine room noise:

It is estimated that the Styrofoam filter and brick wall will absorb noise as following:

Material	Thickness, mm	Approximated noise absorption capacity, dBA
Styrofoam (Acrylic -Poly-Methyl-Meta-Acrylate (PMMA)	100	90
Brick with or without plaster	150	40
Total Equivalent noise absorption		90

It is estimated that the noise abatement measures of the power house building will be capable to absorb around 90 dBA noise from the engine room, but the maximum engine room noise is around 112 dBA near the generators & steam turbine, the further noise emission simulation from the power house building will be determined by the modelling calculation.

Internal Noise Modelling result

Equivalent Noise Power: 112 dBA (from 3 engines and turbines)
Total External surface area: 1640 sq.m
Noise insulation : 90 dBA
Engine room noise: 107 dBa
Turbine Noise : 90 dBA

At 112 dBA equivalent noise output from the 3 engines and turbines and equivalent noise absorption of 90 dBA by the Styrofoam and brick wall, the resultant noise emission simulation has been done by using the Custic 3.2 noise emission simulation model software. The result of the modeling has been given below.

Radius, m	30	50	100	200	300	400
Output Sound power level in dBa	25.03	20.85	16.89	12.52	8.34	4.17

Fig 6.7: Plot of output noise power level in dBA vs Radius in meter (Internal Engine room noise)

B. External noise emission:

The power plant will only emit 65 dBA noise at the stack point. For the measurement of the noise dispersion to the surrounding area from the external noise emission sources, a noise modeling simulation has been done by using CUSTIC-3.2 noise modeling software. The model has calculated the aggregated noise from the 3 HFO engines stacks. The result of the modeling has been given below.

Radius, m	30	50	100	200	300	400
Output Sound power level in dBA	27.70	23.09	18.48	13.86	9.24	4.62

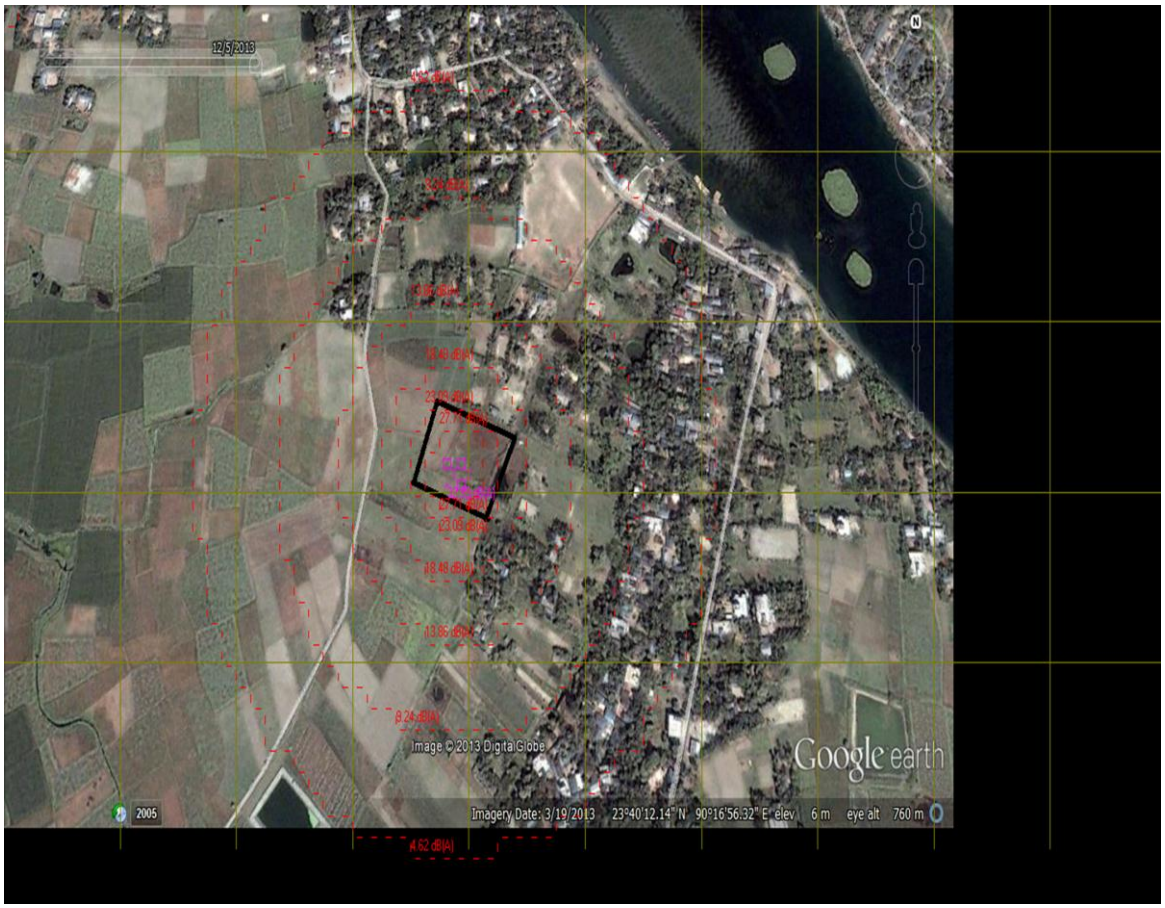


Fig 6.8 : Plot of output noise power level in dB vs Radius in meter (external stack noise)

6. Resultant noise emission from External and Internal Sources

The resultant noise emission from the internal and external sources of the power plant has been calculated by the equivalent noise summation formula and the resultant noise has been given below:

Radius, m	30	50	100	200	300	400
Output Sound power level in dBA (Internal Engine room noise)	25.03	20.85	16.89	12.52	8.34	4.17
Output Sound power level in dBA (External stack noise)	27.70	23.09	18.48	13.86	9.24	4.62
Equivalent Noise emission (internal & external)	**29.58**	**25.12**	**20.77**	**16.25**	**11.82**	**7.41**

The modeling result shows that the power plant will produce max noise 20.77dBA within 100m radius and minimum 7.41dBA in 400m radius respectively during running condition of the project. There are few homesteads at the south west and north west

side of the project within the 100m radius of the proposed project where the noise contribution from the project would be around 20.77 dBA from the project.

The following are the World Bank and Bangladesh standard for the ambient noise:

Standard	Zone	Day time dBA	Night time, dBA
World Bank EHS Guideline 2007	Residential, Institutional, educational	55	45
	Industrial, commercial	70	70
Bangladesh ECR, 1997	Residential area	55	45
	Mixed area	60	50
	Commercial	70	60
	Industrial	75	70

The DSPGL will be established in an area with no industrial set up nearby which falls under the residential zone category of Bangladesh standard. The day & night time average noise was found during the baseline study below the standard of residential zone concentration. The project authority will construct the boundary wall of the project site with hollow bricks and create a green belt surrounding the project to protect noise will be emitted from the site.

It is observed from the noise emission modeling that the max noise level within the 30m radius is 29.58 dBA. There is a school located around 220m northeast and few homestead at 100m northwest to the project site where the approximated noise contribution is less than 20.77dBA and 16.25 dBA respectively. If we consider school time is started from 9.00am to 6.00pm, the average ambient noise level at that time is around 53 dBA (table 4.15), the combined noise effect from the power plant and ambient noise can be found from the link –(http://www.sengpielaudio.com/calculator-spl.htm), and applying the formula of ($\sum L = 10.\ Log_{10}\ (10^{L1/10} + 10^{L2/10})$ dBA, the calculation has been presented below:

The calculated table is presented below:

Radius in m	30	50	100	200	300	400
Output Sound power level in dBA	29.58	25.12	20.77	16.25	11.82	7.41
Ambient sound level in dBA	53	53	53	53	53	53
Summation of two sound level	53.02	53.007	53.002	53.00	53.00	53.00

The above result shows that the noise level after 100m from the power plant will not affect the ambient noise level of the area, so, there would not create any noise problem due to the power plant to the nearest homestead and the school. The result also clearly stipulates that the sound intensity level is within the WBG guideline (55 Dba at day time

of education, institutional, residential zone). So, the noise emission from the project would not create any harm to the surrounding community.

The noise modeling report has been attached in annexure-11.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.3.6 Occupational Health

Impact Origin

The proposed project will employ around 65 people during its operational period. The workers who work inside the plant will face occupational health hazards due to different operational processes. Safe and good occupational health status of the employees and workers is important for only the persons working in the plant, but also for the better plant operation and maintenance.

Mitigation Measures

Protective clothing, earplug, helmets, shoes and accessories should be provided to the workers specially who will work in the power house building and engine room. Adverse impact on worker's safety would be minimized by implementing an occupational health program. Regular medical checkup would be done to ensure the soundness of health of employees and workers. Pollution control measures would duly adopt if necessary, including noise and air pollution.

Residual Impact

Provided that the mitigation measure indicated above is fully implemented, residual impact to be very insignificant.

6.2.4 Socio-economic Impacts

The **Dhaka Southern Power Generations Limited** will contribute to cover the increasing demand of electricity which is a beneficial operation factors, e.g. for producing industries. Site development will not lead to the loss of any jobs; instead will create new job opportunities for the local workers. On the other hand, during the construction activities of the **Nawabganj 55 MW Power Plant,** jobs and income opportunities will be created for the people especially local people and as such per capita income will be enhanced in this area. For operation of the power plant, a good number of long-term skilled and unskilled personnel will be required this will create employment opportunities mostly for the local inhabitants also.

Since there was no habitation located inside the proposed site, resettlement would not be necessary for the project. But migration will be increased due to creating new job opportunities in the plant area. During construction phase, about 300 people will be working at site which will create sudden population influx in the community. Social needs, crimes and some other problems may take place in the area. Mitigation measures will be taken by the project authority with the help of local administration and LGI representatives. People in the neighborhood are expected to get benefit from the employment that would be generated and from the increased business activities during construction period. There is no religious, cultural or historic place near the site, so the noise and air pollution during construction of the project would not create any potential impact. People of the surrounding area will be benefited by the development of local small businesses due to the increase of migration in the area.

6.3 Beneficial Impacts and Enhancement

6.3.1 During Construction

Impact Origin

During construction period, the plant will create job opportunities for approximately 300 of skilled, semi-skilled and unskilled labors. However, the impact will be a relatively short duration, being restricted locally to the construction period. In addition to this, all construction sites attract small traders, who supply food and other consumable to the work force. Although the numbers of people who benefited in this way are relatively small, the impacts on individuals can be disproportionately high compare to the other local people.

Benefit Enhancement Measure

Although labor recruitment is a matter of construction contractor who has the right to determine whom he shall not employ, but still the project proponent shall encourage him to hire local people wherever possible and to give preference to employment of the land less people.

6.3.2 During Operation Phase

Impact Origin

The most significant positive impact of the plant would be the generation of electricity, which will reduce the gap between supply and demand of electricity. The other important positive impact of the plant would be the employment of personnel for the operation of the plant. The project envisages employing 65 skilled and unskilled personnel during its operational phase. Apart from the positive impacts other beneficial impacts include benefit to local economy due to employment, community development, etc.

Benefit Enhancement Measure

Although labor recruitment is a matter of company who has the right to determine whom he shall and shall not employ, but still the project proponent should take initiative to employ local people wherever possible and to give preference to employment of the jobless people.

6.4 Decommissioning

6.4.1 General principles for Environmental Management During Decommissioning

At this project of the project planning & implementation process, the necessity for and timing of the decommissioning of the **Dhaka Southern Power Generations Limited** is not known. Therefore, only general principles of decommissioning are detailed below. These principles must be required to be revisited and supplemented in the event of decommissioning of the power plant.

On decommissioning of the power project, DSPGL will:

- Ensure that all sites not only vegetated are vegetated as soon as possible after operation ceases with species appropriate to the area.
- All structures, foundations, concrete, and tarred areas are demolished, removed and waste material disposed of at an appropriately licensed waste disposal site.
- All disturbed areas are compacted, sloped and contoured to ensure drainage and runoff and to minimize the risk of erosion.
- All hazardous materials should be kept separate, documented and disposed to the safe recycling or disposal site.

A detail decommissioning and restoration of site plan should have to be developed prior to the decommissioning of the project.

Chapter 7

Environmental Management Plan (EMP)

Chapter-7

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.1 GENERAL CONSIDERATIONS

In the context of a project, Environmental Management Plan (EMP) is concerned with the implementation of the measures necessary to minimize and offset the adverse impacts and to enhance beneficial impacts. Unless the mitigation and benefit enhancement measures are identified in EIA and fully implemented, the prime function of the EIA cannot be achieved. Thus, the objectives of EMP for the present project are: (i) Identification of Monitoring requirements and Monitoring indicators; (ii) Mitigation measures to reduce or eliminate negative impacts; and (iii) Enhancement measures to maximize positive impacts. Environmental management plan has to be considered as part of the plant's overall management and it would be part of the plant operational manual.

Monitoring of the performance of a plant is very important and sometimes vital. Industrial units in Bangladesh generally do not monitor the environmental parameters related to plant operation, thereby neglecting the environment. For surveillance of the environmental performance of an industry, and monitoring of the quality of the local environment, environment in the work-zone and the general impact zone have to be performed on a regular basis. A management set up has to be created for the environmental monitoring program which can ensure compliance with national environmental standards. To this end a committee (Environmental Management and Safety Committee) will be created with plant manager as head and with 2-4 other members. The committee must meet at least once in a quarter and take stock of the environmental status of the plant. The main waste products of the plants are sludge and the effluent discharged from the plant. These are to be analyzed as per SOP for the plant. Any additional monitoring required should be defined and resources allocated for the purpose. The proceeding of the committee should be recorded and used to produce quarterly and annual environmental reports indicating compliance or otherwise of the environmental regulations. These reports should be submitted to the DOE and shared with the World Bank. The quarterly and annual monitoring reports will also be placed on the company website for public scrutiny.

The cost of the Environmental Management Plan (EMP) has to be divided into several parts to reflect the different phases of the project and the requirements of each phase. The cost of EMP must include the costs of the capacity building, public consultation and the quality control requirements and the budget allocation should be made in the yearly operational budget of the plant.

7.2 MITIGATION/BENEFIT ENHANCEMENT MEASURES

For effective and environment friendly operation of an industry, a set for guiding tools and suggestions are necessary which need to be followed at various stages of plant installation, operation and maintenance. This plan generally has various components of management depending on the type of industry or plant activity and types of discharge and their pollution potential. This Environmental Management Plan (EMP) once prepared forms the basis of environmental management actions from the part of the plant authority may need modification or up-gradation because of changes in the plant operation or accurate pollution load/environmental problems detected afterwards. The plant authority may also be needed to expand the suggested outline of the EMP proposed in this report.

All beneficial and adverse impacts which may likely to occur at different phases of the project are identified in section 5.0. In section 6.0 predictions, evaluation and aspect of mitigation and benefit enhancement measures have also been discussed concurrently with impacts prediction and evaluation. In view of the earlier discussion summary of recommended mitigation and benefit enhancement measures are presented in Table 7.1.

Table 7.1: Recommended mitigation/enhancement measures

Potential Impacts	Mitigation/Benefit Enhancement Measures
Impact on surface water quality	○ Dispose all domestic waste water through septic tank ○ Surface drainage should be disposed through an interceptor. ○ Collect the waste oil in a sealed tank, store in safe place and dispose through secondary trader for recycling.
Impact on solid waste	○ Collect all solid wastes properly, recycle where possible and dispose in proper place. ○ Waste rugs and waste air filters are collected properly and disposed to the landfill.
Impact on Air Quality	○ Installation of FGD to reduce SO2 emission by 90% which will also reduce PM and NO2 substantially. ○ Proper stack height (32m) has to be installed and maintained for each 3 stacks
Impact on health and safety	○ Set up warning signs, signals and provide helmets for workers in accordance with relevant accident prevention and work safety procedure ○ Restrict access to plan site ○ Supply good quality drinking water to the workers ○ Provide well-planed sanitary facilities ○ Provide regular health inspection among workers ○ Promote health education campaign among workers
Noise/vibration hazard	○ Proper acoustic design should be made for the power house building and silencer in the exhaust of each engine. ○ Provide sufficient buffer strip around the project site and power house building

Traffic congestion	Avoid carrying of materials in peak hour of road traffic
Impact on employment & family finance	Employ local people wherever possible

7.3 Environmental Management during Operation Phase

7.3.1 Overview of Impacts and Mitigation Measures

Power plants invariably have potential for environmental impacts during the operational phase of the project. The following impacts are the most significant in the present case:

- Impacts on air quality;
- Acoustic and vibration impacts
- Wastewater discharge
- Occupational Health and Safety

Over viewing of mitigation measures due to impacts arises from the operation of power plant is atmospheric pollutant emissions, which are being controlled at source by the following mitigation measures:

- The plant would have a flue gas de-sulfurization (FGD) plant to reduce the sulfur level from the exhaust.
- A stack height of 32 m will ensure compliance with the National air quality limits.
- Using waste heat to steam turbine for extra power generation will reduce the pollutant level per unit of fuel used.
- Environmental noise from engine will be controlled through proper acoustic design within the plant.
- A septic tank will be provided to ensure that effluent discharge standards are met.
- Containment for HFO tank will reduce hazards from oil spillage

7.3.2 Atmospheric Emission Management

The combustion of fossil fuels for power generation inevitably results in emission of gaseous pollutants to the atmosphere. As the proposed power plant is fired with HFO, the pollutants of potential concern are likely to be oxides of nitrogen (NO_X), Sulpher Di-Oxide (SO2) and Particulate (PM). The project will install waste 3 heat recovery steam turbine unit to generate additional electricity by using the waste heat from the stack and the final temperature of the exhaust stack would be reduced from 325 ^{0}C to 194 ^{0}C, which indicates that the pollution level will be minimum. In addition, the project authority will also install a flue gas de-sulpharisation (FGD) plant to reduce the sulfur content from the exhaust which will remove 90% sulfur from the exhaust.

The FGD plant will consists of main scrubber tower, limestone mixing and preparation, gypsum buffer solution collection tank, gypsum dehydrating system for gypsum recovery etc.

To comply with World Bank Group's "Environmental, Health and Safety Guidelines for Thermal Power Plants" a desulphurization equivalent to an operation with 2% sulphur in HFO is necessary for non-degraded air shed. Considering maximum sulphur content in the HFO of 3.4%, the required removal efficiency is 43%. The flue gases from the waste heat boiler are routed to one common header ducting after cooling in the individual boilers and afterwards to the scrubber of FGD plant. There the SO2 as well as other acidic gases are reduced below emission limits.

In general limestone CaCO3, quick lime (CaO) or hydrated lime (Ca(OH)2) can be used for the wet FGD process. Normally limestone is the best-available and cheapest absorbent.

The flue gas desulphurization process consists mainly:

- 1free space nozzle scrubber plant with bypass-free liquid distribution system with integrated hot gas quencher and mist eliminator, capable for the flue gas of all 3 engines;
- Utility supplement equipment with reagent storage silo for limestone or lime powder and slurry preparation facility;
- Gypsum preparation plant by de-watering.

After implementing the above measures it is expected that the SO_2, NOx and PM emission level will meet the GOB and IFC/WB Environment, Health & Safety guidelines. The lay-out plan and technical description of the FGD plant has been attached in annexure 9b.

7.3.3 Management of Solid Wastes

The area has no planned solid waste collection system in the area. So, the DSPGL authority will have their own solid waste collection and disposal system in place to abate the pollution from the solid waste. The solid waste which has secondary demand will be sold to the local traders after inspection and other waste will be properly managed and disposed of off-site. The air filter system shall be equipped with pressure measuring devices to indicate the operating conditions and the degree of filter contamination. Therefore, no significant ecological impacts arising from solid waste management are anticipated. Any excavated earth will be stored on-site and later used for landscaping activities.

7.3.4 Water & wastewater Management

The proposed project would have water use for the domestic use, make up water from cooling tower and de-mineralized water treatment plant. There is no chance of polluting surface water from either sources since there will be no discharge from the project to the surrounding environment. The surface drainage network would be connected with an interceptor prior to discharge through natural water. The interceptor will trap all oily matter present in the water.

7.3.5 Domestic Sewage Management

All domestic sewage will be treated in a septic tank. The treated water will be discharged through soak pit.

7.3.6 Noise and Vibration Level Management

Adequate measures have been proposed for the control of noise and vibration from the equipment installed in the plant. Noise level monitoring would be performed periodically and the workers exposed to noise would have adequate protective device. Vibration protecting pad (shoe) would be provided under the generator during installation to protect the vibration during operation. An inlet silencer shall be incorporated to reduce the noise level to the specified level. The silencer shall consist of individual noise absorbing exchangeable elements filled with mineral wool.

7.3.7 Greening Program

A green belt development program with different kinds of trees would be undertaken. The vegetation would purify the air, reduce noise level, maintain ecological balance and generally contribute to the scenic beauty of the air. Soil in and around the plan site is fertile and plenty of water is available. Hence, the green belt as an environmentally sound and friendly project with a buffer zone surrounding the plant area may be created in a short time and therefore green area will be increased and reduce the environmental impacts.

7.4 MONITORING REQUIREMENT

Environmental monitoring is an essential tool in relation to environmental management as it provides the basic information for rational management decisions. The prime objectives of monitoring are-

- To check on whether mitigation and benefit enhancement measures are actually being adopted and are providing effective in practice
- To provide a means whereby impacts which were subject to uncertainty at the time of preparation of ESIA, or which were unforeseen, can be identified, and steps to be taken to adopt appropriate control measures.
- To provide information on the actual nature and extent of key impacts and the effectiveness of the mitigation measures which, through a feedback mechanism, can be taken into account in the planning and execution of similar projects in future

There are two basic forms of monitoring:

- Visual observation or checking, coupled with inquiries
- Physical measurement of selected parameters

In the case of industrial projects in general, monitoring is done by physical measurement of some selected parameters like air, water, noise etc. It should be mentioned here that the monitoring program should be such so that it can ensure compliance with national environmental standards. The importance of this monitoring program is also for ensuring that the plant does not create adverse environmental changes in the area and providing a database of operations and maintenance, which can be utilized if unwarranted complaints are made.

7.5 MONITORING INDICATORS

Environmental monitoring requires a set of indictors that could be conveniently measured, assessed and evaluated periodically to establish trends of impacts. The indicators may be independent or may be functionally related. The physico-chemical, ecological and human interest including socio-economic indicators should be well understood. The monitoring program, in view of the possible impacts as assessed earlier, should consider the indicators for the impact assessment related to following issues is presented in Table 7.2 in the following page.

It is desirable that the mitigation measures for the negative impacts and environmental enhancement for positive impacts are implemented according to the suggestions presented in this report. There are two types of environmental monitoring activities associated with the project, during construction and during operation of the project. Each of the components is to be dealt with according to the requirement of suggested measures.

Monitoring During Construction

The environmental monitoring 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 monitoring should also focus on enhancing the possible beneficial impacts arising from employment of local workforce for construction works. Table 7.2 summarizes the potentially significant environmental parameters needed to be monitored during the construction phase.

Table 7.2 Monitoring plan during construction phase of the project

Issue	Parameters	Location	Monitoring Frequency
Ambient air Quality	PM10, PM2.5, SO2, NO2, CO	Around the project site	Once a month
Groundwater	Groundwater level, pH, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms	At the project site	Once a Quarter
Soil quality	Cr, Cd, Pb and Oil and Grease	At the project site	Once during the construction phase
Noise level	Noise at different locations and to nearest receptor	Around the project site and nearest receptor	Once a month.
Construction waste	Solid waste/construction debris, visual observation and record check	At site	Once a month
Health	Health status of the workers, visual observation and record check	At site	Once every 2 months by the contractor's appointed health professional

Monitoring During Operation

Post construction monitoring is limited to a number of impact parameters to see the actual performance of the project. Some monitoring may be necessary during the operation period of the power plant. Environmental monitoring requires set of indicators that could be conveniently measured, assessed and evaluated periodically to observe the trends of change in base line environmental quality.

Most of the environmental parameters will experience beneficial effects during the operation phase of the power plant project. The plant management authority of DSPGL should be responsible for overall environmental monitoring during the operation phase of the project. The environment monitoring 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 7.3 summarizes the potentially significant environmental parameters needed to be monitored during the construction phase.

Table 7.3 Monitoring plan during operational phase of the project

Issue	Parameters	Location	Monitoring Frequency
Stack emissions	NOx, SO2, PM	Final exhaust (FGD)	Continuous if stack monitoring is available
Ambient air quality	NOx, SOx, PM10, PM2.5,	Plant gate	Continuous
Noise level	Noise at different locations at day & night	Around the project site and nearest receptor	Once in 3 months
Surface water quality	TSS, TDS, COD, BOD, pH, Oil & grease, Total Nitrogen, Total Phosphorus and total coliform	At outlet point of drain after the interceptor.	Once in 6 months

7.6 Cost of Monitoring

The following are the cost of monitoring for the environmental parameters during construction and during operation period of the proposed power plant respectively:

Table 7.4 Cost estimate for environmental monitoring other measures during construction

Item	Parameters	Unit cost (Taka)	Unit per year	Total cost per year (Taka)
Ambient air Quality	SPM, PM_{10} and $PM_{2.5}$	30000.00	12	360,000.00
Groundwater	Groundwater level, pH, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms	30000.00	04	120,000.00
Soil quality	Cr, Cd, Pb and Oil and Grease	30000.00	1	30,000.00
Noise level	Noise at different locations	10000.00	12	120,000.00
	Total Cost			6,30,000.00

Table 7.5 Cost estimate for environmental monitoring during operational phase

Item	Parameter	Unit cost (Taka)	Unit per year	Total cost per year (Taka)
Stack emissions	NOx, SO_2, PM	500000.00	01	500,000.00
Ambient air quality	CO, NOx, SO_2, PM_{10}, $PM_{2.5}$,	500000.00	01	500,000.00
Effluent quality	pH, DO, Sulfate, TSS, TDS, BOD, COD, Total N, Total P	30000.00	04	120,000.00
Noise level	Noise at different locations	10000.00	12	120,000.00
	Total cost			12,40,000.00

7.7 Management Capacity:

The environmental monitoring program should be carried out as an integral 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 Project Director (PD) for this specific project should take the overall responsibility of environmental management and monitoring during the construction period. The PD will form a team with required manpower and expertise to ensure proper environmental monitoring and to take appropriate measures to mitigate any adverse impact and to enhance beneficial impacts, resulting from the project activities. The PD 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 PD 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.

To be an environmentally acceptable industrial unit, the proposed project should have its own environment monitoring unit/cell with trained manpower with necessary equipment and other logistics along with required budget. During the operation period, the project authority should establish their own monitoring team headed by the plant manager. Alternatively, DSPGL may hire any local reputed monitoring company to undertake the environmental monitoring as suggested in the EMP of the ESIA report. In such case, the Plant manager will engage one of his Plant Engineer to look after the monitoring activities and keep the records available to view any concerned people or authority when necessary. In all occasions, DSPGL authority should ensure that the equipment used for the monitoring services are properly calibrated and internationally accepted monitoring methods are followed to monitor the above parameters.

Dhaka Southern Power Generations Limited should develop a working relationship with the Department of Environment (DoE) by undertaking a joint monitoring program per year or they may exchange data and information or submit periodic report of self-monitoring to the DoE or as the situation may require.

7.8 SAFETY MITIGATION PLAN

Safety Management System

Safety is an integral part of the company's work. It is part of the company's operations and there to protect employees, clients, property, the environment and the public. There are many costs to accidents and unsafe work practices. The greatest costs are human cost. Protecting employees also protects their friends, families, fellow workers,

management, the public and the environment from the far-reaching effects of serious accidents. In addition to protecting lives, a safety program contributes to employee morale and pride because employees participate in identifying safety needs and developing safe work procedures.

Visitors to the worksite may also face legal action if they knowingly disobey safety rules. In addition, the company may face legal action and fines for violations of regulatory requirements. Those individuals who do not fulfill their safety responsibilities will become accountable for any problems their negligence creates and may be liable under the law.

Everyone employed by a company is responsible for maintaining the safety program. Managers and supervisors are responsible for identifying safety needs, communicating safety hazards, investigating hazardous conditions and accidents, providing training, supply or wearing appropriate safety and personal protective equipment, and ensuring all equipment is properly maintained and meets legislated safety standards. Their role is supported by input from all employees.

All company employees are responsible for obeying all safety rules, following recommended safe work procedures, wearing and using personal protective equipment when required, participating in safety training programs and informing supervisors of any unsafe work conditions. Everyone has the right and responsibility to refuse to do work when unsafe conditions exist. By fulfilling safety responsibilities, workers will share the benefits of a safety place.

The company must have its own safety management and mitigation plan and policy. Listed below are the important features that need proper attention of company management.

Company Safety Policy

The company must have its own safety policy. The safety policy should be updated from time to time. The policy should be signed and dated by the chief safety officer. The policy should be discussed with all personnel. The chief safety officer should periodically review the policy and re-issue the policy.

Safety Responsibilities

All personnel should have safety responsibilities assigned to them. The documented responsibility should be included in the program manual. Compliance with the responsibilities should be monitored and if these are not carried out for some good reason, corrective measures should be taken.

Management Communication

The management should decide how it communicates periodically with the personnel regarding safety. A site schedule for conducting site tasks should be developed; this should be included in the safety program manual. Documentation of site tours should be retained for verification.

Inspections

A list of all work sheets, equipment, vehicles and work practices requiring inspection should be developed. Checklists and schedules should be developed as part of the inspection program. A system for correcting deficiencies noted during the inspection process must be developed. The system should prioritize deficiencies noted so that serious hazards are dealt with immediately.

Personnel Protective Equipment (PPE)

The work site should be assessed to determine what personal protective and safety equipment is needed and the equipment must be available. A maintenance schedule must be developed for PPE and records for maintenance retained on file. Employees must be trained in fitting, care, maintenance and use of PPE.

Detailed rules and procedures identifying company and legislative requirements and expectations must be communicated to all employees and contractors. They serve as a reference and describe the minimum standard by which business is conducted. Most important rules and procedures ensure consistency in the performance of tasks by all employees. The current rules should be reviewed and assessed as to whether they are appropriate for the operation/facility/employees. The formulated rules must be communicated to the workers effectively, and workers must ensure that they understand the rules and have no difficulty to comply with the rules.

Standard Work Procedure

The intent of standard work procedures is to ensure consistency in the performance of hazardous work and it must form the minimum standards by which specific tasks are performed. Workers must have clear understanding of the procedures they are required to follow. A system for periodic review of procedures must be developed. The employees involved in the work will be given an opportunity to suggest steps that would provide for continuous improvement to the procedures. The work procedures shall also ensure that all hazardous tasks have been accounted for. Procedures and codes of practice have to be developed for hazardous work. To determine compliance with safety and hazard issues while performing a task by a worker, efforts should be made to ensure the following:

- Confirm that employees affected by these tasks participate in the development of safe work procedures,

- Confirm that the employees are involved in the maintenance of safe work procedures,
- Interview workers to determine if they know what tasks have work procedures, where these procedures are located and generally what makes up to content,
- Review records to ensure that employees receive training on hazardous work procedures and codes and practices,
- Where practical, observe employees performing critical tasks to confirm use of standard work procedures and codes of standards.

Emergency Procedures

Emergency procedures will identify who does what and when in the event of an emergency. Responsibility for who is in charge of the co-ordination of emergency actions shall be identified. The procedures shall be easily referenced, concise and understandable. All employees shall be aware of the content and location of the procedures. The content lists associated with the procedures will be current. The procedures will be updated and tested on a regular basis. The training record and level of training gained by an employee shall be verified so as to ensure his first aid training. Subcontractor employees will also be trained in first aid. The following are the important events that need emergency procedures.

- Fire
- Injury/death
- Leakages and other releases of hazardous substances
- Natural disasters

Safety Orientation and Training

Initial safety training is one of the most important aspects of any safety program. All employees and contractors must receive some level of basic training, specific to the facility and nature of the job. It must be ensured that appropriate orientation is given to:

- Employees
- Contactors
- Sub-contractors
- Visitors

The orientation shall also include a review of the following:

- Company safety policy and procedures
- Specific job hazards
- Safety precautions
- Job responsibilities
- Regulatory requirements
- Company enforcement policy, and
- Worker right-to-know and authority to refuse unsafe work.

Reporting Incidents and Accidents

All accidents and near-miss incidents shall be investigated to determine what caused the problem and what action is required to prevent a recurrence. Employees required to perform investigations shall be trained in accident investigation techniques. The incident/accident investigation should be a fact-finding exercise rather than faultfinding. The investigations will focus on collection of evidence to find out the "root cause" of the incident. The recommendations of the investigation report are implemented in phases.
Power plant construction and operation facilities have been and will continue to be designed to comply with the legal elements of both national and international standards, legislation, codes of practice and design specifications, and best practices. As a part of this process, measures to minimize the probability of releases and reduce potential impacts through selection of alternative processes to be considered as an integral part of the development.

Mitigation should reflect the intent and regulatory framework outlined in the GoB Environmental policy and in applicable World Bank Operational Directives. The purpose of impact mitigation and counter measures is to avoid creating negative impacts wherever possible, to minimize impacts where they may be unavoidable, and to generate opportunities for improvements or positive impacts where appropriate.

Protective Equipment

The main reason for protecting workers is to eliminate or reduce the possibility of injury. The Occupational Health and Safety Act (USA) requires that every worker shall "wear or use such personal protective clothing, equipment or devices and is necessary for his or her protection from the particular hazards to which he or she is exposed".

There are some people who resist wearing protective clothing or devices, and will only wear protective equipment when forced to do so. This is not the right attitude to take for the worker's own safety. The consequences of an accident to his quality of life can be major. He can also lose his life. Personal protective equipment provides the worker with a measure of protection, but for it to be really effective; it must be accompanied by the right attitude towards during his job the right way. The wearing of personal protective equipment does not guarantee that he won't get injured. However, when coupled with a good safety attitude it will reduce the likelihood and severity of accidents

Body Parts That Require Protection

The body and its internal organs can be seriously injured, by any violent impact with an object. A direct blow to any part of a worker's body, even with protection, can easily result in some injury, either major or minor. The following eight areas or parts of the body require protection:

- Head
- Arms

- Eyes
- Chest
- Hearing
- Legs
- Hands
- Feet

The worker's head houses his brain, which controls all the motor and sensory functions of his body. Any blow to his head, no matter how slight, can be very dangerous and result in injuries ranging from dizziness to total disability and even death. One of our most valuable senses is light. One must protect his eyes from the dangers of flying objects, bright light and chemicals. Without eyes one would live a life in total darkness. Hearing damage is not often a result of an accident, unless someone has had a head injury. A more common problem is hearing loss which can occur one exposed to noise levels above the exposure limits, as outlined in the Noise Regulation. In Table 7.6 Occupational Exposure Limits are described with a maximum permitted duration in the following page. Without hearing protection in a sound level of 100 dBA maximum permitted duration is 1 hour/day.

Table 7.6: Occupational Exposure Limits (Without hearing protection)

Sound level (dBA)	Maximum Permitted Duration (hours per day)
85	8
90	4
95	2
100	1
105	2
110	1/4
115	1/8
Greater Than 115	0

The longer one is expected to high noise levels, the greater the potential hearing loss. Hearing loss associated with exposure to noise tends to be gradual. It may take several years before one can realize that for some reason he has difficulty hearing normal conversation. Hearing is a valuable asset that should be preserved, so the worker can have a full and productive life. In Table 7.7, Safety hazard prevention, control and mitigation measures are described for particular event.

Table 7.7: Safety Hazard Prevention, Control and Mitigation Measures

Event	Prevention, Control and Mitigation Measures
General Instruction of Workers	○ Personal and continuous visual supervision of the worker who is not competent to perform the job. ○ Workers to be conversant on the codes and standards of safety. ○ Workers must be confident that they have adequate training on

Event	Prevention, Control and Mitigation Measures
	handling or unsafe hazards material.
Maintenance of Equipment	○ Employer shall ensure that all equipment used on a work site is maintained in a condition that will not compromise the health and safety of workers using or transporting the equipment. ○ Will perform the function foe which it is intended or was designed ○ Is of adequate strength for that purpose ○ Is free from potential defects.
Traffic Hazard	○ Where there is a danger to workers from traffic, an employer shall take appropriate measures to ensure that the workers are protected from traffic hazards. ○ Ensure that workers who are on foot and who are exposed to traffic hazards on traveled rural roads wear reflective vests or alternative clothing that is cleanly distinguished. ○ Where the operator of vehicle does not have a clear view of the path to be traveled on a work site, he shall not proceed until he receives a signal from a designated signaler who has a clear view of the path to be traveled.
Illumination	○ Ensure that illumination at a work site is sufficient to enable work to be done safely. ○ Where failure of the normal lighting system would endanger workers, the employer shall ensure that emergency lighting is available that will generate sufficient dependable illumination to enable the workers to a) Leave the work site in safety b) Initiate emergency shutdown procedures c) Restore normal lighting
House keeping	○ Ensure that each work site is clean and free from stepping and tripping hazards ○ Waste and other debris or material do not accumulate around equipment, endangering workers
Falling Hazards	○ Ensure that where it is possible for a worker to fall a vertical distance greater than 3.5 meters the worker is protected from the falling by guard rail around the work area a safety net fall arresting device
Overhead power Lines	○ Ensure that no worker approaches and that no equipment is operated and no worker shall approach or operate equipment, within 7 meters of a overhead power line.
Sanitary facilities & drinking Water	○ Ensure that an adequate supply of drinking fluids is available at the work site. ○ Ensure that work site is provided with toilet facilities in accordance with the requirement of general health protection guidelines.

Event	Prevention, Control and Mitigation Measures
Working proper clothing	○ Ensure that where is a possibility that a worker or worker's clothing might come in to contact with moving parts of machinery, the worker: a. wears close-fitting clothing b. confines or cuts short his head and facial hair c. avoids wearing jewelry or other similar items
Head protection	○ Ensure that during the work process adequate alternative means of protecting the workers head is in place.
Eye protection	○ Where there is a danger of injury to or irritation of a worker's eyes, his employer shall ensure that the worker wears property fitting eye protective equipment.
Foot protection	○ Where there is a danger of injury to a worker's feet, ensure that the worker wears safety footwear that is appropriate to the nature of the hazard associated with particular activities and conditions.
Respiratory protective Equipment	○ Where the worker is exposed to hazards gases, gums, vapors, or particulates appropriate respiratory protective equipment to be supplied.
Transportation of water	○ A worker in a vehicle shall not allow any part of his body to produce from the vehicle where this action creates or may create danger to the worker. ○ A worker shall ensure that no equipment or materials for which he is responsible is carried in the compartment of a vehicle in which another worker is traveling unless it is so placed and secured as to prevent injury to himself and other workers.
Testing & commissioning	○ Mobilize test rigs at site ○ Ensure that the test equipment is in good condition ○ Ensure other equipment and facility conforms to the approved specification of test. ○ Public notice to be served before testing.

7.9 Capacity Building and Training

For proper implementation the EMP, qualified manpower is absolutely essential. There should be a core group of people in the plant who should be well trained on environmental issues but all plant staff should be given basic training on environmental issues. The skills of staff should be upgraded periodically through need based training program.

Chapter – 8

Emergency Response and Disaster Management Plan

Chapter-8

EMERGENCY RESPONSE AND DISASTER MANAGEMENT PLAN

8.0 EMERGENCY RESPONSE AND DISASTER MANAGEMENT PLAN

8.1 EMERGENCY RESPONSE

The initial response to an incident is a critical step in the overall emergency response. Like all other Industries and installations, Power generation facilities must have adequate measures against accidents or incidents to meet the emergency. The purpose of having an Emergency Response Plan (ERP) is to:

- Assist personnel in determining the appropriate response to emergencies.
- Provide personnel with established procedures and guidelines.
- Notify the appropriate Company Emergency Response Team personnel and regulatory/ Govt. agencies.
- Manage public and media relations.
- Notify the next-to-kin of accident victims.
- Promote inter-departmental Communications to ensure a “Companywide” Co-ordinated emergency response.
- Minimize the effects that disruptive events can have on company operations by reducing recovery times and costs.
- Respond to immediate requirements to safeguard the subtending environment and community.

Generally, the initial response is guided by three priorities Ranked in importance these priorities are:

1. People
2. Property
3. Environment

Emergency Response Procedures will identify who does what and when in the event of an emergency. Responsibility for who is in charge and their coordination of emergency actions shall be identified. Nature of Emergency & Hazardous Situations may be of any or all of the following categories:

I. Emergency

- ❖ Fire,
- ❖ Explosion,
- ❖ Electric shock
- ❖ Medical emergency,

II. Natural Disasters

- ❖ Flood,
- ❖ Earthquake/ cyclone,
- ❖ Storm/ typhoon/ tornados, and
- ❖ Cloud burst lightning.

III. External Factors

- ❖ Food poisoning/water poisoning,
- ❖ Sabotage, and
- ❖ War.

8.1.1 Six Steps in Emergency Response

Step-1)

a) Determine the potential hazards associated with the incident, substance or circumstances and take appropriate action identify the type and qualities of dangerous goods involved and any known associated hazards.

b) Determine potential hazards stemming from local conditions such as inclement weather water bodies etc. and ensure that the initial response team is aware of these conditions.

Step-2)

Determine the source/cause of the event resulting to the emergency and prevent further losses.

Step-3)

Conduct an assessment of the incident site for any further information on hazards or remedies.

Step-4)

Initiate redress procedures.

Step-5)

Report the incidence its nature cause impact applied redress procedures and any further assistance required etc. to the appropriate company, government and/or land owner.

Step-6)

Take appropriate steps with respect to hazards to wildlife, other resources and addressing public and media concerns and issues, as applicable. Response priorities are to protect human lives, property and the environment.

8.1.2 Reporting Incidents and Accidents

All accidents and near-miss incidents shall be investigated to determine what caused the problem and what action is required to prevent a recurrence. Employees required to perform investigations shall be trained in accident investigation techniques. The incident/accident investigation should be a fact-finding exercise rather than faultfinding. The investigations will focus on collection of evidence to find out the “root cause” of the incident. The recommendations of the investigation report are implemented in phases.

8.1.3 Approaches to Emergency Response

For this project, emergency response systems should be in place to deal with dangerous goods uncontrolled releases of dust and gaseous emission, natural calamities fires burns and injuries. There are to be trained emergency response teams, specific contingency plans and incidence specific equipment packages in place to cope with these types of emergencies. In case of an emergency incident occur, immediate action must be taken to mitigate the impacts.

In order to minimize the possibility of injury to the responders and others it is important that emergency responders follow a specific sequence of actions as stepped out in the preceding paragraphs

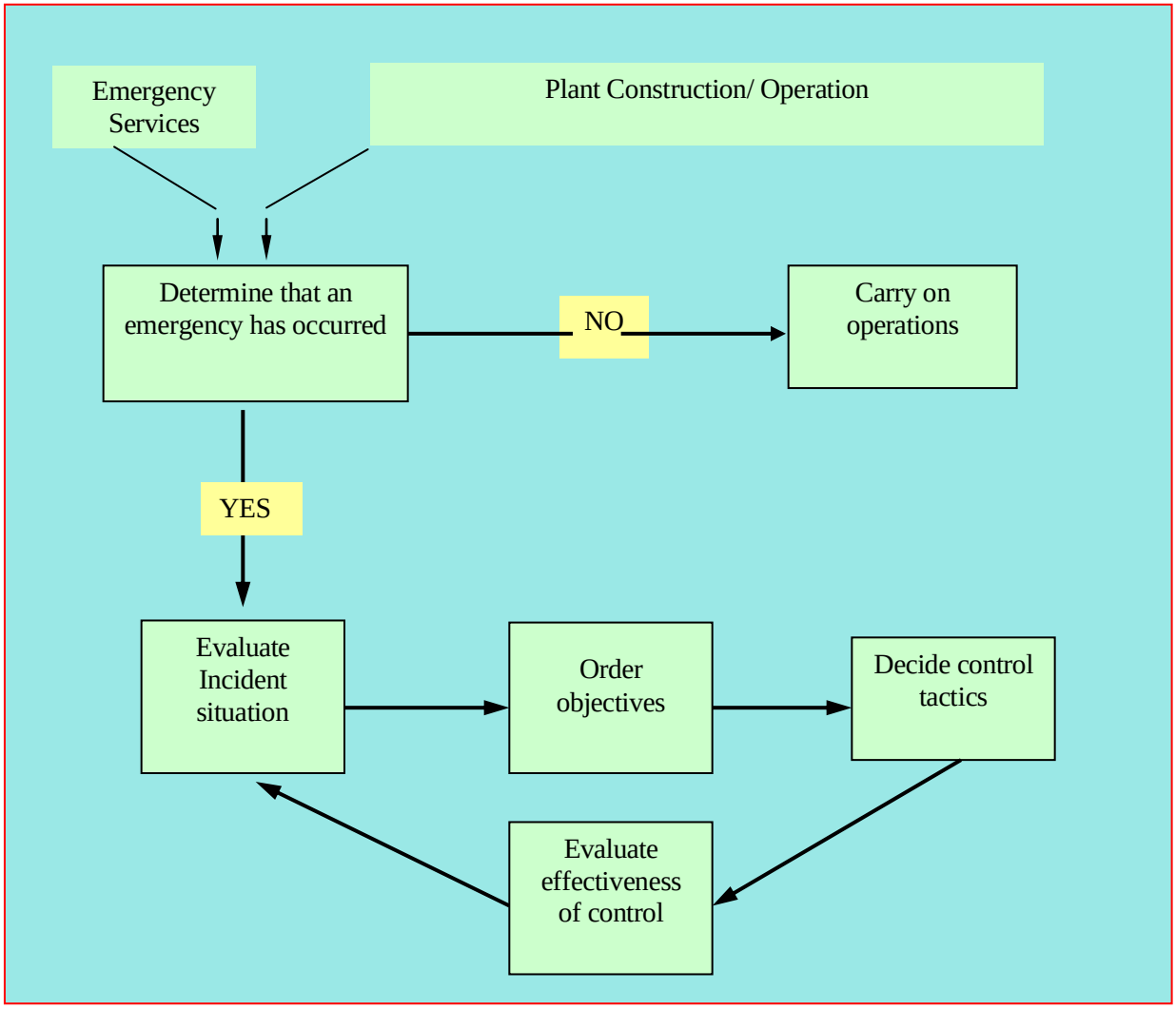


Figure-8.1: Illustrates an Example System Approach to Plant Construction & Operations.

8.2 DISASTER MANAGEMENT PLAN

In normal operation of the plant, when all environmental protection equipment works according to design specification, then there would be no environmental problems for the present plant.

Disaster (to certain degree) may occur if the environmental protection equipment fails to work at normal condition. This situation may arise for any of the following causes-

- When plant runs at abnormal situation e.g. if emission level increases than its normal level or if the engines give unwanted noise than normal level

- If liquid waste over flows and pollutes the surroundings

Therefore, appropriate management plan should have to be taken by the project proponent to prevent any unwanted disaster in the plant. In this regard, there should be a provision to stop the production immediately during any process failure as discussed above.

The disaster management plan should consist of preventive measures including, among others, the following.

- Formulation and strict implementation of safety codes and measures;
- Periodic inspection of safety relief valves provided with pressure vessels and equipment;
- Preventive maintenance;
- Aware the workers about electric shock
- Declaring the factory a “no smoking zone”
- Mock drills by the fire fighting cells/ groups
- Provision and inspection of firefighting equipment and fire hydrant system in all the sections;
- Proper training of the employees about the importance of codes;
- Training the employees and the residents of the surrounding villages about the actions to be taken during an accident, disaster etc.

It is imperative to develop entire facility environment policy and display necessary documentation for ease in accessing information. Some of these documents include:

- ✓ Emergency contacts;
- ✓ Emergency response procedures for fires

The facilities operations and monitoring are carried out under the management and help from both the employees and relevant government lead agencies. In order to take care of any hazards the following control should be adopted:

- All safety precautions and provisions covering the general cleanliness of the entire facility down to, ventilation, lighting, sanitary, waste collection, smoke detector, heat detector, sand bucket, water bucket, fire blanket, first aid box provision, adequate fire extinguishers and site security by fencing.

8.3 ENVIRONMENT, HEALTH AND SAFETY (EHS)

Health and safety aspects of the entire facility should be given due attention. Protective devices as provided should continuously be used within the unit's operations to ensure the safety of the natural resources and boat owners is guaranteed.

The maintenance of Material Safety Data Sheets (MSDS) will be followed to ensure safety all section of the facility that chemicals are utilized.

An Environment, Health and Safety register is essential for monitoring of performance of the entire facility community in relation to the environment. The management will use this as a self-auditing tool. This register should include:

- Fire extinguisher servicing records
- EHS meeting schedules and training records
- Electrical installations
- Generator inspection and maintenance records
- Waste disposal records
- Inventory records (fuels, paints, cleaning agent
- Emergency response procedure.
- Record off all incidents, accidents, near miss etc.

8.4 FIRE HAZARD& FIRE EVACUATION PLAN

Fire hazards such as large quantities of fuel, combustible/flammable liquids, electrical hazards, combustible dusts, and warehousing are common in electric power generating plants. Although fires are not a daily occurrence, they usually will cause severe property damage and business interruption. Sometimes the fire protection equipment systems have not received attention since they were installed. If these systems are needed, however, they are counted upon to perform reliably and protect vital plant equipment from fire. Fire protection systems are a combination of mechanical and electrical components and, like power generation equipment, need regular attention.

In addition, some people in charge of fire protection do not have an adequate knowledge of necessary inspection and testing frequencies, or they use the minimum frequencies prescribed by their authority having jurisdiction. For example, some jurisdictions only

require annual water flow alarm tests on sprinkler systems, a frequency which is considered inadequate by most fire protection professionals.

The information contained in this part is based on the current standards established by the National Fire Protection Association (NFPA); the most widely used in North America, and generally accepted guidelines. Most fire protection systems are designed and installed according to these standards. Unfortunately, information on inspection, testing and maintenance is not contained in a single standard but is contained within the various system-specific standards, making it cumbersome and difficult to obtain an overview of the tasks which need to be accomplished.

Other codes and standards such as UBC, UFC, BOCA, OSHA and MSHA also address fire protection, but their contents are usually based on NFPA documents and may not address testing/maintenance requirements. Members on the NFPA technical committees comprise a wide range of fire protection expertise and include representatives from manufacturers, testing laboratories, users, authorities having jurisdiction and insurance companies. Adherence to NFPA standards will satisfy most jurisdictions and insurance companies.

Suitable fire protection and detection systems shall be provided designed to the requirements of National Fire Protection Association (NFPA) standards. Gas detection systems and alarms shall also be included.

Fire protection shall consist of wet pipe, automatic deluge systems, hydrants, CO_2 gas flooding systems, and portable extinguishers of CO_2 and dry powder in sufficient quantities.

Areas to be covered by fixed protection installations shall be included but not be limited to:

- All oil filled transformers
- Gas engine
- Lub oil system
- Cable areas
- Storage areas.

The gas engines are to be protected against fire by a CO_2 total flood system within the enclosures. The only other significant fire risks are associated with the lube oil systems on the gas engines, cable areas, stores and with oil contained within transformers. Such systems will be protected from fires by water deluge sprays. All necessary systems are

required to be fire 'protected' with suitable extinguishing agents. Additional protections are to be provided by a ring main and hydrant system with hose/equipment cabinets located at strategic points. This ring main shall be provided with suitable section valves located in valve pits.

The firefighting water will be taken from the fire tank and will be pumped by a dedicated electric pump with a diesel powered back-up pump available in case of electrical failure. Pressure in the firefighting mains is maintained using an electric jockey pump.

A site wide fire and gas detection system will be provided to initiate the fire protection and alarms. Manual "break glass" fire alarms shall also be situated at strategic locations around the site and inside the buildings.

A modern electronic fully addressable master fire alarm panel shall be located in the Central Control Room. All local fire panels shall be linked into the master fire alarm panel. This master panel should have a separate section for the gas detection system. A repeater panel should be provided in the site gatehouse to allow swift identification of the affected fire zone to incoming local fire-fighting appliances. This master fire panel shall be provided with its own dedicated battery system.

8.5 Emergency and Disaster Management of DSPGL

The following team will work in DSPGL in the event of any emergency or disaster:

1. Plant Manager
2. Environmental Health & Safety Manager
3. Plant Engineer (Electrical)
4. Plant Engineer (Mechanical)

The Emergency team will sit in a regular interval to discuss about their responsibilities in case of any emergency. The team will also be responsible for taking care of disaster and emergency handling devices enable them available in good working condition in case of emergency. The following are the major responsibilities of the disaster management team of DSPGL:

1. Organize regular fire or emergency evacuation drill,
2. Check all emergency sign, emergency exit, alarm are in good working order.
3. Regular check of emergency evacuation alarm by blowing a test alarm for few seconds in a certain time of a day.
4. Sit with different emergency subcommittee to discuss various issues about the responsibilities of the subgroups in the event of emergency.

To Prevent any unwanted Disaster or emergency, the following subcommittee will be in

action during any emergency:

a. Fire prevention:

i) Fire Attacking team - to attack fire with prevention appliances within shortest possible time.
ii) Supporting team – This team will support the attacking team .
iii) Breathing apparatus team - will supply BA equipment.
iv) Containment team - for additional support.
v) First Aid support team: For providing first aid support to the victims, first aid boxes will be provided with sufficient first aid equipment.
vi) Emergency Casualties team: There will be plan to evacuate any injured or casualties to the hospital. These includes pick up, driver and stretcher.

b) Special event team: This team will be responsible for the following activities or other emergencies not mentioned in the list above:

1) Unrest management: Local police or law & force agencies will be contacted in case of any labor or political unrest will be beyond control.
2) Natural Calamity: The team will be trained to face any natural calamity like flood, earthquake, cyclone, tsunami, heavy rainfall etc.
3) Fear of unknown: Training will be given to the team to face any unwanted happening like aggrieved mob , sabotage etc.

Chapter – 9
Alternative Analysis

Chapter-9

ALTERNATIVE ANALYSIS

9.0 ALTERNATIVE ANALYSIS

9.1 THE 'NO BUILD' SCENARIO

From a purely physical environmental point of view, the 'do-nothing' is preferable to any project implementation, since it would avoid creation of any of the adverse impacts associated with the project. However, the potential socio-economic benefits to the nation would be foregone and industrial growth would be hampered.

It is concluded that the 'No build' alternative is unacceptable, and the potential socio-economic benefits of implementation of such project far outweigh the adverse impacts, all of which can be controlled and minimized to an allowable level.

The project will be HFO fired. The power generation cost and environmental consequence of any HFO fired power project is minimum.

9.2 CONSIDERATION OF ALTERNATIVES

i. Hydroelectricity:

The country is flat having relatively limited potential for hydroelectricity.

ii. Geothermal Plant:

No active geothermal site has been found.

iii. Renewable Energy Plant:

Solar and wind energy can be considered as renewable energy but per KWh cost of renewable energy is not cost effective for the end users especially in the country like Bangladesh.

iv. *Coal-Fired Plant*:

The country has about 1700 million tons of bituminous coal, most of which lie buried at depth of over 400-900 meters thus making extraction relatively expensive. However, coal from low-lying structure (Barapukuria) is being dug out for power generation. Coal is less environment friendly as it gives high emission of dust sulfur dioxide and carbon dioxide which lead to the acid rain.

v. *Resettlement :*

Site selection is ideal as it involves no resettlement issues.

vi. *Pollution Control:*

As shown in subsequent sections, environmental pollution during the period of construction and also during the period of operation will be mostly insignificant.

vii. *Connectivity with High transmission line:*

The proposed site is in a fairly close proximity to the 33/132KVHasnabad Sub-station. So, the project is in a suitable location to get connected with the high tension grid line.

As per Power Purchase Agreement (PPA) signed with Bangladesh Power Development Board (BPDB) the Power Plant need to be connected and deliver its generated electricity through the existing Hasnabad 132/33 kV grid sub-station. So, as per BPDB requirement and contractual obligation the power plant need to be installed at a place from where the plant can be connected with Hasnabad 132/33 kV grid sub-station.

9.3 SITE ALTERNATIVES

The proposed project will be set up in the land of REB. Moreover the land was unutilized since long time and very near to the river Dhalwshwari from where HFO can be very comfortably transported to plant. The site is well connected with the wide road which is also very suitable for transportation of project equipment and raw materials.

Dhaka Southern Power Generations Limited is located at Daulatpur, Nababganj, Dhaka. The plant's visual looks are modern and environmentally compatible, the site is environmentally acceptable, the plant construction has started and the IEE checklist has been submitted to DOE earlier for obtaining the Environmental Site Clearance Certificate. So there is no logical need to look into alternative sites.

Chapter – 10

Stakeholder Consultation

Chapter-10

Stakeholder Consultation

10.0 Stakeholder Consultation

Stakeholder consultation is a means of involving all primary and secondary stakeholders in the project's decision-making process in order to address their concerns, improve project design, and give the project legitimacy. Stakeholder consultation, if conducted in a participatory and objective manner, is a means of enhancing project sustainability.

Community input (both of knowledge and values) on socioeconomic and environmental issues can greatly enhance the quality of decision-making. Stakeholder consultation was therefore conducted in the project area not only to satisfy the legal requirements of the EIA process in Bangladesh but also to improve and enhance the social and environmental design of the project.

10.1 Objectives of Stakeholders Consultation

The process of public participation and consultation was endorsed in the United Nations Conference on the Environment and Development (UNCED) in 1992 through one of the key documents of the conference–Agenda 21. Agenda 21 is a comprehensive strategy for global action on sustainable development and deals with issues regarding human interaction with the environment. It emphasizes the role of public participation in environmental decision-making for the achievement of sustainable development.

For projects that have environmental and social impacts, consultation is not a single conversation but a series of opportunities to create understanding about the project among those it will likely affect or interest, and to learn how these external parties view the project and its attendant risks, impacts, opportunities, and mitigation measures. Listening to stakeholder concerns and feedback can be a valuable source of information that can improve project design and outcomes and help a company to identify and control external risks. It can also form the basis for future collaboration and partnerships. For stakeholders, a company's consultation process is an opportunity to get information, as well as to educate company staff about the local context in which a project will take place, to raise issues and concerns, ask questions, and potentially help shape the project by making suggestions for the company to consider and respond to.

Through the public consultation process, DSPGL hopes to:

- Promote better understanding of the project, its objective, and its likely impact;
- Identify and address concerns of all interested and affected parties of project area;

- Provide a means to identify and resolve issues before plans are finalized and development commences, thus avoiding public anger and resentment and potentially costly delays;
- Encourage transparency and inculcate trust among various stakeholders to promote cooperation and partnership with the communities and local leadership;

10.2 Consultation Process

Primary stakeholders were consulted during informal and formal meetings held in theproject area. The consultation process was carried out in the Bangla language. During these meetings a simple, non-technical, description of the project was given, withan overview of the project's likely human and environmental impact. This was followedby an open discussion allowing participants to voice their concerns and opinions. Inaddition to providing communities with information on the proposed project, theirfeedback was documented during the primary stakeholder consultation. The issues andsuggestions raised were recorded in field notes for analysis, and interpretation.

By reaching out to a wider segment of the population and using various communicationtools—such as participatory needs assessment, community consultation meetings, focused group discussions, in-depth interviews, and participatory rural appraisal—ESIA involved the community in active decision-making. This process will continue even during construction and operation phase of the project to create consensus among stakeholders on specific environmental and social issues raised in the context of proposed project.

Secondary stakeholder consultations were more formal as they involved government representatives and local welfare organizations consulted during face-to-face meetings and through telephonic conversations. They were briefed on the EIA process, the project design, and the potential negative and positive impact of the project on the area's environment and communities.

It was important not to raise community expectations unnecessarily or unrealistically during the stakeholder consultation meetings in order to avoid undue conflict with local leaders or local administrators. The issues recorded in the consultation process were examined, validated, and addressed in the EIA report.

10.3 Stakeholder Consultation Technique

In recognition of the diversity of views within any community, it is very important to obtain a clear understanding of the different stakeholders and to analyze their capacity and willingness to be involved in some or all of the project and its planning process. It is important to be aware of how different power relations can distort participation. It is also important to examine how community skills, resources, and 'local knowledge' can be

applied to improve project design and implementation. All of this can be achieved by careful use of the various tools of Stakeholder Consultation. Therefore, the following participatory technique was employed during stakeholder consultation:

- Informal meetings with communities in surrounding areas. Men and local elders attended these meeting.

10.4 Stakeholders Consulted

In the consultation process for ESIA, following key stakeholders were consulted:

- Local communities, Men, women and local elders attended meetings.
- Local Government & NGO representatives

Meetings with stakeholders consisted of community consultation meetings, focus groupdiscussions, and in-depth interviews with men and limited focus-group discussions with women. There were three stakeholder meetings organized at project site on 02.03.2013, 07.11.2013 and 19.11.2013 by verbal notice and paper advertisement respectively. The advertisement was published in the two national daily newspapers in Bangla and English. The location of the meetings, the process followed, and the outcomes are discussed in this section.

10.5 Stakeholder Concerns and Recommendations

The findings of the Community consultations are given in *Table 10.2*. All these have been addressed in various sections of the ESIA, and the mitigation plans have been incorporated into the EMP. The summary of the various stakeholder consultations is given below.

10.5.1 Community Concerns

Project Approval

The community consultations demonstrated that goodwill towards the project proponents indeed exists; approval for project activities by the communities was evident. The consultations were *considered* a good gesture and appreciated, especially by the men and women. The poverty level is such that communities are looking to any project proponent to improve their financial well-being to a great extent. DSPGL recognizes that benefits from the project should be distributed judiciously and equitably especially among primary stakeholders in the project area, and will continue to ensure that this principle is followed in its projects and community development program.

Resettlement/ Relocation

The proposed site of 55 MW HFO Fired Power Plant is located at Daulatpur, Nawabganj, Dhaka. The proposed power plant site is situated in the vacant land of REB. Most of the part of the land is vacant low land and the rest of the part is fallow and watery low land. There was no household inside the land. Therefore, physical relocation/resettlement issue is not applicable for the proposed project. A separate Social Impact Assessment (SIA) has been prepared for this project in which the detail about the resettlement and compensation issues discussed.

Local Employment

Communities in the project area emphasized that local people should be given priority when employing people for various project-related works and activities according to their skills.

Compensation

As the proposed power plant site is situated in the vacant land of REB, there is no private land owners fall in the project site. REB has paid compensation to all of the affected people through the Deputy Commissioner at current market price in 2010. People expressed satisfaction with compensation rates. REB has handed over land to the DSPGL in 2013. So no compensation regarding land ownership has been paid by the DSPGL to the local people.

Interaction with Local Community

Non-Local work force to be engaged in the project may not be aware of the local customs and norms, it may result conflicts with the local community, particularly in some benefit sharing issues. Keeping in mind of the sensitive issues and culture of the area law and order situation will be kept quiet by taking help of the local administration and LGI.

Impact on Livelihood

The communities also expressed some fear that construction process would disturb their cattle and that their livestock might get hurt or run away or die accidental death due to construction process. Scope of livelihood of the local people will be increased due to job and business/sub-contract opportunities to be created in the project.

Discussion with School Authority

As discussed earlier, there is a school within 220m north to the project site and adjacent to the project approach road. A discussion was held with the school teachers, school governing body and guardian representatives about the goals and objective of the project, potential impacts and mitigation measures. During the discussion, a brief description on the project activities, probable air & noise emission and it's abatement measures have been discussed.

10.5.2 Local Government Representatives

The consultations were considered a good gesture and appreciated. They also expressed the jobs and business opportunities for the local community will be increased due to project activities. They also expressed the concern that most of the unskilled and skill jobs should be reserved for the local communities.

10.6 Additional Stakeholder consultation for the transmission line

The project has 4.40 km transmission line from the project site to Hasnabad Power Station, Keraniganj. This 4.40 km transmission line follows the LGED road and RHD road. A separate stakeholder consultation has been conducted on 10.12.2013 with the road side shop owners, road side residents and other road users. The list of the participants in the public consultation meeting is given in *Table 10.1 (e),* while the findings of the Community consultations are given in *Table 10.2*. The photographs of consultations are included as f*igure 10.4.*

10.7 Stakeholder consultation participants and Recommendations

The list of the participants in the public consultation meeting is given in *Table 10.1 (a, b, c , d, & e),* while the findings of the Community consultations are given in *Table 10.2*. The photographs of consultations are included as f*igure 10.1, fig.10.2 ,fig. 10.3 & fig.10.5 & 10.6.*

Table 10.1: Participants in the Stakeholder Consultation meeting

a) Local Community:

Date	Location	Name	Age	Occupation
02.03.2013	Nearby DSPGL Plant	Samsul Bepari	50	Agriculture
		Abbas Mia	50	Agriculture
		Mohammad Ali	50	Businessman
		Md. Roni	30	Unemployed
		Sohel	17	Driver

Shamim	18	Service Holder
Shahin	16	Student
Jamal Uddin	36	Businessman
Selim	35	Businessman
Abdus Samad	36	Businessman
Md. Gias Uddin	55	Businessman
Md. Mohiuddin	60	Agriculture
Abdus Samad	41	Ag Labourer
Najimuddin	28	Rickshaw puller
Jamal Uddin	55	Businessman
Motiur Rahman	34	Businessman
Md. Moinul	28	Imam
Md. Bayejid	24	Imam
Md. Sekandar	25	Imam
Md. Swapan Khan	34	Service Holder
Sheikh Md. Shahin	26	Service Holder
Md. Reazul	29	Businessman
Md. Abdul Kadir	35	Tailor
Murad Khan	41	Businessman
Md. Nabi Nur Islam	33	Service Holder
Mokbul Hossain	32	Businessman
Fazlu Sheikh	30	Businessman
Arif Hossain	27	Businessman
Aseruddin Sheikh	23	Businessman
Nurul Bepari	35	Businessman
Kajol	25	Student
Rab Bepari	65	Businessman
Jamal	55	Businessman
Ahsan Ahmed	40	Businessman
Mofzul Khan	36	Businessman
Azhar Ahmed babul	33	Businessman

b) Local Government& NGO:

Date	Location	Participants
04.08.2013	Kailail union	Yahia Khan Thandu Kailail Union Member
	Galimpur, Nawabganj	Ibrahim Miah Branch Manager, ASA (NGO)

c) Consultation meeting after advertising the news Paper:

Date	Location	Name	Age	Occupation
07.11.2013	Nearby DSPGL Plant	Yahia Khan	50	Union Member
		Lolita Shorkar	35	Union Member
		Abbuas	50	Agriculture
		Md. Murad Khan	40	Agriculture
		Md. Hasem Shak	70	Agriculture
		Md. Hasan Ali shak	70	Agriculture
		Md. Nuru	45	Labor
		Syed Ali	80	Agriculture
		Md. Ali	55	Agriculture
		Ahasan Uddin	48	Agriculture
		Mofajjol	45	Agriculture
		Md. Monir Khan	24	Agriculture
		Md. Reyaj Khan	35	Businessman
		Md. Mofij		Ag Laborer
		Md. Riyaj		Labor
		Md Nawab Ali	65	Agriculture
		Shokha Rajbongshi	38	Labor
		Md. Forhad		Ag Laborer
		Md. Fajlul Shak	55	Agriculture
		Md. Lotif	37	Agriculture
		Md Giash Uddin	62	Agriculture
		Md. Manik	35	Agriculture
		Md. Shohel Khan	18	Labor
		Md. Shohorab	55	Agriculture
		MD. Abdul Alim	50	Agriculture
		Md Liyakot Mia	35	Agriculture

d) Consultation meeting with School governing body, Teacher & Guardian:

Date	Location	Name	Age	Identification / Occupation
19.11.2013	Kobi Nazrul High School	Md. Anisur Rahaman	33	Head Teacher
		Azhar Rahaman babu	33	Governing Body
		Md. Nobinoor Islam	33	Governing Body
		Md. Nasir Uddin	31	Guardian
		Md. Abdus Samad	78	Accounts
		Mohammad Ali	46	Guardian
		Md. Jahangir Hossain	26	Teacher
		Md. Sharif Ahmed	27	Teacher

		Md. Aminul Islam	30	Teacher
		Md. Mokter Hossian	32	Teacher
		Md. Mosharraf Hossian	26	Asst. Teacher
		Uaddhap Mondol	27	Asst. Teacher
		Shahidul Islam	30	Asst. Teacher
		Md. Mofajjal Hossian	32	Asst. Teacher
		Ful Mia	26	Asst. Teacher
		Suda Rani	36	Asst. Teacher
		Beauti Akter	27	Asst. Teacher
		Milton	34	Asst. Teacher

e) Consultation meeting with Shop owner / tenants & Settlement near the road side:

Date	Location	Name	Age	Identification / Occupation
10.12.2013	Beside the Roadside Settlement/ Household	Md Sajol	18	Student
		Munna Pagla	60	Labor
		Md. Jinnat Ali	54	Farmer
		Md. Murad Hossian	40	Businessman
		Hana Akter	40	Housewife
		Md. Ibrahim	35	Driver
		Shumi Begum	27	Housewife
		Jomshar	50	Farmer
		Ajam	18	Student
		Shohidul Khan	35	Businessman
		Monowara Begum	40	Housewife
		Raju	18	Student
		Doli Begum	60	Housewife
10.12.2013	Gowal Khali Bazar	Md. Lotif	36	Businessman
		Md. Jahangir	32	Businessman
		Md. Johurul	40	Businessman
		Md. Mahadi	20	Businessman
		Md. Mokles	38	Businessman
		Md. Abdul Rajjak	40	Driver
		Md. Jalal Mia	50	Businessman
		Md. Israfil	45	Businessman
		Md. Mahi Sorkar	28	Businessman
		Md. Nur Mohammad	50	Businessman
		Md. Hashim Mia	65	Farmer
		Md. Size Uddin	40	Businessman
		Md. Tajul Islam	45	Businessman

Table 10.2: Concerns Raised by the Communities during Stakeholder Consultations

Issues	Concern Raised by theCommunity	Communities' Remarks
Employment	Provision of semi-skilled and unskilled jobs for the local labor	Maximum unskilled jobs should be allocated to the locals.
Livelihood	Restriction of livestock grazing and accidental killings of livestock	Grazing and vegetation areas should be protected and speed of vehicles should be limited to avoid accidents
Compensation	Several kinds of losses or damages may happen due to the construction and operational purpose	Project authority should ensure the proper guideline for compensation purpose.
Repair of local roads	Existing road may be damaged by construction activity	Project authority should repair the local roads in a regular basis
Health check up	Provision of health check-up of school student	DSPGL should arrange health checkup for school students in a regular basis
Sand filling of school field	School field was low and marshy, DSPGL has done the sand filling the school field and raised the level adequate enough enable the student to play in the field	The school authority & local community thanked to the DSPGL authority for this activity and assure to extend their co-operation in future
Sports instrument for school	School doesn't have enough sports instrument for the students	DSPGL assures that they will supply the sports instrument to the school at regular basis
Transmission line Construction	May obstruct road or disturb local business	DSPGL assures the local community that the transmission line will brought road side and will not obstruct road and affect local business.

Figure 10.1: Photographs of Public Consultations during Field Visit

Consultation nearby DSPGL

Consultation nearby DSPGL

Figure 10.2: Photograph of Consultations with Union Member & NGO representative

Consultation at Daulatpur with Yahia Khan Thandu, Kailail Union Member

Consultation with Ibrahim Miah Branch Manager, ASA at Galimpur, Nawabganj

Figure 10.3: Photograph of Consultations after Circular of Newspaper

Figure 10.4: Photograph of Consultations with Kobi Nazrul High Schools Governing Body, Teachers & Guardian.

Figure 10.5: Photograph of Consultations with Settlement near by the road side

Figure 10.6: Photograph of Consultations with Shop owner /Tenants

Figure 10.7: Circular in the Newspaper

দৈনিক ইত্তেফাক

মঙ্গলবার ২১ কার্তিক ১৪২০
৫ নভেম্বর ২০১৩

৭

মত বিনিময় সভার বিজ্ঞপ্তি

এই মর্মে সর্বসাধারনের অবগতির জন্য জানানো যাচ্ছে যে পরিবেশগত সমীক্ষা প্রতিবেদন (ই আই এ) প্রনয়নের অংশ হিসেবে আগামী ৬ই নভেম্বর, রোজ বুধবার, দুপুর ১২ ঘটিকার সময় দৌলতপুর, কৈলাইল, নবাবগঞ্জ এ প্রস্তাবিত পাওয়ার প্লান্ট সাইটে এক মতবিনিময় সভার আয়োজন করা হয়েছে।

উক্ত সভায় আপনাদের সকলের অংশগ্রহন একান্ত কাম্য।

কর্তৃপক্ষ
ঢাকা সাউদার্ন পাওয়ার জেনারেশন লিমিটেড

The Daily Star DHAKA MONDAY NOVEMBER 4, 2013

NOTICE FOR PUBLIC CONSULTATION MEETING

A Public Consultation Meeting will be held as a part of preparation of Environment Impact Assessment (EIA) at proposed Power Plant Site at Doulotpur, Kailail, Nowabgonj, Dhaka on 6th Novemember, 2013, Wednesday at 12:00 Noon.

Your kind participation will be highly appreciated.

Authority
Dhaka Southern Power Generations Ltd.

Chapter – 11

Grievance Redress Mechanism and Disclosure

Chapter-11

Grievance Redress Mechanism and Disclosure

11.0 Grievance Redress Mechanism and Disclosure

11.1 Grievance Redress Mechanism

Public participation, consultation and information disclosure undertaken as part of the local EIA process have discussed and addressed major community environmental concerns. Continued public participation and consultation has been emphasized as a key component of successful project implementation. As a result of this public participation during the initial stages of the project, major issues of grievance are not expected. During the operational phase of the project, the complaints that may be anticipated are mostly related to dust, noise & vibration of the engines and some other social and environmental issues. However, unforeseen issues may occur. To settle such issues effectively, an effective and transparent channel for lodging complaints and grievances will be established. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process. It should also be readily accessible to all sections of the community at no cost and without retribution.

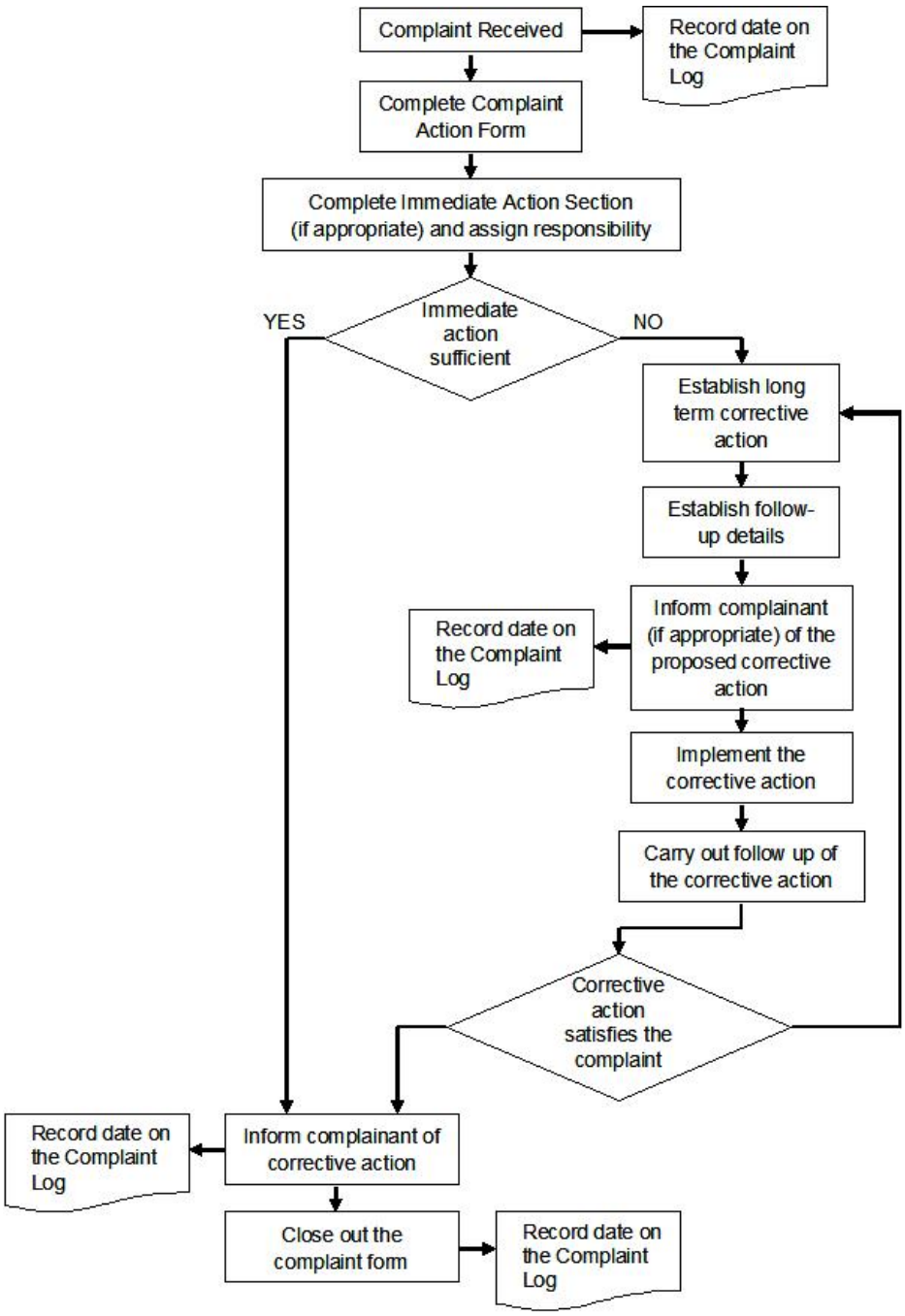
The Grievance Mechanism will be implemented during both the construction and operational period of the project to ensure that all complaints from local communities are dealt with appropriately, with corrective actions being implemented, and the complainant being informed of the outcome. It will be applied to all complaints from affected parties.

The mechanism will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple means of using this mechanism, including face-to-face meetings, written complaints, telephone conversations should be available. Confidentiality and privacy for complainants should be honored where this is seen as necessary or important.

A grievance redress mechanism and procedures is setup to provide opportunity for project affected persons to settle their complaints and grievances amicably. The established grievances redress procedures and mechanism ensures that project affected persons are provided with the appropriate compensations and that all administrative measures are in line with the law. It also allows project affected persons not to lose time and resources from going through lengthy administrative and legal procedures. Grievances are first preferred to be settled amicably.

DSPGL shall set-up a grievance redress committee that will address any complaints during both the construction and operational period of the project.

Figure 11.1 - Flowchart of Complaints/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. The following list presents members of the committee.

Table 11.1: Members of the Committee of Grievance Redress (GRC)

No.	List of Member Organizations	Contact Number	Responsibility
1	Dr. Moktar Hossain Chairman Koilail Union Parishad	01912796774	Chair Person
2	Mostafa Moin Director (Development) DSPGL	01713012493	Member Secretary
3	Engr. Fazle Elahi Khan General Manager DSPGL	01730709628	Member
4	Engr. Salman Hossain Manager Civil Engineering DSPGL	01913471471	Member
5	Mohammad Ali Doulatpur, Koilail	01833222100	Member

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 DSPGL project office.

Table 11.2 : Sample Grievance Reporting Form

Contact Details	Name:		
	Address:		
	Telephone Number/ Cell Phone 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:		Date:	

11.2 Disclosure

The draft ESIA report will be uploaded on the Company website (www.doreenpower.com) and a copy is kept at the plant for public review. Once the final version is ready, it will replace the draft version on the website. The executive summary will be translated into Bangla and will be made available to the public.

Chapter – 12

Conclusion & Recommendations

Chapter-12

CONCLUSION AND RECOMMENDATIONS

12.0 CONCLUSION AND RECOMMENDATIONS

12.1 CONCLUSIONS

The present ESIA report finds that though there are certain adverse environmental impacts associated with the industrial unit under consideration, these are manageable provided recommendations in the EMP are followed with due diligence. A separate Social Impact Assessment (SIA) has also been prepared for this project to discuss elaborately about the social, stakeholder engagement & consultation, resettlement & compensation issues (if there is any).

The project is indispensable in view of the current energy shortage scenario in Bangladesh. The impact on the social environment is positive given the job and business opportunities created for local residents from the project. The project will help in the industrialization, accelerating socioeconomic growth, and improving quality of life. One of the most critical issues for the project is safety. This has been adequately addressed through compliance with national building code (BNBC) in the construction to ensure safety during natural disasters like earthquake and cyclone and a full-containment for the HFO storage tank.

The project has been designed to comply with the country's environmental laws and regulations, especially on air emissions, ambient air quality, wastewater effluent, and noise. The project management has taken steps to ensure that the plant meets the World Bank's environmental standards. To mitigate the impact of the use of high sulfur HFO in the plant, a FDG is being installed to reduce sulfur-di-oxide emission by 90%. Given the management measures and monitoring commitments by the DSPGL for the project, environmental impact of the project will be manageable.

Given the proponent's commitments, actions undertaken for further measures to be adopted in due course of time as required, the Dhaka Southern Power Generation Plant is going to be a nationally important and environmentally sustainable industrial venture.

12.2 Recommendations

In order to manage the potential adverse environmental impacts, especially in the operational phase of the plant, the recommendations provided in the EMP should be followed with due diligence. Some of important actions required are:

1. Activation of Environmental Monitoring Committee, holding of its regular meeting and preparation of the monitoring report.
2. Activation of Emergency Management and Safety Committee and holding of its regular meeting.
3. Training of staff on EMP related issues.
4. Activation of the Grievance Redress Committee and prompt response to public complaints.
5. Development of an Environment Management System (EMS) for the plant and preparation of SOPs on specific issues.
6. Allocation of adequate resources in the yearly budget for implementation of EMP.
7. Conducting a post construction environmental study to evaluate the environmental impacts from the project and compare those with the ESIA.

However, most important issue is the commitment for the implementation of the actions required under the EMP by the management.

Chapter – 13

References

Chapter-13

REFERENCE

13.0 REFERENCE

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